LabAutomation'97

Conference Program

January 18-22, 1997

San Diego, CA
USA

sponsored by:

The Association for Laboratory Automation

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Welcome To LabAutomation’97!

January 18-22, 1997
San Diego, CA

A Message from the LabAutomation’97 Scientific Committee

Welcome to LabAutomation’97! The LabAutomation conference is one of the growing list of activities sponsored by the Association for Laboratory Automation (ALA), an international non-profit organization, established in April 1995, whose mission is to advance the worldwide utilization of automation, robotics, and artificial intelligence to improve the quality, efficiency, and relevance of laboratory analysis. The ALA has introduced several new vehicles to keep you informed about developments in this rapidly expanding field. Laboratory Automation News (LAN), is now a bimonthly 32 page full color guide to the products, news, and scientific articles related to laboratory automation. In addition, our state of the art web site <*http://labautomation.org*>, organized by Tony Beugelsdijk, is updated regularly with information about the ALA and its activities, LAN, and the annual LabAutomation conference.

The scientific committee and the organizers have been working diligently since last January to bring you state-of-the-art lectures presented by leaders in the exponentially growing field of laboratory automation. The exhibition area, organized and directed by David Herold, has been significantly expanded to include all of the leading vendors of laboratory automation equipment and software. We also have many new vendors this year which promise to be tomorrow's leading companies. Each of our exhibitors is committed to providing you with hands-on exposure to their products and services.

The scientific program will be opened this year by an important event, our Beckman Award Lecture given by Dr. Joseph Engelberger who is considered to be the father of modern industrial robotics. His lecture, entitled "Medical Robotics: From Hospital to Home Care," will position the laboratory automation field in the broader perspective of the growing robotic market. Similar to last year we will continue our popular, simultaneous sessions, which focus on selected areas of laboratory automation including laboratory medicine, drug synthesis and discovery, environmental monitoring, artificial intelligence, and software tools. The short course program on Saturday and Sunday will teach skills which can be immediately applied in your laboratory from artificial intelligence to implementing electronic laboratory notebooks. Finally, Wednesday morning has been devoted to standards and emerging technologies which will shape the future of laboratory automation.

The high quality of our scientific program is result of the efforts of our scientific committee with the generous support of our sponsors. We sincerely wish you a pleasant stay at the Sheraton San Diego and a productive LabAutomation'97 meeting.

Tony J. Beugelsdijk, Ph.D., M.B.A.
Team Leader, Robotics & Automation

Pierangelo Bonini, M.D.
Professor of Pathology

Sheila H. DeWitt, Ph.D.
Vice-President of Technology

Alain Donzel, Ph.D.
SCITEC

Robin A. Felder, Ph.D.
Professor of Pathology

William Godolphin, Ph.D.
Professor of Clinical Chemistry

Steven D. Hamilton, Ph.D.
Director of Information and Automation Services

David A. Herold, M.D., Ph.D.
Professor of Pathology

Gary W. Kramer, Ph.D.
Group Leader, Chemical Sensing & Automation

Jonathan S. Lindsey, Ph.D.
Professor of Chemistry

Rodney Markin, Ph.D.
Professor of Pathology

Masahide Sasaki, M.D., Ph.D.
Professor of Clinical Laboratory Medicine

Dr. Reinhold Schaefer
Professor of Database Systems

Dr. Jan van der Greef
Managing Director, TNO Pharma

LabAutomation'97 at a Glance

Friday, January 17, 1997

5:00pm - 8:00pm	**Registration**

Saturday, January 18, 1997

7:00am - 6:00pm	**Registration**
8:00am - 5:00pm	**Short Courses** *(All in West Tower)* Neural Networks - Terrace D Machine Vision - Terrace B Introduction to Laboratory - Coronado A Introduction to Clinical Robotics - Point Loma A&B Internet I - Terrace C
8:00am	**Exhibitors Set Up**

Sunday, January 19, 1997

7:00am - 9:00pm	**Registration**
8:00am - 5:00pm	**Short Courses** *(All in West Tower)* Neural Networks - Terrace D Machine Vision - Terrace B Introduction to Laboratory Robotics - Coronado A Internet II - Terrace C Visual BASIC - Terrace A Combinatorial Chemistry - Coronado B Electronic Laboratory Notebooks - Point Loma A LIMS - Point Loma B Barcode Technology - Catalina
4:00pm - 5:00pm	**Exhibitors Reception**
5:00pm - 8:30pm	**Opening Reception - Exhibit Area**

Monday, January 20, 1997

8:00am -10:00am	**Plenary Session**	
10:00am - 10:30am	***Break***	
10:30 - 12:00pm	**Plenary Session**	
12:00pm - 3:30pm	***Poster Session - Exhibits Open*** ***Box lunch provided in Exhibit Area***	
3:30pm - 4:30pm	**Clinical Overview Session**	**Mass Spectometry Session** *(starts at 3:00pm)*
4:30pm - 4:45pm	***Break***	
4:45pm - 6:00pm	**Standards Session**	**Mass Spectometry Session**
6:00pm - 8:30pm	***Wine and Cheese Reception in Exhibit Hall***	

Tuesday, January 21, 1997

	Track 1	Track 2	Track 3
8:30am - 10:00am	**Clinical Session**	**Analytical-Engineering Session**	**High Throughput Screening-Combinatorial Chemistry Session**
10:00am - 10:30am	***Break***		
10:30am - 12:00pm	**Clinical Session**	**Analytical-Engineering Session**	**High Throughput Screening-Combinatorial Chemistry Session**
12:00pm - 2:30pm	***Poster Session - Exhibits Open*** ***Boxed lunches provided in exhibit area***		
2:30pm - 4:00pm	**Clinical Session**	**Analytical-Engineering Session**	**High Throughput Screening-Combinatorial Chemistry Session**
4:00pm - 4:30pm	***Break***		
4:30pm - 6:00pm	**Clinical Session**	**Analytical-Engineering Session**	**High Throughput Screening-Combinatorial Chemistry Session**
5:00pm - 9:00pm	***Reception in Exhibit Area/Gala Evening***		

Wednesday, January 22, 1997

8:00am - 10:00am	**Advanced Topics Session**	
10:00am - 10:30am	***Break***	
10:30am - 12:00pm	**High Throughput Screening-Combinatorial Chemistry Session**	**Biotechnology Session**
12:00pm - 1:30pm	***Lunch on own or Industry-Sponsored Workshops***	
1:30pm - 3:00pm	**High Throughput Screening-Combinatorial Chemistry Session**	**Biotechnology Session**
3:00pm - 3:30pm	***Break***	
3:30pm - 4:30pm	**High Throughput Screening-Combinatorial Chemistry Session**	**Biotechnology Session**
4:30pm - 6:00pm	***Hosted Reception*** ***Beer/Chips***	

Final Conference Program

Friday, January 17, 1997

5:00pm - 8:00pm	**Registration**

Saturday, January 18, 1997

7:00am - 6:00pm	**Registration**
8:00am - 5:00pm	**Short Courses - West Tower**
8:00am	**Exhibitors Set Up**

Sunday, January 19, 1997

7:00am - 9:00pm	**Registration Opens**
8:00am - 5:00pm	**Short Courses - West Tower**
5:00pm - 8:30pm	**Opening Reception - Exhibit Area**

Monday, January 20, 1997

Grand Ballroom A

7:00am - 8:30pm **Registration**

Continental Breakfast - Grand Ballroom A

BECKMAN AWARD LECTURE

Chair: Robin A. Felder

Grand Ballroom B & C

8:00am - 8:15am **Welcome and Presentation of the Beckman Lecture Award**
Robin A. Felder, Program Chairman

8:15am - 9:00am **Robotics in Medicine - From Hospital to Home Care**
Joseph Engelberger, Chairman, HelpMate Robotics Inc., Danbury, CT, USA

9:00am - 9:30am **Investments in Automation Boost Productivity while Increasing Quality**
Skip Klein, Investment Manager, T. Rowe Price Health Sciences Fund, Baltimore, MD, USA

9:30am - 10:00am **Assay Miniaturization in High Throughput Screening: Present Success and Future Challenges**
Al Kolb, Packard Instruments, Inc., Meriden, CT, USA

10:00am - 10:30am *Coffee break*

10:30am - 11:00am **Recent Advances in Combinatorial Chemistry**
Sheila DeWitt, Diversomer Technologies, Inc., Ann Arbor, MI, USA

11:00am - 11:30am **Changing Technologies for High Throughput Screening**
Mark Goldman, Signal Pharmaceuticals, Inc., San Diego, CA, USA

11:30am - 12:00pm **Fundamentals of Mass Spectrometry for High Throughput Screening**
Ronald C. Hendrickson, Department of Chemistry, University of Virginia, Charlottesville, VA, USA

12:00pm - 3:30pm **Poster Session/Exhibition**

Food and Drinks will be served in the Exhibition Hall

Monday Afternoon - Track 1

CLINICAL OVERVIEW SESSION

Chair: William Godolphin

Grand Ballroom C

3:30pm - 4:00pm **Recent Trends in Clinical Laboratory Automation**
Rodney S. Markin, University of Nebraska, Omaha, NE, USA

4:00pm - 4:30pm **Modular Automation: Maximum Flexibility at a Manageable Cost**
David O'Bryan, SmithKline Beecham Laboratories, Collegeville, PA, USA

4:30pm - 4:45pm *Break*

STANDARDS SESSION

Chair: Rodney Markin

Grand Ballroom C

4:45pm - 6:00pm **Annual Report from International Standardization Committees**
Rodney Markin (NCCLS), Moderator, University of Nebraska, Omaha, NE, USA
Gary Kramer (NIST), Gaithersburg, MD, USA
Torsten Staab (ASTM), Los Alamos National Laboratory, Los Alamos, NM USA
Pierangelo Bonini and Alberto Sanna, (European Committees), Istituto Scientifico Hospitale San Raffaele, Milano, Italy
Tom Astle (Microplates), Tomtec Inc., Hamden, CT, USA

Monday Afternoon - Track 2

MASS SPECTROMETRY SESSION

Chair: Jacqueline A. Gibbons

Grand Ballroom B

3:00pm - 3:30pm **Combinatorial ADME/PK: Applications of Mass Spectrometry**
Jacqueline A. Gibbons, Eric W. Taylor, Hong Luo and Rene A. Braeckman, Chiron Corporation, Emeryville, CA, USA

3:30pm - 4:00pm **Simultaneous Pharmacokinetic Screening of Compound Mixtures Using Atmospheric Pressure Ionization LC/MS for Increased Throughput**
Kathy A. Halm, Kim K. Adkinson, Judd Berman and Joel E. Shaffer, Glaxo Wellcome, Research Triangle Park, NC, USA

4:00pm - 4:30pm **Identification of Novel Receptor Ligands from Combinatorial Libraries: Affinity Selection-Mass Spectrometry**
V. Huebner, S. Kaur, L. McGuire, D. Tang, G. Dollinger, Chiron Corporation, Emeryville, CA, USA

4:30pm - 4:45pm *Break*

4:45pm - 5:15pm **Automated Time-of-Flight Mass Spectrometry for the Analysis of Small Molecules and Biological Polymers**
Marvin Vestal, Dale Patterson, and Steve Martin, PerSeptive Biosystems, Inc., Framingham, MA, USA

5:15pm - 5:45pm **Automated LC/MS Analysis of Combinatorial Libraries: From Analytical Characterization to Preparative Scale Purification**
D. B. Kassel, L. Zeng, CombiChem, Inc., San Diego, CA, USA

L. Burton, K. Yung and B. Shushan, Perkin Elmer-Sciex, Thornhill, Ontario, Canada

6:00pm - 8:30pm **Wine and Cheese Reception**

Exhibit Hall

Tuesday, January 21, 1997

7:00am - 7:30pm **Registration**

Tuesday- Track 1

CLINICAL SESSION

Chair: Robin A. Felder

Grand Ballroom C

8:00am - 8:20am **Redesigning your Laboratory on a PC - New Tools for Simulation-Based Workflow Analysis**
Georg Hoffmann, Trilium GmbH, Grafath, Germany

8:20am - 8:40am **Implementation of a Full Scale Automation System**
Pat Collins and Karl Frostrop, Metro McNair Clinical Laboratories, Burnaby, British Columbia, Canada

8:40am - 9:00am **Planning and Implementation of Staged Automation**
Geof Auchinleck, Automed Corporation, Richmond, British Columbia, Canada

Kris Bailey, Chiron Diagnostics, Scoresby, Victoria, Australia

9:00am - 9:30am **The Impact of the Sysmex SE-Alpha Hematology Automation System**
Barbara Connell, The Carle Clinic, Urbana, IL,USA

9:30am - 10:00am **Experience With The Boehringer Mannheim/Hitachi Clinical Laboratory Automation System**
Dennis A. Lamb, South Bend Medical Foundation, South Bend, IN, USA

10:00am -10:30am *Break*

CLINICAL SESSION

Chair: Masahide Sasaki

Grand Ballroom C

10:30am - 11:00am **Laboratory Automation - Ingredients for Disaster and Recipes for Success**
Michael Quinlan, Labotix, Peterborough, Ontario, Canada

11:00am - 11:30am **Opening Doors With Automation**
Arthur E. Glenz, Susan Hurbutt, Barbara Burns, ACM Medical Laboratory, Inc., Rochester, NY, USA

11:30am - 12:00pm **Lab Automation: A Stepwise Approach**
Kirk Kimler, Abbott Laboratories, Abbott Pk., IL, USA

12:00pm - 2:30pm **Poster Session/Exhibition**

Food and Drinks will be served in the Exhibition Hall

CLINICAL SESSION

Chair: Pierangelo Bonini

Grand Ballroom C

2:30pm - 3:00pm **Clinical Laboratory Engineering In A Multidisciplinary Platform**
Alain Truchaud, H. Brochard, S. Malvaux, M. Cazaubiel, and T. Le Neel, Insitute de Biologie, Nantes, France

3:00pm - 3:30pm **Automated Sample Handling: A Case Study**
Sue Steven, SmithKline Beecham Laboratories, Norristown, PA, USA

3:30pm - 4:00pm **Project Management and Laboratory Automation**
Beth Rokus, Lehigh Valley Hospital, Allentown, PA, USA

Mark Cederdahl, LAB-Interlink, Omaha, NE, USA

4:00pm - 4:30pm *Break*

CLINICAL SESSION

Chair: Rodney Markin

Grand Ballroom C

4:30pm - 5:00pm **Laboratory Automation: The Design Of User Interfaces**
Alain Laugier, Technidata SA, Zirst, Meylan, France

5:00pm - 5:30pm **Strategic Partnering in Lab Automation Initiatives**
David G. Beckwith, Lehigh Valley Hospital, Allentown, PA, USA

5:00pm - 7:00pm **Reception in Exhibit Area**

7:00pm - 9:00pm **Gala Evening - Grand Ballroom**

Presentation of:
HEWLETT-PACKARD AWARD
BOEHRINGER MANNHEIM AWARD
BECTON DICKINSON AWARD

Tuesday - Track 2

ANALYTICAL/ENGINEERING SESSION

Chair: Gary Kramer

Grand Ballroom B

8:00am - 8:30am **A New Approach To Supporting Biopharmaceutical Automation**
Steven D. Hamilton, Joel Boymel, Peter L. Burris, Richard A. Gerren, Burt Goodman, Garry W. Gregory, Keith M. Hoyle, Mark E. Jury, James V. Petersen, Amgen Inc., Boulder, CO, USA

8:30am - 9:00am **Robotic Workstations Compliment Tracked Robot Systems**
Robert F. Trinka, Cyberlab, Inc., Brookfield, CT, USA

9:00am - 9:30am **Automated Retrieval of Clone Libraries Utilizing the Biomek 2000 Robotic Workstation**
Petar Stojadinovic, Douglas N. Gurevitch, Andy R. Watson, Sequana Therapeutics, La Jolla, CA, USA

9:30pm - 10:00am **Automated Workstation for Potency Testing of Transdermal Systems**
Ben Mendoza, Steven Lenz, Scott Echols,
Cygnus Therapeutic Systems, Redwood City, CA, USA

10:00am -10:30am *Break*

ANALYTICAL/ENGINEERING SESSION

Chair: Reinhold Schaefer

Grand Ballroom B

10:30am - 11:00am **A Fully Automated Oligonucleotide Ligation Assay Using the Biomek® 2000 Robotic Workstation**
Marcos A. Piani, Robert Saiz, Phillip A. Morin and Andy R. Watson, Sequana Therapeutics, La Jolla, CA, USA

11:00am - 11:30am **A Real-Time Microtiter Plate Reader Based On A High Throughput Imaging Fluorometer**
John F. Turner II, University of Pittsburgh, Pittsburgh, PA, USA

Patrick J. Treado, ChemIcon, Inc., Pittsburgh, PA, USA

Paul Hyslop, Eli Lilly & Company, Indianapolis, IN, USA, Thomas W. Astle, Tomtec, Inc., Hamden, CT, USA

11:30am - 12:00pm **The ASTM Laboratory Equipment Control Interface Specification**
Torsten Staab and John Elling, Los Alamos National Laboratory, Los Alamos, NM, USA

12:00pm - 2:30pm **Poster Session/Exhibition**

Food and Drinks will be served in the Exhibition Hall

ANALYTICAL/ENGINEERING SESSION

Chair: Alain Donzel

Grand Ballroom B

2:30pm - 3:00pm **Generic Hardware-Independent User Interface for Laboratory Automation**
Andrew Corkan and Nader Donzel
Scitec, Inc., Wilmington, DE, USA

3:00pm - 3:30pm **cDNA Library Subtraction Using a Neural Net Classifier**
Rick Stanton, Merrie Jo Johnson, Jennifer Giles, Amgen, Inc., Thousand Oaks, CA, USA

3:30pm - 4:00pm **The Mathematica Link To LABVIEW: An Environment To Develop Electronic Laboratory Notebooks**
Jean Peccoud, Grenoble School of Medicine, La Tronche, France

4:00pm - 4:30pm *Break*

ANALYTICAL/ENGINEERING SESSION

Chair: Steve Hamilton

Grand Ballroom B

4:30pm - 5:00pm **A Novel Enzyme-Linked Oligonucleotide Assay (ELONA) Using Olignucleotide Aptamers Created By The SELEX Combinatorial Chemistry Process**
Daniel W. Drolet, Lotus Moon-McDermott, Timothy S. Romig, and Sumedha Jayasena, NeXstar Pharmaceuticals, Boulder, CO, USA

5:00pm - 5:30pm **The Master Patient Index Mediator: Merging Disparate Patient Record Number Systems**
Patricia A. Medvick and Dave G. Kilman, Los Alamos National Laboratory, Los Alamos, NM, USA

5:00pm - 7:00pm **Reception in Exhibit Area**

7:00pm - 9:00pm **Gala Evening**

Presentation of:
HEWLETT-PACKARD AWARD
BOEHRINGER MANNHEIM AWARD
BECTON DICKINSON AWARD

Tuesday - Track 3

HIGH THROUGHPUT SCREENING
COMBINATORIAL CHEMISTRY SESSION

Chair: Sheila DeWitt

Grand Ballroom A

8:00am - 8:30am **Automated Purification for Combinatorial Chemistry**
Harold N. Weller, Bristol-Myers Squibb Pharmaceutical Research Institute, Princeton, NJ, USA

8:30am - 9:00am **Solenoid Valve-Based Inkjet Dispensing for Combinatorial Synthesis and High Throughput Screening**
Don Rose, Tony Lemmo, and H. Mario Geysen, Glaxo Wellcome, Research Triangle Park, NC,USA

9:00am - 9:30am **Workflow Analysis, Automation And HTS: A Case Study In Optimizing Complex Transcriptional Cellular Assays For HTS**
Melvin Reichman, Ligand Pharmaceuticals Inc., San Diego, CA, USA

9:30am - 10:00am **A Massively Parallel, Microfabricated System for Drug Discovery**
Pat Conway, Orchid Biocomputer, Inc., Princeton, NJ, USA

10:00am-10:30am *Break*

HIGH THROUGHPUT SCREENING COMBINATORIAL CHEMISTRY SESSION

Chair: Mark Goldman

Grand Ballroom A

10:30am - 11:00am **Standardization Of 96-Well Microplates For Automated Handling**
Thomas W. Astle, Tomtec Inc., Hamden, CT, USA

11:00am - 11:30am **Implementation of Microvolume Assays in High-Density Microtiter Plates**
Jonathan Burbaum, Pharmacopeia, Princeton, NJ, USA

11:30am - 12:00pm **High-Throughput Functional Drug Screening Based on Measurement of Intracellular Free Calcium by Fluorescence Imaging**
Michael Akong, Robert Siegel, Emanuel Vasserman, Purabi Datta, Kym Callahan, Ken Stauderman, Mark Varney, Gönül Veliçelebi,, Michael Harpold, Kenneth Lloyd, SIBIA Neurosciences, Inc., La Jolla, CA. USA

12:00pm - 2:30pm **Poster Session/Exhibition**

Food and Drinks will be served in the Exhibition Hall

HIGH THROUGHPUT SCREENING COMBINATORIAL CHEMISTRY SESSION

Chair: Jonathan Lindsey

Grand Ballroom A

2:30pm - 3:00pm **Accelerating Drug Discovery By High-Throughput Combinatorial Synthesis**
Steve Banville and Ronald N. Zuckermann, Chiron, Emeryville, CA, USA

3:00pm - 3:30pm **Automated Parallel Synthesis of Antitubercular Agents**
J. Andrew Towell and William Baker, PathoGenesis Corporation, Seattle, WA, USA, James Harness, Bohdan Automation, Mundelein, IL, USA

3:30pm - 4:00pm **The Use Of Reactive Fragment Structure Transformations For Automated Structure Generation In Automated Combinatorial Chemistry With Applications To Diversity Analysis**
John Cargill, Ontogen Corporation, Carlsbad, CA, USA

4:00pm - 4:30pm *Break*

HIGH THROUGHPUT SCREENING COMBINATORIAL CHEMISTRY SESSION

Chair: John Cargill

Grand Ballroom A

4:30pm - 5:00pm **A Novel Spatially Addressable Automated Synthesizer for Combinatorial Chemistry and Drug Development**
W. Rapp, Rapp Polymere GmbH, Tübingen, Germany

J. Gerhardt, C.A.T. GmbH & Co. KG, Tübingen, Germany

5:00pm - 5:30pm **Closed-Modular Approach to Solid-Phase Synthesis**
Patty Ahrweiler, Bohdan Automation, Inc., Mundelein, IL, USA

5:30pm - 7:00pm **Reception in Exhibit Area**

7:00pm - 9:00pm **Gala Evening - Grand Ballroom**

Presentation of
HEWLETT-PACKARD AWARD
BOEHRINGER MANNHEIM AWARD
BECTON DICKINSON AWARD

Wednesday, January 22, 1997

ADVANCED TOPICS SESSION

Chair: Tony Beugelsdijk

Grand Ballroom B & C

8:00am - 8:30am **Genosensors and Model Hybridization Studies**
M. Doktycz and Kenneth L. Beattie, Oak Ridge National Laboratory, Oak Ridge, TN, USA

8:30am - 9:00am **Radioisotope Redux: Accelerator Mass Spectrometry**
John S. Vogel, Lawrence Livermore National Laboratory, Livermore, CA, USA

9:00am - 9:30am **An Autonomous, Bottom-Transecting Vehicle For Making Long Time-Series Measurements Of Sediment Community Oxygen Consumption To Abyssal Depths**
R. C. Glatts, A. H. Uhlman, R. J. Baldwin, and K. L. Smith, Scripps Institute of Oceanography, San Diego, CA, USA

9:30am - 10:00am **Is There A Role For Ultrasensitive Fluorescence Detection - Down To The Single Molecule Level - In High Throughput Screening?**
James H. Jett, W. Patrick Ambrose, John P. Nolan, David Semin, Larry A. Sklar, Richard A. Keller, Los Alamos National Laboratory, Los Alamos, NM 87545, USA

Department of Pathology (LAS), School of Medicine, University of New Mexico, Albuquerque, NM, USA

10:00am -10:30am *Break*

Wednesday Morning - Track 1

HIGH THROUGHPUT SCREENING COMBINATORIAL CHEMISTRY SESSION

Chair: Melvin Reichman

Grand Ballroom B

10:30am - 11:00am **Automated Technology With Interactive Graphical Sample Tracking For Analytical HPLC And Milligram Scale Preparative Chromatography Of Combinatorial Analogues**
Joan Stevens, Gilson Instruments, Middleton, WI, USA

11:00am - 11:30am **Design Considerations For A Chemists Automated Workstation**
Wayne Schmidt and Kimber D. Fogelman, Hewlett Packard, Wilmington, DE, USA

11:30am - 12:00am **High Throughput Analysis Of Tandem Mass Spectrometry Data For Peptides**
John Yates and Jimmy K. Eng, University of Washington, Seattle, WA, USA

Wednesday Morning - Track 2

BIOTECHNOLOGY SESSION

Chair: Petar Stojadinovic

Grand Ballroom C

10:30am - 10:40am **Opening Remarks and Agenda**
Petar Stojadinovic, Sequana Therapeutics, La Jolla, CA, USA

10:40am - 11:05am **Automation in DNA Sequencing**
Andre Marziali, Stanford DNA Sequencing & Technology Center, Stanford, CA, USA

11:05am - 11:25am **Design, Development and Implementation of a General-Purpose Enzyme-Based Robotic Screening System**
Colin S. McRavey, Daniel P. Maloney, Joseph J. Yacobucci, John G. Kochins, Ramesh Padmanabha, Susan P. Manly. and Derek J. Hook, Bristol-Myers Squibb Pharmaceutical Research, Wallingford, CT, USA

11:25am - 11:45am **Future Laboratory Automation: Lessons from Drug Discovery**
David W. Brandt, Beckman Biotechnology Research Institute, Fullerton, CA, USA

11:45am - 12:00pm **Publications in Automation**
Carla Fjerstad, John Wiley Publishers, New York, NY, USA

12:00pm - 1:30pm *Lunch on own*

Wednesday Noon

INDUSTRY-SPONSORED WORKSHOPS

Pregistration Required - Lunch Provided

12:00pm - 1:30pm **Advanced Hardware and Software Architecture for Laboratory Robotic Systems Information Management for Automated Parallel Synthesis**
Zymark Corporation Workshop

New Offerings in Robot and Machine Vision-based Laboratory Automation
CRS Robotics Workshop

High Density Plates, Multi-Technology and Homogenous Applications: Key Words in HTS
Wallac Workshop

Wednesday Afternoon - Track 1

HIGH THROUGHPUT SCREENING COMBINATORIAL CHEMISTRY SESSION

Chair: Harold Weller

Grand Ballroom B

1:30pm - 2:00pm **Information Management for Automated Parallel Synthesis**
Dave G. Nickell, Sheila H. Dewitt, and Ela M. Hogan, Parke Davis Pharmaceutical and DIVERSOMER Technologies, Ann Arbor, MI, USA

2:00pm - 2:30pm **A Modular Approach to Automating Organic Synthesis Using Dedicated Robotic Workstations**
Robert Elliott, J-KEM Scientific, Inc., St. Louis, MO, USA

2:30pm - 3:00pm **Automation For High-Throughput Parallel Synthesis**
Cheryl Garr, Panlabs, Bothell, WA, USA

3:00pm - 3:30pm **Break**

HIGH THROUGHPUT SCREENING COMBINATORIAL CHEMISTRY SESSION

Chair: Don Rose

Grand Ballroom B

3:30pm - 4:00pm **No Static At All: Using Radiofrequency Memory Tubes Without (Human) Interference**
Tony Czarnik, IRORI Quantum Microchemistry, San Diego, CA, USA

4:00pm - 4:30pm **Automated Synthetic Chemistry: Resins To Instrumentation**
Paul Van Eikeren, Argonaut Technologies, San Carlos, CA, USA

4:30pm - 6:00pm **Hosted Reception**

Fine imported and domestic beers and chips will be served.

Wednesday Afternoon - Track 2

BIOTECHNOLOGY SESSION

Chair: Petar Stojadinovic

Grand Ballroom C

1:30pm - 1:55pm **Automated Systems for HTS at AMGEN**
Jason Armstrong, Robert Pacifici, David Sawutz, Jennifer Batac, Kathy Henige, Steve Hamilton, Amgen Inc., Thousand Oaks, CA, USA

1:55pm - 2:20pm **Automation for Genotyping and Sequencing at Sequana Therapeutics**
Doug Gurevitch, Barbara Armstrong, Marcos A. Piani, Michael Stewart, Petar D. Stojadinovic, Lois C. Tack, Timothy R. Walker, Andy R. Watson, Sequana Therapeutics, La Jolla, CA, USA

2:20pm - 2:45pm **Integrating Vision-Guided Motion in Biotechnology**
Sarath Krishnaswamy and Chris French, Acuity Imaging, Inc., Nashua, NH, USA

2:45pm - 3:10pm **New Directions in Laboratory Automation Software**
Darrel Kent, CRS Robotics Corporation, Burlington, Ontario, Canada

3:10pm - 3:30pm **Break**

BIOTECHNOLOGY SESSION

Chair: Petar Stojadinovic

Grand Ballroom C

3:30pm - 4:00pm **The QBot® MkIII: A Multi-Tasking Robot For High Throughput Genome Research**
Sue Richards, David Elverd, Amy Malterer, Nigel Malterer, Phillippa Neville, and Mark Reid, Genetix, Ltd., Christchurch, UK

4:00pm - 4:30pm **High Throughput Screening for Discovery of Robust Biocatalysts**
Dan E. Robertson, Recombinant BioCatalysis, La Jolla, CA, USA

4:45pm - 6:00pm **Hosted Reception**

Fine imported and domestic beers and chips will be served.

Poster Presentations

1. The Swiss Blood-Testing Unit (STU): An Innovative Project To Prevent Transfusion Transmitted Diseases

Pierre Bachmann and J. Burckhardt
ZLB Central Laboratory Blood Transfusion Service SRC, Berne 22, Switzerland

M. Oberli
Hamilton, Bonaduz AG, Bonaduz, Switzerland

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2. Studies on Contamination Risk of PCR by a New Automation Concept

Gerhard Bienhaus, P. Wenzig, G. Haberhausen, J. Kleiber, Ch. Markert-Hahn, J. Schwab, and U. Kolb
Boehringer Mannheim GmbH, Tutzing, Germany

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3. Custom Engineered Automation for Scientific Research

C. E. Ball, M. F. Fischer and D. P. McCampbell
Midwest Research Institute, Kansas City, KS, USA

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4. Automated Solution Preparation and Distribution of Chemical Compounds at Merck using the Packard MultiPROBE®

Collette S. DeChard, *Merck and Company, Rahway, NJ, USA*
Craig Cardella, *Packard Instrument Company, Meriden, CT, USA*

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5. Off-the-Shelf Robotics for Nucleic Acid Sequencing and Detection

A. D. Ellington, Peter Rudolph, Jean Gehlhausen, and R. C. Conrad
Indiana University, Bloomington, IN, USA

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6. The Implementation of Matrix Codes in the Clinical Laboratory

Christopher Estey and Robin Felder
University of Virginia, Charlottesville, VA, USA

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7. High Throughput Automated Plasmid Purification on the Biomek® 2000

Diana Gonzalez and Graham Threadgill
Beckman Instruments, Fullerton, CA, USA

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8. The Amgen Boulder Sample Bank: Data Handling, Automated Sample Handling, and Storage Functions

Burt Goodman, Joel Boymel, Tiff Kramer, Mark Deiparine, Paula McMahon, and Jennifer Williams
Amgen, Inc., Boulder, CO, USA

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9. An Inexpensive Multiplexer of Video Signals for Automated Detection of Abnormal Events in Laboratory Systems

Peter J. Grandsard
Amgen, Inc., Thousand Oaks, CA, USA

Gary W. Kramer
National Institute of Standards and Technology, Gaithersburg, MD, USA

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10. A Custom User Interface for Packard MultiPROBE® Robots

Douglas N. Gurevitch, Gary V. Millard, and Andy R. Watson
Sequana Therapeutics, San Diego, CA, USA

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11. Architectural Considerations For Laboratory Automation System Integration

Michael K. Hagemeier and Gary W. Kramer
National Institute of Standards and Technology, Gaithersburg, MD,USA

Reinhold Schaefer
Fachbereich Informatik, Fachhochschule-Wiesbaden, Wiesbaden, Germany

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12. Automation of Multiple Kinase Assays on an ORCA Rail System

Becky G. Laskody, Anne Shrago Howe, Ann M.Edison, Peter Leitner, Jeremy Roth, Al Smith, Gaochao Tian, and Paul Domanico
Glaxo Wellcome Inc., RTP, NC, USA

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13. New Pharmaceutical Robotics System Developed for Performing Cell-Based Screening Assays

Steven Lenz and Melvin Reichman
Ligand Pharmaceuticals, Inc., San Diego, CA, USA

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14. Automated Extraction of Antisense Oligonucleotides from Animal Tissues in the 96-Well Format

Steven R. Owens, LoAnne Truong, Jon Fitchett, and Lendell L. Cummins
ISIS Pharmaceuticals, Inc., Carlsbad, CA, USA

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15. Glass and Chemically Resistant Polymer Plates and Closures for HTS

David Root and Greg Mathus
Corning Costar, Cambridge, MA, USA

Thierry Dannoux and Isabelle Geahel
Corning Europe Incorporated, Avon, France

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16. Expert System for Dynamic Scheduling Supporting Sample Preparation Constraints

Reinhold Schaefer and Bernd Stiehl
Fachbereich Informatik, Fachhochschule-Wiesbaden, Wiesbaden, Germany

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17. The Flexchem® Solid Phase Chemistry System: A Modular System For High Throughput Synthesis

James E. Stanchfield, Christopher Bailey, David Wright, and David Batey
Robbins Scientific Corporation, Sunnyvale, CA, USA

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18. Microdevices for a New DNA Test Platform Utilizing Existing Lab Equipment

Marilyn J. Stapleton
Gene Tec Corporation, Durham, NC, USA

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19. Modular Automation for Filtration Receptor Binding Assays

Philip Tagari, Nathalie Tremblay, and Kathleen Metters
Merck Frosst Centre for Therapeutic Research, Pointe Claire, Quebec Canada

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20. Competition Binding Assay for Evaluation of SELEX-Derived Oligonucleotides to Human L-Selectin

Chris Tucker, Larry Dihel, and Stanley C. Gill
NeXstar Pharmaceuticals, Inc., Boulder CO, USA

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21. Automation Of The Polymerase Chain Reaction (PCR) Using The

Packard Multiprobe® 104DT

Randy A. Turner and Robin A. Felder
University of Virginia Health Sciences Center, Charlottesville, VA, USA

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22. A Unique Automated Approach To Clinical HDL Analysis Using The Gilson 215 Pipetting Station

Randy A. Turner and Robin Felder
University of Virginia Health Sciences Center, Charlottesville, VA, USA

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23. Automatic Pick Up And Delivery By Mobile Robot

Randy A. Turner, Christopher A. Estey, J. W. Holman, and Robin A. Felder
University of Virginia Health Sciences Center, Charlottesville, VA, USA

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24. The Use Of Reactive Fragment Structure Transformations For Automated Structure Generation In Automated Combinatorial Chemistry With Applications To Diversity Analysis

Francisco Velasquez, Allan Klickstein, Deborah Bartholomew, Silvia Catizone, and Giselle Bousquet
Boston University Medical Center, Boston, MA, USA

Deborah Taylor
Taylor and Taylor Company, Boston, MA, USA

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25. Automated High Throughput Screening: A State of the Art Approach

Alan J. Wyatt
Thurnall PLC, Manchester, UK

Paper Abstracts

Joseph Engelberger

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Robotics in Medicine - From Hospital to Home Care

The first industrial robot went to work in 1961. The technology has since come a long way. A robotics toolchest today is loaded and makes possible a broad range of jobs in the service arena. Paramount among these are roles in health care. When robots can be mobile, see, feel, and communicate by voice, they can serve as hospital orderlies, parapharmacists, parasurgeons, and companions for the elderly and infirm.

The argument will be developed through a brief historical glimpse at industrial robotics, now a six billion dollar industry, followed by an overview of technology at hand and the range of service activities under robot atttack.

All of which will naturally culminate in robotics for hospital courier service, parapharmacy, prostate surgery, neurosurgery, laparoscopy, physiotherapy, monitoring vital signs and the speaker's cause celebre, elder care.

Skip Klein

Investment Manager
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Investments in Automation Boost Productivity while Increasing Quality

The delivery of health care has traditionally been viewed more as an art than a science. Today, we are witnessing the transition of medicine from a fragmented cottage activity to an organized industrial process. While the "medical artists" will no doubt resist the encroachment of robotic technology that automates health care processes, the application of technology is an unrelenting characteristic of industrialization, whether we consider agriculture, automobiles, oil & gas, or even health care. Industry participants that embrace robotic automation as a "technology assist" to human judgment will thrive in the new environment, benefiting from increased productivity and quality that the new technology can permit. Investors in automation can benefit by placing well-researched bets on the management teams that are implementing "user friendly" technology in a form that enhances the human element, while not threatening the provider of care. The delicate balance between enhancing the human element and encroaching upon the human element will ultimately determine the speed by which automation technology is adopted. Potential investments to be examined include: automated pap smear screening, combinatorial chemistry, automated medicine dispensing systems, laser-radar assisted eye surgery, and stereotactic neurosurgery.

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Assay Miniaturization in High Throughput Screening: Present Success and Future Challenges

Assay miniaturization has been a topic of discussion for several years. Drug discovery scientists have long recognized the growing need to be more efficient in screening since they are faced with testing many more compounds with only small budget increases. The discussion of assay miniaturization has recently been elevated to active experimentation with the availability of 384-well microplates and the instruments to process and measure them. Pipettors, dispensers, plate washers, colorimeters, luminometers, fluorometers and radioisoptic counters are available for this format. Fortunately, many of today's popular assay technologies can be easily scaled down from 96- to 384-well formats with little or no optimization.

Many scintillation proximity assays can be scaled down to the range of 25 to 50 uL from current volumes of 100 uL or more. Luciferase reporter genes can be accurately quantitated with 4,000 cells or less in volumes of 30 uL. In-plate, non-separation isotopic assays in FlashPlates give the same results with far lower reagent concentrations. Homogeneous time resolved fluorescence (HTRF) has achieved high sensitivity in screening assays which will result in substantial miniaturization while maintaining very high throughputs.

Even as these assay methods are being scaled down to the 384-well plate and incorporated into screening programs, scientists in drug discovery and industry are co-operating on the development of the next generation of assays and instruments for higher density formats and more sensitive and rapid measurements. The current progress in miniaturization and ongoing developments in high density assay formats, nanoliter pipetting and imaging will make high throughput screening an exciting field for technological innovations.

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Recent Advances in Combinatorial Chemistry

The advent of combinatorial chemistry for the high throughput synthesis of compounds has driven the advancement of new and emerging technologies for synthetic chemistry laboratories and has intensified interest in the application of automation. Automated methods for reaction design, information management, chemical synthesis, compound analysis, and and purification have been implemented to realize the full potential of combinatorial chemistry efforts. The decision to execute syntheses by manual or automated means is often dictated by the necessary sample throughput and the compatibility of the chemistry with existing instrumentation. Critical issues in the selection and implementation of automation include system architecture, reactor design, ease of use, and targeted objectives.

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Changing Technologies for High Throughput Screening

The empirical evaluation of large numbers of samples in biological assays has become a major driving force in most lead discovery organizations. Clearly, the identification of novel lead molecules is a function of the number of diverse samples tested. In the 1980s, when investigators had many years to identify lead molecules, tens of thousands of samples per assay per year was considered to be an acceptable rate. In the 1990s, when investigators were given a year to identify leads on each target, hundreds of thousands of samples per assay per year were evaluated. In the next few years, however, another 10-fold increase in throughput is anticipated to meet the expectation of novel leads each month.

In order to reach the goal of rapid lead identification, samples from chemically-diverse sources (discretely synthesized molecules, combinatorially-derived molecules and natural product extracts) must be tested in a reasonable time-frame. This goal requires having the sample solutions available for evaluation in many assays, having the assays amenable to testing the samples in a cost-effective manner, being able to identify the interesting molecules and being able to track all of these events via a data management system.

The screening function is only a single component of the HTS process leading to the identification of novel biologically-active molecules. As throughput demands increase, so too must the number of samples, the sophistication of assays and the ability to monitor data. The success of drug discovery organizations is dependent upon the efficient integration, optimization and evolution of these activities.

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Fundamentals of Mass Spectrometry for High Throughput Screening

Advances in ionization techniques and instrument designs have transformed mass spectrometry into a fast and versatile analytical technique. This presentation will describe the fundamentals of mass spectrometry (MS) and relate them to high throughput screening. Issues such as speed, selectivity, and sensitivity will be discussed. For example, MS can generate molecular weight information over a wide mass range and requires only milliseconds to accomplish. In addition, mass spectrometry can be used to generate information related to fine structural detail. The technique is sensitive requiring as little as attomole amounts of sample. It can be used to identify individual components without extensive purification and can quantitate individual species within such mixtures. MS couples with separation techniques such as HPLC and CE to provide additional selectivity.

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Recent Trends in Clinical Laboratory Automation

Clinical laboratory automation has become a moniker for automation of the process of extracting information from patients specimens; formerly know as performing tests. Clinical laboratory automation has its beginnings in laboratory in the early 1980's in Japan were innovators such as Dr. Sasaki and Mr. Itoh (IDS) developed specimen transportation systems. As we have progressed through an evolutionary pathway that has been driven by changes in reimbursement for healthcare services and fueled by innovation. Recent trends can be grouped into several categories: 1). Automation "ready" instruments, 2). Automation Control Software, 3). Issues of venue, and 4). Heighten awareness amongst laboratorians and inatrumetn vendors.

The prevalence of automation ready instruments is increasing. Instrument manufacturers are either modifying or designing direct track hardware and software sampling mechanisms into their instruments. The automation ready capability of instruments will support the proliferation of automation technology in the clinical laboratory. Automation of the process of clinical laboratory automation can not be solved in the absence of Laboratory specific automation software. Automation is a software problem, not a transportation problem. Issues of venue are one of the most significant problems to understand. Patient, customer and client requirements are dependent upon multiple factors, not all of which are controlled by the laboratory. Automation systems need to support the patient care issues, not attempt to drive them. Laboratorians and instrument manufacturers are developing an understanding of laboratory automation issues as products are developed and fielded.

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Modular Automation: Maximum Flexibility at a Manageable Cost

With the need to reduce laboratory costs to compensate for lower test reimbursement from payers, including the government and managed care organizations, laboratory automation presents a significant opportunity to impact labor costs. However, the problem for many labs is that total laboratory automation is too new and expensive to provide a solution in the short-term. This is true for both hospital and commercial reference labs and requires that labs look for automated systems that are modular so that components can added as they can be justified.

This presentation will cover what characteristics to look for when selecting automated system components that can function as both stand-alone and as well as integrated into a system. It will cover both specimen processing and testing automation functions including, specimen transport, centrifugation, aliquotting, pipetting, instrument sampling, sorting and storage. It will also touch on cost / benefit issues to consider when looking at modular automation and sequential implementation of components.

The presenter has practical experience in the design and implementation of modular automation systems and will relate first-hand insights on modular approaches to automate the laboratory. Examples of modular components will be shown working in an operating laboratory.

The final part of the presentation will provide suggestions on how to plan to convert a manual operation to an automated one using modular components. It will be a checklist to review with modular automation suppliers.

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Laboratory Automation and Standardization Efforts for Patient Security - Reports on the Activity of the IFCC CAT (Committee on Advanced Technology) and CEN (Commission Européenne de Normalisation) TC 251 (Medical Informatics) Working Group 6 Health Care Security and Privacy, Quality and Safety)

The quick progress in biomedical technologies and the great pressure to reduce the patients stay in hospitals have resulted in a rapidly growing complexity of a typical hospital environment. This means that nowadays hospitalized patients receive a number of medical acts (and acts indirectly related to their management) much greater than in the past. Managing this more and more complex hospital environment in an efficient way, fulfilling the requirements of quality and patient security requires the healthcare process to be completely re-engineered. Many European and worldwide established organizations have been working for long time in establishing guidelines and possibly standards to meet the need of quality, safety and security in healthcare re-engineering . Security of medical information systems (that is prevention of breaches of confidentiality, integrity and availability) and safety of operators (that is reduction of risks of human injury or death) are the goals of the activity of the Working Group 6 (Healthcare, Security and Privacy, Quality and Safety - Convenor Dr. Gunnar Klein, Sweden), within the CEN (Commission Européenne de Normalisation) TC (Technical Committee) 251, on Medical Informatics.

Biosafety and patients security have been for many years important problems also for the major international association in the field of Laboratory Medicine (IFCC - International Federation of Clinical Chemistry). A relevant activity in this field has been done by the previous IFCC-EPI (Expert Panel on Instrumentation) and CAS (Committee on Analytical Systems) and is ongoing nowadays in the IFCC-CAT (Committee on Advanced Technology). The progress in concepts and perspectives of standardization of such organizations will be illustrated.

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Combinatorial ADME/PK: Applications Of Mass Spectrometry

In targeting small molecules for development as drugs, a major goal is the achievement of favorable bioavailability, metabolic stability and duration of action. These endpoints can be reached only by consideration of absorption, distribution, metabolism and excretion (ADME) in conjunction with the kinetics of these processes, or the pharmacokinetics (PK). Recent advancements in synthetic chemistry have provided for the generation of "controlled" product mixtures, forming the cornerstone of innovative synthesis and testing strategies, collectively referred to as "combinatorial" technologies. The principal advantage to applying these technologies to ADME/PK testing is two- fold: 1. Combinatorial chemistry provides a means of searching vast chemical space, thereby presenting an opportunity to explore new paradigms for physicochemical properties of molecules governing their ADME/PK behavior. 2. Combinatorial methods provide a means of testing multiple compounds simultaneously (i.e., as chemical mixtures) so that ADME/PK data can be obtained in a high-throughput manner. A challenge that faces the pharmaceutical industry is the transition from ADME/PK assays that are based on single compounds to assays that involve chemical mixtures. This presentation will cover the use of mass spectrometry (MS) for reaching this goal, focusing on: 1) accelerator MS for in vivo high-throughput testing, 2) MS in permeability assays; and 3) MS in simultaneous evaluation of the in vivo PK of multiple test agents.

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Simultaneous Pharmacokinetic Screening of Compound Mixtures Using Atmospheric Pressure Ionization LC/MS for Increased Throughput

In pharmaceutical research, large numbers of potent and selective compounds are identified from in vitro screens. Traditional methods of dosing individual compounds for in vivo pharmacokinetic characterization can be a bottleneck in selection of an optimal compound for progression to development. We have increased in vivo screening throughput an order of magnitude by dosing mixtures of lead compounds to a single animal and using Atmospheric Pressure Ionization LC/MS for quantitation. The inherent detection sensitivity and selectivity of mass spectrometry afforded rapid analytical method development and application for simultaneous pharmacokinetic screening of drug mixtures administered in vivo. This strategy (N-in-One Dosing) was applied in the context of screening for appropriate pharmacokinetic half-life, clearance and volume of distribution within a structurally related series of compounds in a drug discovery program. Analytical strategies for screening multiple compounds in biological matrices will be discussed. This methodology may offer application in lead identification and optimization of combinatorial libraries.

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Identification of Novel Receptor Ligands from Combinatorial Libraries: Affinity Selection-Mass Spectrometry

The creation of libraries of small molecules by combinatorial synthetic methods in conjunction with high throughput screening is a recent development in drug discovery which has accelerated the identification of lead compounds. The use of the target or receptor molecule to physically isolate the active components in a mixture followed by identification of the bound compounds by mass spectrometry has proven to be a direct and rapid approach for the identification of active compounds from such mixtures. Our procedure involves incubation of the receptor in solution with the compound library, under receptor-limiting conditions, allowing only those compounds with the highest affinities for the receptor to remain bound. The receptor:ligand complex is separated from excess free ligands by rapid size exclusion chromatography. The sample is then concentrated and desalted on-line with an electrospray triple quadropole mass spectrometer using a reversed phase peptide trap. The identities of the bound compounds are determined by comparison with the expected masses from the compound library and the structures confirmed by MS/MS. Using this approach, we have been able to rapidly identify lead compounds from a chemically diverse library of compounds. Additionally, we have been able to rapidly optimize such compounds for receptor affinity by carrying out selections with libraries of analog compounds. In cases where more than one compound is selected, identification of the bound molecules offers insight into the structure-activity relationship for that family of compounds.

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Automated Time-of-Flight Mass Spectrometry for the Analysis of Small Molecules and Biological Polymers

Time-of-flight (TOF) mass spectrometry, employing either electrospray or matrix-assisted laser desorption/ionization (MALDI), provides a unique combination of speed, resolution, mass accuracy, and sensitivity for analyzing both small molecules and biological polymers. This paper presents recent results toward the development of an automated system for ladder sequencing of biopolymers by MALDI-TOF. Briefly the present system consists of a liquid-handling robot and a Voyager-DE mass spectrometer. Applications of this system to C-terminal peptide and protein sequencing are described. Up to 20 peptides can be sequenced in a single run using four levels of enzyme digestion, and all of the steps involved in sample preparation: pipetting, dilution and addition of enzyme, and addition of matrix are carried out by the robot without manual intervention. The sample plate containing up to 100 discrete sample spots is manually transferred to the mass spectrometer and multiple mass spectra are automatically acquired on each of the sample spots. Spectra are interpreted using proprietary DECODE software which provides the most probable C-terminal sequence for each peptide and a statistical estimate of the reliability of the determination. Typically, the time required for sample preparation (including digestion) is less than 30 minutes for a full sample plate, and the time required for acquiring and processing spectra is comparable. Potential applications of extended versions of this automated system to protein characterization and to sequencing of oligonucleotides are briefly described.

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Automated LC/MS Analysis of Combinatorial Libraries: From Analytical Characterization to Preparative Scale Purification

Combinatorial chemistry has fast emerged as an enabling technology for accelerating drug discovery for the pharmaceutical and biotechnology industries. Typically, split-couple-recombine methods have been used to generate the largest sized libraries. The isolable amounts of these libraries are generally small and their composition and purity are rarely assessable. Alternatively, automated parallel synsthesis has permitted the synthesis of large quantities (10-100mg) of highly purified libraries, most often containing far fewer members. Their smaller size permits accurate assessment of both composition and purity. To ensure the reliability of the biological assay and best use of resources, it is essential that each library's intended design has been accurately synthesized. Consequently, recent efforts have focused on automating the characterization and purification of chemical libraries.

We have developed a fully automated LC/MS method for assessing purity of combinatorial libraries produced by automated, parallel synthesis. Samples are synthesized in "batches" of 40 compounds and analyzed using fast chromatography (5-10 min/sample) coupled with electrospray ionization-mass spectrometry (ESI-MS). Data processing and purity assessment is performed automatically, by aid of apple scripting routines and the results are exported to a text or Microsoft Excel file. Compounds failing to meet our purity criterion for biological screening (<85% pure) are subjected to on-line preparative LC/ESI-MS. Relying strictly on the unique mass "fingerprint" for a given compound, the selected mass (or extracted) ion current is used to trigger fraction collection. The process has been fully automated and has enabled preparative purification of large numbers of samples at the 10 mg level, unattended, overnight with purities of greater than 95 per cent achieved.

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Redesigning Your Laboratory on a PC - New Tools for Simuation-Based Workflow Analysis

Computer simulation is a powerful tool to justify automaiton and reorgnaization in the clinical laboratory area BEFORE money is spent and people are replaced by machines. However, adaptation of commercial simulation software to laboratory needs, data collection, calibration of the "virtual lab" against the real situation, realistic definition of future scenarios, and appropriate presentation of the simulated data, is extremely tedious and often too costly. Thus, the expected benefits are not realized.

We will present and demonstrate a software package which is based on the Simlab engine described earlier (Clin. Chem. 40, 922, 1194) plus two new tools for simplified data collection and effective data presentation. The software runs on a normal PC (486 and up). The effort for data collection is 2 to 3 days, depending on how knowledgeable the investigator is about the daily workload, equipment, staffing, and work rules of his or her lab. The simulation itself takes only a few minutes per run, but calibration of the model against reality and redesign of the lab may take another 3 to 5 days, depending on the complexity of the task. Data evaluation and presentation is immediately available. All data can be exported to commercial software like MS Excel or MS Access for further evaluation.

A practical demonstration will be given using a large US and a medium-sized German hospital lab as models. Actual and desired workflows are compared.

Pat Collins

Karl Frostrop

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Implementation of a Full Scale Automation System

Metro-McNair is the largest private laboratory operating throughout the province of British Columbia. About 7,000 patients visit Metro-McNair service centers each day.

In B.C. over 90% of outpatient testing services are paid for by the provincial government. The government sets fees and regulations. In recent years, there has been a slow decline in funding and attempts to reduce utilization of lab services. Metro-McNair felt that funding pressures would escalate and that a dramatic change would occur by the year 1997/ In order to prepare for the challenges, Metro-McNair decided to make radical changes in processes, tools and structure. In mid-1994, the company began the process of redesigning all operational and corporate processes and sought automation tools to support new processes. The company also began to redesign the organizational structure and began planning a new physical plant. Automation of the sample handling processes was identified as an enabler for supporting continuous processing and more consistent quality of service. It was also seen as a tool for moving the process of day to day management down to the fron line of operations. It was not chosen primarily for direct savings.

In late 1995, the company began the simultaneous design of an automation system and a laboratory facility. In December of 1995, the Vancouver operation moved to the new facility and in March of 1996, the sample handling automation was installed. The automation system handles all "tubes" and delivers samples to the high volume testing areas, routine hematology, routine chemistry, endocrinology, and urinalysis. The system also handles storage and retrieval of samples and sorting of samples for low volume work areas. The system has been in production since June of 1996. Implementation has been staged. We do not expect to achieve the full operational effectiveness until early 1997 because of the human adjustment to a new technology.

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Planning and Implementation of Staged Automation

Effective introduction of automation into the sample preparation area of the laboratory will occur only if appropriate planning is done in advance. It is inappropriate to expect laboratories to force their operations to suit the needs of an automation system. A better approach is to develop a detailed vision of how the laboratory should change to become more effective, then use automation tools to make the effective process more efficient. Automation products are now available which facilitate this approach. Independent modules which automate particular sample preparation operations can be introduced in a stepwise fashion to allow a laboratory to implement an automation development plan with minimal disruption. This approach also permits scaling of the automation system to respond to changing test volumes and provides flexibility to establish interim configurations of the laboratory during the transition to automated sample preparation.

The key elements of such a planning process are outlined. Emphasis in on responding to the challenges of consolidation, elimination of duplication, and standardization of processes will be discussed. A summary of automation modules available from AutoMed Corporation will also be described.

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The Impact of the Sysmex SE-Alpha Hematology Automation System

The Carle Clinic is a 300 physician owned clinic, consisting of a centrally located main clinic, 12 branch clinics and a 300 bed hospital. In 1993 the Hematology lab had lost a total of 2 FTEs and was experiencing a continual increase in workload. At this time we were faced with the decision to replace our aging and failing cell counters. Our challenge was to find a single solution to our staffing and workload problems. The Sysmex SE-Alpha Hematology Automation System was our solution. The introduction of the SE-Alpha into our lab allowed us to fully absorb the 2 FTEs that we had previously lost. The SE-Alpha greatly improved the Hematology workflow by eliminating the need for a separate work area and additional personnel for processing CBC specimens. The combination of Sysmex cell counting technology and automated slide processing enabled us to decrease our CBC review rate from 40% to 27% and our turn-around - times by more than 50%.

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Experience With the Boehringer Mannheim/Hitachi Clinical Laboratory Automation System

On October 22, 1996, the installation of the first BMC / Hitachi CLAS system in North America began at the South Bend Medical Foundation in South Bend, Indiana. The system is being installed into an existing clinical laboratory and is comprised of preanalytical equipment, a chemistry line utilizing three Hitachi chemistry analyzers, a hematology line with a Sysmex HST-430 II Automated Hematology Workstation and the beginning of a coagulation line which includes a centrifuge and sample stocker. This line and an immunoassay line will be completed in mid to late 1997.

This presentation will cover the experiences gained by this laboratory during the short time period of use prior to the conference. Information will be presented on the installation process including special consideration of automating in a space and incorporating analyzers in routine use during the installation. Metrics will be presented including the number of specimens handled by the system, system capacity, testing turnaround times and the initial impact on staffing.

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Laboratory Automation - Ingredients for Disaster and Recipes for Success

Shrinking budgets and increasing workloads are continually challenging laboratories to reduce their operating costs. For some, this need is a matter of economic viability, for others, it translates into shrinking or growing market share.

Because labor costs normally account for a major portion of a lab's operating costs, the need to reduce operating costs is often translated into a direct need to reduce labour input. Automation is then targeted as the means to address this need and begins its journey with labor reduction as its initial and primary focus. Solutions become "immediately apparent" and project phasing and budgeting proceed around early embraced needs for "Front-End Automation".

While it is imperative that automation solutions be cost-effective and quite likely that automation applied to the pre-analytical areas is sensible, this early-defined focus can mask alternative strategies which could prove more advantageous overall.

This session will examine positive as well as negative factors which typically influence laboratory automation projects. From the early stages of the decision making process through to post-installation service and support, common steps can be taken to enhance an automation project's success and to avoid common pitfalls. Guidelines developed from first hand experience will be offered for:

- Streamlining the decision-making process
- Developing general consensus for automation solutions
- Minimizing implementation time to full production status
- Achieving self-sufficiency and self-reliance with automated equipment
- Optimizing cost efficiency and operational benefits of automated solutions

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Opening Doors With Automation

The presentation will cover:

- What is ACM?
- Who are our customers?
- The Early Days
- Planning for Expansion
- Building our Facility
- Selecting our Software
- The Laboratory Information System (LIS)
- Introducing Automation
- Challenges
- The State of Health Care
- The Future of ACM
- Q & A Session

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Lab Automation: A Stepwise Approach

Lab Automation is moving rapidly in the clinical laboratory market. Hundreds of laboratories around the world are considering the implementation of this new and exciting technology. How can customers negotiate the LAS implementation minefields? Abbott believes there is a "stepwise approach" to automation which begins with process reengineering and data management enhancements. This presentation will highlight Abbott's approach though the use of case study data. Additionally, AxSYM and Cell-Dyn interface work will be discussed. The presentation will preview three workcell projects in development at Abbott, which include modular platforms for immunoassay, clinical chemistry/immunoassay and hematology.

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Clinical Laboratory Engineering In A Multidisciplinary Platform

The clinical laboratory is moving from an activity focused on the analysis to an in vitro diagnostic service network. Laboratories are merging to optimize sample and information handling, and equipment utilization ratio.

About the “full automated laboratories” which are often presented as the future of the clinical laboratory, we would like to emphasize that laboratory analysis is a disassembly process, very different from manufacturing processes which are assembly processes.

Specific quality goals must be discussed before adapting robotization. As an example, Quality goals in sample handling induce requirements for automation of sample handling : transportation, centrifugation, sample aliquotting, and loading on the analytical system.

The architecture of the laboratory must allow a good communication between activities with a high level of automation and specialized activities using a large panel of technologies allowing complementary testing.

The concept of multidisciplinary laboratory platform was experimented in the Institute of Biology of Nantes, including clinical laboratories, research laboratories, and start-up companies in an opened space of 10.000 m^2 shared between two floors. Sample transportation is automated from clinical wards to laboratory workstations.

Our strategy, more than job elimination, is to emphasize the technical and medical expertise through improved communication networks and to involve laboratory professionals in the development of new activities induced by this integrated laboratory practice.

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Automated Sample Handling: A Case Study

SmithKline Beecham Clinical Laboratories (SBCL) is in their second year of implementing Total Laboratory Automation (TLA) at one of their reference laboratories, located in Norristown, PA. This talk examines SBCL's laboratory planning considerations, implementation of and experience with automated sample handling. Specifically, the criteria for selection of an automation platform, the characteristics of one automated workstation product flexible to meet SBCL's needs, and the applications of that product are addressed. Implementation issues, training, employee perspectives, and quality improvements are reviewed. Advantages and disadvantages of automation from our experience are described. Alternative configurations for dissimilar laboratories are proposed, demonstrating the flexibility of the workstation chosen.

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Project Management and Laboratory Automation

The focus of this session is on the project planning and management that must occur when implementing a laboratory automation system. The presentation will describe the steps that Lehigh Valley Hospital took in redesigning their laboratory and the impact that it had on operations and personnel.

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Laboratory Automation: The Design Of User Interfaces

Total Laboratory Automation is the logical extension of workbench automation. However, as the number of parameters to be controlled is expanding rapidly, key requirements for the proper management of the multiple devices involved is the quality of the User Interface and Data Accessing capabilities.

A large part of instrument workstation design concepts can be reused like the "dashboard" concept giving at a glance the general status of the entire configuration. The hypertext approach, to navigate from the higher levels of information down to required detail is also needed. Only relevant information should be brought to the attention of the operator. The user interface look and feel is also of paramount importance to zoom on the individual components like sample feeder, centrifuge unit, uncapper, aliquot production unit, bar code production/labelling unit, sample conveyor and the various instruments for which both analytical process and data handling interfaces need to be considered.

The efficiency of the configuration is largely dependent on the reliability of the different subsystems for which preventive actions and troubleshooting should be computer aided. In addition, remote access from expert maintenance centers can further improve the time to repair. Automatic processes can be involved with, as the last resort, operator intervention, both cases needing suitable user interfaces.

Finally, how the huge volume of potential errors is handled significantly impacts the general throughput and production of the whole system. Appropriate dashboard warnings integrated with efficient hypertext type navigational aids are key features for success.

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Strategic Partnering in Lab Automation Initiatives

Laboratories must develop a vision and strategy if the lab is to systematically enact change to ensure its future. Strategy entails identification of competencies, trade-offs with competitors to position oneself in a sustainable market niche, and operational effectiveness. Partners can expedite change and rate of progress by contributing their competencies to strategic initiatives, leveraging their market position to advantage the laboratory, contribute resources and share risk for financial outcomes, and contribute information and information technology to the lab's knowledge base. Partnerships need to be mutually advantageous and should be based on tangible outcomes and improvements not the least of which are market share, competitive edge, and lower unit costs. Automation is a prime area where partnerships make sense. In order to implement a partnership around an automation initiative, automation must represent a strategic fit to which resources are committed. Identifying potential strategic partners involves 1) identifying corporations which could benefit from collaboration, 2) explicitly developing requirements defining contributions and timetables, measurements and expected outcomes, and risks, and 3) testing the fit. One approach is to us an RFP process. Strategies are never short term and an expectation should be set that long-term commitments are on the table which, at the same time, mutually advantage and place at risk the participants. The process by which Heath Network Laboratories identified its strategic partners in our lab automation initiative with LAB-Interlink, Johnson and Johnson Clinical Diagnostics, Abbott Diagnostics, and Sunquest Information Systems will be described.

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A New Approach To Supporting Biopharmaceutical Automation

In 1995, Amgen initiated a small molecule research effort at it's Boulder, Colorado location. With this new effort came the freedom to create a new style of automation and informatics organization, cutting across traditional boundaries, to provide techno logy in support of biopharmaceutical research moving into the next century.

Combining expertise in robotics, data management, IT infrastructure support and library information services, we have created an organization that can master the interwoven challenges of automated systems, their generation of increasing volumes of data, c
onverting that data into useful information and relating it to the larger global body of information to facilitate further research directions.

This paper will describe some of the technology support of Amgen high throughput biology and chemistry programs, and the benefits, challenges and choices involved in creating a new program.

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Robotic Workstations Compliment Tracked Robot Systems

Robotic workstations are a useful type of laboratory automation, both as stand-alone instruments for sample preparation, and as part of tracked robot systems.

Workstations are usually defined as having one or more cartesian axes, having a modest footprint (usually on the order of 500 cm x 1 m), able to manipulate sample containers (e.g. vials, test tubes, micro-well plates, etc.), and have at least one other function, such as pipetting, dispensing, weighing, mixing, etc. Workstations are available from a number of vendors, including Beckman Instruments Inc., Bohdan Inc., and Cyberlab Inc., to name a few.

Workstations gain economies over customized robot systems because typical users' needs can be satisfied, for a given application, with standardized hardware software. Various devices are available on the workstations to allow them to perform a variety of typical sample preparation tasks. Examples of these include liquid and powder dispensing, liquid transfer, mixing, uncapping and recapping, bar code reading, heating, cooling, etc.

Because the various vendors have standard, yet flexible, workstation software, the user is able to perform a wide variety of sample preparation routines without the need for custom software. When a sample preparation method can be accomplished on a robotic workstation, it generally offers the user the most value for their money.

For some applications, however, a larger work envelope is required, and a tracked robot usually meets these needs. Many times an optimum system will utilize a workstation with a tracked robot. The workstation easily and economically performs the sample preparation or liquid transfer tasks, and the tracked robot addresses the need for a larger work envelope.

There are numerous installations where workstations are working within tracked robot systems. These workcells combine the strengths of each type of robot..

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Automated Retrieval of Clone Libraries Utilizing the Biomek® 2000 Robotic Workstation

Sequana Therapeutics is engaged in identifying the genes responsible for common diseases such as asthma, diabetes, osteoporosis, and others. Effective selection of positive cDNA from large numbers of frozen clone library storage trays is necessary for successful gene discovery.

We have automated the recovery process of catalogued frozen clones utilizing the Biomek 2000 Workstation. The Biomek® 2000 offers appealing flexibility and performance. In order to harness its full capabilities we have developed custom software. A Visual Basic front end program, running under Windows® 3.1, generates low level embedded TCL and BioScript® commands and sends the commands, via interprocess communication with Bioworks®, to instruct the robot. The systems can retrieve clones from library input plates in 384 and 96 well formats and inoculate clones into an output plate. The output plate is prepared by transferring liquids from Beckman reservoirs positioned on the work surface. The Visual Basic user interface allows Laboratory technicians to access their data selections from a data base or select positive clones by mouse clicking on plate wells. Plates scheduled for processing may be removed or added in a plate manager window. In this talk we will present the user interface, TCL issues, development and support issues, and a qualitative assessment of the program's day to day use.

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Automated Workstation for Potency Testing of Transdermal Systems

The purity assay for transdermal systems involves the manual transfer of diluent to a jar, sonication for two hours with occasional manual shaking, filtration of the extract, transfer to a high performance liqiuid chromatography (HPLC) vial, and measurement of the extract on an HPLC system using external standard technique. An alternative automated process was developed using the Bohdan Automated Workstation. The workstation consists of a capping/uncapping module, vortexer, HPLC injector, syringe pump for transferring liquids, balance for verifying transfer volumes, barcode reader and Bohdan gantry style robotic arm. The automated process duplicated the steps of the manual process with the exception of the extraction procedure which was performed by vortex extraction. The automated process was proven to accurately dispense methanol into the EPA vials, extract the active drug from the transdermal system by vortexing, showed no carry over from sample solution transfer, and passed system suitability for complete analysis of the active drug. The system is currently being validated for lot release in the Quality Control.

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A Fully Automated Oligonucleotide Ligation Assay Using the Biomek® 2000 Robotic Workstation

The OLA (Oligonucleotide Ligation Assay) is a point mutation detection system used in genetic biallelic typing. The method employs an initial PCR amplification of targets followed by a ligase-mediated reaction able to distinguish single nucleotide variations in the target DNA. Ligated products are then detected using a colorimetric immunoassay method performed on microtiter plates. Manual and semi-automated implementations of the method were described elsewhere. We have demonstrated a fully-automated implementation of the process which includes reagent pipetting, incubations and immunoenzimatic detection using a Biomek® 2000 robotic workstation. The successful automation of the process required hardware modifications on the Biomek® 2000 robotic workstation and use of labware different that that used in the original manual protocol. The time required to process 96-well plates was approximately 4 hours, excluding thermocycling times. Operator hands-on time is limited to placing reagents and labware in the robot's worksurface at the start of the procedure and corresponded to approximately 15 min. The background signal and false results observed with the automated method were at least as low or lower than those observed with the manual method. The strategy adopted for method development and increased throughput obtained will be discussed

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A Real-Time Microtiter Plate Reader Based On A High-Throughput Imaging Fluorometer

Conventional microtiter plate readers analyze each plate by sequentially rastering an optical reader head assembly from well to well or by sweeping a one dimensional detector array across the second dimension of the plate. Traditionally, a single scan requires several seconds and may take as long as a few minutes. As the number of wells increases, the time required to scan the plate increases proportionally and limits the temporal resolution of the experiment.

To address the limitations of conventional reader technology, we have developed a high throughput chemical imaging fluorometer that combines a charged coupled device (CCD) camera for detection with novel liquid crystal tunable filter (LCTF) imaging spectrometers to select the excitation and emission wavelengths under digital electronic control. Each detector acquisition represents a spectral image of the entire plate making the temporal resolution of the experiment independent of the well geometry and well number. By appropriately tuning the LCTFs, complete excitation, emission, and reflectance spectra can be acquired without the use of filter wheels or inefficient dispersive monochromators. The development of the microtiter plate imaging fluorometer will be described as well as the role of chemical imaging in bioanalysis, bioprocess monitoring, and drug discovery.

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The ASTM Laboratory Equipment Control Interface Specification

The American Society for Testing Materials (ASTM) E49 Computerized Systems and Chemical and Material Information committee, E49.52 Computerization of Analytical Sciences Data subcommittee, has developed the Laboratory Equipment Control Interface Specification The specification describes the external interactions that must be accessible to remote control in order to set up and operate laboratory equipment in an automated laboratory. Each interaction is specified in terms of standard state behaviors and standard message exchanges between the equipment and the controller that coordinate the transitions between the states. The emphasis is upon control of the discrete events in the sample processing in an automated laboratory and material hand-off between components in the system.

The intent of the Laboratory Equipment Control Interface Specification is to allow deterministic remote control of laboratory devices that meet the National Institute of Standards and Technology Consortium on Automated Analytical Laboratory Systems (NIST CAALS) definition of a Standard Laboratory Module. The standard will facilitate modular agent-based control of laboratory automation, and thereby significantly reduce the cost and effort to develop fully-automated laboratories.

The ASTM specification is derived from the CAALS Common Command
Set and the Generic Equipment Interface Specification developed by the Intelligent Systems and Robotics Center at Sandia National Laboratory. This presentation will describe the specification and present implementation examples and provide an update of the status of standard balloting.

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Generic Hardware-Independent User Interface for Laboratory Automation

A major obstacle to laboratory automation is the effort required to design or modify the user interface and control software. What is needed is a hardware-independent user interface that can be customized through device specific software drivers. Towards this goal we have developed a generic user interface that can be adapted to various robots and a wide range of hardware, yet still provides a consistent and versatile method of planning experiments on robotic equipment. The interface does not access hardware directly but uses a simple DDE connection to hardware specific device drivers to both initially identify the hardware that is available, and issue commands during an experiment. This DDE connection is a simple open-architecture standard that allows rapid development of drivers using simple programming tools, such as Visual Basic, and reuse of existing drivers.

The user-interface polls hardware drivers for information about the hardware environment and combines this information with a set of generic operations to create a menu of all available robotic procedures. The generic operations include material addition, transfers, washing, temperature control and data collection. In addition to basic material handling operations the software also includes a scheduler and limited resource monitoring.

Once the software has built the menu of procedures the user selects operations from the menu to build experimental protocols. An experimental protocol can be run as a single experiment or can be modified with variable parameters and used as a template to create a set of experimental protocols as part of an optimization experiment.

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cDNA Library Substraction Using a Neural Net Classifier

The goal of the Amgen Genome Program is to find therapeutic compounds via the discovery of novel genes from cDNA libraries. The efficiency of finding novel genes is significantly improved by removing the commonly found genes from a cDNA library prior to the resource intensive task of DNA sequencing. One step involved in the removal process (i.e. library subtraction) is the classification of bacterial colonies based on selective hybridization with a radioactively tagged DNA probe.

Input to the classifier are high resolution gray scale images quantifying the presence of the radioactive probe. The probe selectively hybridizes to a percentage of bacterial colonies which have been spatially "gridded" upon a nylon membrane. However, the probe is not limited to those sites, and classification is made difficult by the presence of a high and varying noise background.

A software based solution for classifying cell colony images using a feedforward, backpropagation, neural network in conjunction with a signal-minus-noise estimate is presented. The method is implemented using the Matlab application using Signal Processing, Image Processing and Neural Network Toolbox function calls.

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The Mathematica Link To Labview: An Environment To Develop Electronic Laboratory Notebooks

The non predictable structure of data collected during a research project is one of the main challenges Electronic Laboratory Notebooks (ELNBs) designers have to face.

The last release of Mathematica has several features that make it a good candidate language for developing ELNBs. It provides a number of programming techniques that are usually not available in most languages. Transformation rules and pattern matching are the bases of its symbolic computation capabilities. The possibility to handle expressions according to their pattern independently of their data type is particularly valuable to process data of unpredictable structure. Moreover, the user interacts with Mathematica through hypertext documents named notebooks. The Mathematica programming language has a large number of functions to generate notebooks from their highest level of organization down to subtle typesetting details. These functions can be used to automate the experiment report generation.

Mathematica has been linked to LabVIEW, a high level graphical programming language for instrumentation applications. The link allows to run LabVIEW applications from within the Mathematica notebook either locally or on a remote computer over the network. Portability of Mathematica and LabVIEW applications over systems under UNIX, Windows 95/NT, or MacOS ensures the generality of ELNBs based on the Mathematica link to LabVIEW.

A small mobile robot is used as a model instrument to evaluate this technology. It will be demonstrated that it is possible to record experimental protocols, operate the robot, and automatically generate experiment reports.

Current limitations of this technology as well as research prospects will be discussed.

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Novel Enzyme-Linked Oligonucleotide Assay (ELONA) Using Oligonucleotide Aptamers Created By The SELEX Combinatorial Chemistry Process

The development of combinatorial chemistry methodologies that can identify molecules capable of binding to specific targets offers opportunities to expand the range of technologies that rely on molecular recognition. These new chemically defined molecules are smaller in size and complexity than antibodies, easy to manufacture and modify, chemically consistent between lots, and stable during storage. The systematic evolution of ligands by exponential enrichment (SELEX) process is a combinatorial chemistry method capable of identifying nucleic acid ligands (aptamers) that bind to a desired target molecule, by virtue of the three dimensional structure of the aptamer, with high affinity and specificity. The SELEX process can be performed with modified nucleotide triphosphates, producing nuclease-resistant ligands to a wide variety of chemically distinct targets. With the development of this wide target repertoire, several *in vivo* and *in vitro* applications have begun to emerge. In one application an aptamer specific for human vascular endothelial growth factor (VEGF) was used in a sandwich assay format to reliably quantify VEGF in serum. Error analyses as well as precision, accuracy, interference and specificity analyses have shown equivalence to a typical sandwich ELISA, demonstrating that SELEX process derived ligands represent a viable alternative to the use of antibodies in clinical and research assays. Other applications to be presented include the use of aptamer inhibitors of *Taq* polymerase to increase the specificity of PCR and the use of a human L-selectin specific aptamer as an affinity purification reagent.

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The Master Patient Index Mediator: Merging Disparate Patient Record Number Systems

Architects of laboratory automation systems that deal with medical data should consider how to accomodate the future trends in electronic medical records. Representatives of many public and private sector organizations are working on a solution to a major obstacle to the integration of patient record systems--the ubiquity and incompatibility of patient record numbering systems. During the first two meetings, working groups developed technical specifications for object-oriented classes designed to help link together disparate patient record systems. These specifications may serve as the blueprint for future commercial developments. They may also help shape the future of healthcare data interchange standards.

The design philosophy behind the specifications and the reference prototype, now in progress, emphasizes interoperability and the integration of existing master patient index applications. This approach minimizes the amount of change required for the local systems and simplifies security and access issues for enterprise wide activity. Local systems maintain control and responsibility for their own data access, updates and amendment histories.

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Automated Purification for Combinatorial Chemistry

Automation of combinatorial chemistry begins with an efficient synthesis apparatus. Once synthesis has been automated, however, other bottlenecks emerge in the overall work flow. This talk will describe some of the significant non-synthesis automation challenges in combinatorial chemistry, along with solutions to these problems that have been used at BMS. The primary focus of the talk will be automation of high throughput analysis and purification by HPLC, preparative HPLC, SPE, and other methods.

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Solenoid Valve-Based Inkjet Dispensing for Combinatorial Synthesis and High Throughput Screening

The application of inkjet dispensing technology to drug discovery is necessary to meet the need for submicroliter dispense volumes. In addition to providing small volumes, inkjet dispensing provides rapid dispensing due to the response time of the valves (100 -1000 dispenses per second) and the non-contact nature of the dispense (i.e. no washing between dispenses). Inkjet valves are available in two types: piezoelectric and solenoid. The former, provides ultra-small drop sizes on the order of picoliters per drop whereas solenoid-based dispensing provides drop volumes on the order of nanoliters.

For our applications, solenoid-based inkjet valves have been chosen for reasons of robustness, reproducibility, and wide dispense range. Liquid dispensing using a solenoid inkjet valve involves connecting the valve inlet to a pressurized fluid source (5 to 10-psig) and connecting the valve outlet, via a delivery tube, to a restrictive orifice. The dispense occurs by momentarily opening the valve for several milliseconds, which launches an acoustic or pressure wave down the delivery tube to the restrictive orifice. Upon reaching the restrictive orifice, the velocity of the liquid stream increases, causing the liquid to "jet" from the orifice.

This paper will show detailed characterization of solenoid-based inkjet dispensing in terms of linearity, reproducibility, and dispense quality. In addition, inkjet dispensing instrumentation will be described (ChemJet) which is being developed for high-density formats useful in combinatorial synthesis (ChemSheet) and high-throughput screening (BioSheet).

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Workflow Analysis, Automation And HTS: A Case Study In Optimizing Complex Transcriptional Cellular Assays For HTS

Ligand is a leader in discovering and characterizing new drugs that modulate gene transcription. Most of the HTS assays run in New Leads Discovery (NLD) are cellular assays that employ transiently or stably transfected cells to provide specific readouts of drug induced modulation of transcription. Because our core technology is so broadly applicable to a variety of therapeutic targets, we undertook an intense, multifaceted campaign to optimize our standard operating procedures. One approach involved acquiring a suite of custom and off-the-shelf workstations equipped with plate stackers, allowing for semi-unattended operation of our most difficult assays.

Another approach involved designing, implementing and validating a fully automated robotics system to run our simpler cellular assays. Finally, we optimized the overall workflow in the lab and enhanced our informatics capabilities. Upon integration, these improvements allowed for a ten-fold increase in throughput and a four-fold increase in capacity in the lab. Moreover, the approaches we have validated offer new models for stepwise and fully automated HTS systems.

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A Massively Parallel, Microfabricated System for Drug Discovery

Orchid Biocomputer, Inc. is developing an advanced system for the massively-parallel synthesis and screening of drug leads, based on the advanced microfabrication capabilities of the David Sarnoff Research Center. The goal is to apply microfabricated chip-based technologies to performing conventional chemical reactions in thousands of cells simultaneously, with each cell operating independently. The system under development utilizes novel, microfabricated components for valving and pumping of fluids, integrated within multi-layered planar structures. A key aspect of the approach is the ability to pump reagents without the need for moving parts. This enhances device reliability and ease of chip fabrication. The synthesis and screening system will be presented along with related opportunities in genomics and high-throughput screening offered by our miniaturization technologies.

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Standardization Of 96-Well Microplates For Automated Handling

Under the auspices of the Society for Biomolecular Screening, an intensive effort has been made during the last year to define a standard for 96-well Microplates. More mechanization is being provided to meet the increasing use of 96-well microplates in biological assays. This involves various forms of stackers and robotic hands. These mechanical systems are far less tolerant of plate variations than manual systems. Minimizing the dimensional variations in the microplates will increase the reliability and decrease the costs of handling microplates. As with any standardization effort, there are compromises that must be made. These will be discussed, along with the reasons for the final dimensional choices.

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Implementation of Microvolume Assays in High-Density Microtiter Plates

Screening is a reliable, time-tested method for the discovery of new pharmaceuticals that is now becoming a focus for technological development. Significant advances in both combinatorial chemistry and genomics are the forces driving this development. Combinatorial chemistry, particularly directed toward large encoded libraries, has increased the number of pharmaceutically-relevant compounds available for screening, and will continue to do so well into the future. As a complement, genomics is rapidly increasing the number of potential targets for screening. The explosion in both libraries and targets mandates improvements in screening technologies.

Lower volume bioassays are clearly advantageous, conserving both target reagents and compound collections. Reductions in volume also allow samples to be arrayed at higher densities to increase sample throughput. Reducing assay volumes presents a number of technological challenges to both biologists and engineers. A wide range of bioassays, including enzymatic, receptor binding, and cell-based assays need to be addressed in a microvolume format. Further, to carry out these assays in an efficient manner, improvements in liquid handling and detection, as well as the design and molding of new containers, will need to be implemented. Experimental approaches and technical strategies for meeting these challenges will be discussed.

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High-Throughput Functional Drug Screening In Stably Transfected Mammalian Cells Using Fluorescence Imaging Of Intracellular Calcium

SIBIA Neurosciences has previously reported a functional assay, applicable for drug screening, that measures changes in the concentration of intracellular free calcium ($[Ca^{2+}]_i$) in recombinant mammalian cell lines expressing human ion channels and receptor subtypes. To further adapt this assay for screening large numbers of compounds, a fully automated high-throughput screening (HTS) system was developed. This system integrates a CCD-based imaging system for fluorescence detection, 96-channel liquid handling systems, a robotic system for plate handling, fully-automated data analysis and quality control, including automated dose-response curve fitting. The flourimetry system can detect changes in calcium as low as 2 nM in solution. The fluorescence from changes in $[Ca^{2+}]_i$ are detected in real-time in whole, live, mammalian cells preloaded with the calcium-sensitive fura-2 or fluo-3 dyes. Several cell lines expressing recombinant human subtypes of excitatory amino acid receptors, voltage-gated calcium channels, and nicotinic acetylcholine receptors were used to validate the HTS system in response to reference compounds. The pharmacology determined by the HTS system was in agreement with that determined by biochemical and electrophysiological measurements. This functional screen has advantages over binding assays since it allows the detection of compounds that functionally interact anywhere on the ion channel or receptor, including binding or modulatory sites. Furthermore, the use of secondary assays may be avoided since compounds can be directly screened for both agonist and antagonist activity in a single assay process. The functional screen can identify novel compounds that interact with specific ion channels and receptors at previously unrecognized sites.

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Accelerating Drug Discovery By High-Throughput Combinatorial Synthesis

A fully automated organic synthesizer has been constructed to generate diverse chemical libraries for use in drug screening programs. This high-throughput chemical synthesizer is based on proprietary robotic synthesis hardware and software. By combining the robotic synthesis technology with novel oligomerization chemistry, a small set of low-cost starting materials can be transformed into an equimolar mixture of tens of thousands of diverse chemical structures. These mixtures can then be screened against a wide variety of pharmaceutically relevant receptors. Peptoids (N-substituted glycines) as well as peptides can be synthesized in very high yields. Peptoids have the added advantage that they can be synthesized from an incredibly large pool of commercially available primary amines in well defined steps. This makes peptoid synthesis well suited for automation. Highly potent peptoid trimers have been discovered with this technology. The development of new chemistries as well as the need for more complex chemical structures has prompted design changes in both the synthesis hardware and software. The most recent generation of synthesizer features a high temperature heat block as well as more flexible software. As a consequence of these design improvements, this automated system has evolved from a peptide synthesizer into a more general purpose organic synthesizer.

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Automated Parallel Synthesis of Antitubercular Agents

An automated organic synthesis Workstation to support a variety of medicinal and combinatorial chemistry functions has been developed. The Workstation features the RAM™ Synthesizer, a modular reaction block, which allows for the convenient preparation of 48 compounds in a spatially addressed format. The RAM Synthesizer is composed of a number of sections that, when combined, create the required reaction environment to support both solution and solid-phase synthesis. The RAM Synthesizer's capabilities include the following: variable reaction temperatures; reflux conditions; two reaction vial sizes; inert atmosphere; and vacuum functions. The Automated RAM Synthesizer (ARS) Workstation features: reactant preparation and mapping; reagent and product weighing; reaction work-up; and compound dissolution and dispensing. Product solutions are readily transferred to archive vials and/or a microplate for analytical or biological evaluation. In addition, the ARS provides modifiable method set-up capabilities using sequence building software. This presentation will describe in detail the component parts of the ARS and its application to the parallel synthesis of a series of novel antitubercular agents.

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The Use of Reactive Fragment Structure Transformations for Automated Structure Generation in Automated Combinatorial Chemistry with Applications to Diversity Analysis

Computer programs for the automated generation of molecular structures are requried to handle the volumes of data produced by recent advances in combinatorial chemistry. Typically, a list of reagents and a reaction template are provided as input to these programs and a set of structures is generated as output. One demostrated approach to this problem is based upon a parent-substituent model in which a parent structure is invariant and a set of substituent AR-groups are varied. In the Ontogen approach, we specify a structure transformation rule which defines a mapping from the graph structure of each reagent to the graph structure of the reactive fragment that is incorporated into the desired structure post-synthesis. By specifying the connection points among the fragments we can generate the final structures without the limitation of an invariant parent fragment. The reactive fragment approach is universally applicable for the many reactions in which a parent-substituent approach fails. In addition, we demonstrate a method of diversity analysis utilizing reactive fragments which has several desireable features.

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A Novel Spatially Addressable Automated Synthesizer for Combinatorial Chemistry and Drug Development

So far there are two distinct approaches for synthesis of chemical libraries. The split synthesis technique is used for synthesis of large libraries containing up to several billion compounds. Applying this “one bead one substance” approach, each bead contains one single component at the end of the synthesis. Tagging and encoding techniques document the synthetic history of the component. The alternative synthesis technique uses the spatially addressable approach. The compounds are synthesized individually and parallel and each reaction compartment encodes the individual chemical history.

We here describe a novel automated synthesizer system which allows the synthesis of individual compounds applying combinatorial methods. As the system is designed as a modular system, any number of reaction units can be used. One reaction unit contains 12 spatially separated reaction vessels, thus precluding cross-contamination. N x 12 reaction vessels can be used as synthesis format. Each reaction unit is controlled individually with respect to time and temperature, whereby both heating or cooling are possible. All reaction vessels are equipped with glass filters and reflux condensers. The reactants are added by a dilutor and mixed by gas bubbling with inert gass creating a completely inert atmosphere. The concept of an open system also allows reactions to be run with expanding or decreasing reaction volumes as well as the use of gaseous reactants. Additional reagents can be added while the reaction is running. The format of the reaction unit allows the components to be collected automatically and individually in collecting vessels or alternatively in 96-well micro titer plates. With this automatic synthesizer, a number of libraries have been synthesized and syntheses optimized by solid phase chemistry on supports such as TentaGel or polystyrene.

For miniaturization of chemical reactions and screening either glass microtiterplates equipped with glassmicro-fritts are used or the synthesis is performed in glass capillaries by using special designed resins. This miniaturization scales the synthesis down to the nmolar level.

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Closed-Modular Approach to Solid-Phase Synthesis

Advances in molecular diversity have been made possible by developments in solid-phase chemistry, automation, and interdisciplinary coordination in the fields of chemistry, biology, robotics, and computers.

This presentation will explore details and rationale behind one automated approach to solid-phase synthesis developed at Bohdan Automation in close cooperation with leading scientists in drug discovery programs worldwide. This approach is best suited to centralized synthesis groups whose needs are served by multiple, highly specialized Workstation offering very high throughput.

The key functional components of this set of three Workstations include:

1. Resin Dispensing/Reagent Preparation
2. Reaction Mapping/Setup/Resin Washing
3. Product Cleavage and Collection

These Workstations support one or more Bohdan bottom filtration reaction blocks and heat/cool/shake stations. Together, these "factory" components define a closed-modular approach to synthesis based on a reaction block designed for efficient, high throughput solid-phase synthesis.

Key considerations addressed by the hardware and highlighted in the presentation include:

- Automated weighing to determine reagent and resin dispensing weights
- Bar-code labeling and tracking of reagents
- 5-channel dispensing for common solvents and resin washes
- Liquid level sensing and visual inspection port
- Graphical software interface to define mapping patterns

- External file input compatibility
- Enclosed, locally vented work area
- Vacuum elution of washes or cleaved product, 40 or 48 simultaneously
- Reflux and mixing capabilities in reaction block
- Direct compatibility with commercial evaporators

These key areas, as well as practical examples will be presented as key components of the wide variety of technologies required to make drug discovery programs work.

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Genosensors and Model Hybridization Studies

Genosensors take advantage of the specific hybridization properties of nucleic acids to characterize the DNA sequences in specific genes or even entire genomes. The genosensors are miniaturized arrays of nucleic acids, spatially separated, and on either planar or porous surfaces. They are also referred to as SBH (sequencing by hybridization) or DNA chips. Optimal function of the genosensor is necessary for applications in genomic typing, organism identification, RNA structure analysis and transcriptional profiling. Other applications are readily envisioned however the construction and effective use of genosensors must be determined. The porous format is called a flowthrough genosensor and offers advantages in terms of sensitivity. The robotic spotting and immobilization of presynthesized oligonucleotides will be discussed. Extensive efforts have been made to characterize the thermodynamics of model oligonucleotides. The temperature stability of several hundred pairs of oligonucleotides has been examined by optical melting to characterize perfect matching and mismatching as a function of position in short oligonucleotide probes. The effects of probe length and unpaired dangling ends have also been examined to assist in the selection of genosensor probes and interpretation of hybridization results. Genosensors of similar sequence probes are under construction and will be useful in the comparison of solution and chip based measurements. A thorough understanding of the stability of DNA probes will allow for effective applications of genosensors.

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Radioisotope Redux: Accelerator MS

Radiocarbon, followed by other isotopes, became a central tool of biochemical research 40 years ago, providing an easily detected and chemically exact label for kinetic studies and binding assays. Radiation hazards and expensive waste streams have decreased the interest in radioisotopes. Modern assays herald their non-isotopic nature. Long-lived radio-isotopes still provide unmatched sensitivity and selectivity beyond those available from stable isotopes or fluorescent moieties. accelerator MS brought on a second radiocarbon revolution in geochronology (dating) by quantifying radiocarbon at zeptomole precision in attomole quantities., and is poised to do so in biochemical applications at such low radiative and chemical doses that human tracing can easily be justified and no “Rad Waste” is generated. The use of AMS in studies of kinetics, metabolism, and binding at doses equivalent to daily human exposures is shown and future instrumentation is described.

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An Autonomous, Bottom-Transecting Vehicle For Making Long Time-Series Measurements Of Sediment Community Oxygen Consumption To Abyssal Depths

Resolution of the coupling between the input of a pelagically- derived food supply and its utilization by the benthic community in the deep sea has been hampered by the lack of instrumentation capable of providing measurements over long time scales. One process that is critical in resolving the temporal variability of pelagic-benthic coupling in the carbon cycle is sediment community oxygen consumption (SCOC), a measure of benthic community activity. Until recently SCOC had only been measured over short time periods of one month or less. We have now developed and successfully collected data with a unique, bottom-transecting vehicle (ROVER) that permits the first long time-series measurements of SCOC. This instrument has the following capabilities: 1) operates on the sea floor to 6000 m depth for periods up to six months as an autonomous free vehicle, 2) transits across the sea floor, minimizing the impact that a long-term, free-vehicle structure would have on measurement sites, 3) measures SCOC using duplicate benthic chambers at up to 30 different sites over a single deployment period, 4) measures sediment pore water oxygen concentration as an independent measure of SCOC using a microprofiler at up to 30 different sites over a single deployment period, 5) has an incubation period of programmable duration for each SCOC measurement, 6) monitors operation of instruments and the surrounding area with time-lapse still and video cameras, 7) has the flexibility to be used as an autonomous programmable platform for a wide variety of benthic boundary layer measurements, and 8) collects a water sample for oxygen and other analyses at the end of the deployment. The ROVER resembles a small fork-lift with a forward- mounted instrument assembly, a current meter, double-tread propulsion system, central battery and controller electronics,

flotation, acoustic releases and disposable ballast. This autonomous instrument was deployed for a 4-month period (January to May 1996) to measure SCOC at 4,100 m depth in the eastern North Pacific. During this deployment the ROVER occupied 17 sites with benthic chamber incubations of 152.3 hrs with a 17-hr interval between incubations for repositioning and transit. SCOC ranged from 0.50 to 0.91 mmol O2 m-2d-1, generally declining from January until the end of February and then increasing irregularly to the end of the deployment in late May. Comparison of these measurements with those made at the same site with another autonomous instrument, the free-vehicle grab respirometer, at the beginning and end of the Rover deployment show good agreement. The increased spatial and temporal sampling resolution provided by the ROVER over conventional techniques should provide valuable new insights into the dynamics of nutrient cycling in the benthic boundary layer from continental shelf to abyssal depths.

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Is There A Role For Ultrasensitive Fluorescence Detection - Down To The Single Molecule Level - In High Throughput Screening?

Recent advances in fluorescence detection, both in flowing and static systems, have achieved single molecule detection. Flowing systems using flow cytometry, or a derivative of flow cytometry, are capable of analyzing cellular systems, molecular assemblies on microsphere carriers, and molecules in solution. For cellular systems, kinetic measurements of ligand binding to cell surfaces combined with calcium response, are made with a sample/reagent mix to analysis time of 300 msec. Subsequent time course measurements follow the interactions and provide data for quantitative determination of rate constants and binding affinities. Using similar instrumentation, the kinetics of molecular assembly and interactions can be characterized by attaching peptides or DNA oligomers to microspheres and following the growth/decay of fluorescence resulting from interactions between the molecules bound to the spheres and the molecules in solution. Competition and inhibition assays can be performed. At the single molecule level of detection, assembly of molecular aggregates can be quantified by labeling partners with different fluorophors. Simultaneous detection of both fluorophors by the cytometer is a sign of aggregation. Since all of these assays are homogeneous, separation of unbound or liberated fluorescence is not necessary.

At the other end of the spectrum, when large microspheres (~100 um in diameter) are used as carriers in the construction of combinatorial libraries, reaction of the synthesized molecules attached to the sphere with a probe molecule can be measured and used as the basis for physical separation or sorting of the 'hits'. The throughput of flow cytometers allows analysis of 100's of spheres per second in a sorting mode of operation.

Fluorescence analysis on a surface also provides a sensitive analysis capability. Both near field and far field microscopies have achieved single molecule detection sensitivity and are thus capable of analyzing volumes on a microliter scale. An example of a small volume assay might be the effectiveness of molecules in a combinatorial library to cleave a fluorogenic substrate.

This work is supported by the U. S. Department of Energy and by the National Institutes of Health through grants RR-01315 to the National Flow Cytometry Resource and AI-19032 to LAS.

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Automated Technology with Interactive Graphical Sample Tracking For Analytical HPLC and Milligram Scale Prep Chromatography of Combinatorial Analogues

Through extensive collaboration with a number of pharmaceutical companies, Gilson now offers a range of instruments ideally suited for Combinatorial Chemistry. Configurations have been assembled for analytical and preparative HPLC systems. A single HPLC instrument can be configured for: a) analytical scale quality control of lead library products; and b) preparative scale isolation of milligram quantities of synthesized compounds. The autosampling injectors can be configured with up to 10 microtitre plates for high throughput into HPLC systems with MS detectors or for fraction collection into the remaining mictrotitre plates or vials. The Gilson's Unipoint® System Software provides a graphical audit trail that ensures sample and fraction fate is accurately tracked and conveniently reported.

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Design Considerations For A Chemist's Automated Workstation

The Hewlett-Packard 7686 PrepStation system provides unattended, multi-functional sample preparation capabilities, including dispensing, vial-to-vial liquid transfer, heating, evaporation, and optional solid-phase extraction (SPE) in a single module. Added capabilities of mixing, bar-coded sample identification and multi-sample heating are available with additional hardware. PrepStation hardware can be setup to run as a stand-alone workstation or can be mounted directly into chromatographic systems using the HP 7673 autosampler tray. A single MS DOS workstation controls both the PrepStation modules and the chromatographic instrument in an overlapped manner. PrepStation automation is compared with manual sample preparation. A detailed description of both the PrepStation hardware and example uses as an automated workstation are provided.

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High Throughput Analysis Of Tandem Mass Spectrometry Data For Peptides

Tandem mass spectrometry affords a rapid method for peptide and protein sequencing. The rate limiting step is frequently analysis of the tandem mass spectral data. Methods will be presented for the automated analysis of tandem mass spectra of peptides with application for screening peptide libraries, surveying protein identities in subcellular locations, and identifying interacting proteins.

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Information Management for Automated Parallel Synthesis

The ability to rapidly screen many thousands of chemical entities in high throughput biological assays has raised the issue as to how the necessary number of compounds will be obtained for testing. The problem has been approached from a number of directions by different organizations. Managing the information necessary to automate these systems at the enterprise, laboratory, or desktop levels will require creative solutions which may involve paradigm shifts in the way chemical synthesis is performed in the laboratory.

The development of fully integrated systems to address the growing demand for automated organic synthesis is an area which is receiving much attention. The first generation information systems will support individual automated synthetic workstations. Later systems will include interfaces to pick-and-place robots, proprietary reaction equipment, purification and analysis tools as well as existing databases. Modularly designed information systems will have the capability to grow with the expanding needs of the automated synthesizers.

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A Modular Approach to Automating Organic Synthesis Using Dedicated Robotic Workstations

The last five years has witnessed an explosive growth of robotics in synthetic organic research. The automation of organic synthesis directly resulted from changing the methods by which discovery chemistry is conducted. The classical method, whereby a single compound is synthesized in gram quantities has little need for automation since conducting a single reaction is efficiently performed manually. With the popularization of combinatorial and solid phase techniques and the practice of running tens or hundreds of reactions in parallel the need to automate repetitive tasks is imperative. Despite the increased productivity possible by automating organic synthesis, only moderate success has been realized. Efficiency gains can be expected as chemist gain experience with the effective use of robotics and manufactures make robots that are better suited to the types of tasks performed in organic synthesis.

This talk considers the obstacles to the efficient use of robotics for organic synthesis and J-KEM's approach to over come them. Two topics discussed are the difficulties of rapidly programming robotics to perform new tasks and the prohibitive cost of versatile robotic workstations. J-KEM's robotic command language is demonstrated which accepts English style commands such as "move_X 1000" (i.e., move 1000 steps on the X-axis in the positive direction) issued from any PC or PC program. The ability to automate new tasks by issuing English style commands makes writing a robotic routine trivial. A second topic is how the availability of an affordable robotic workstation makes it possible to automate tasks that were previously not cost effective (J-KEM's 3-axis robotic workstations are priced from $10,000).

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A Flexible Integration of Humanoids and Robotics in Production

The natural progression of Panlabs' combinatorial chemistry efforts has evolved from low to high throughput synthesis of screening compounds. The time line has, accordingly, carried us from development to full staff production to the current mix of human and machine cooperation. Our "workstation" approach allows for flexibility of the chemistry, in staffing, and in the work flow. With proper organization, automation and computational processing can be used to relieve bottle-necks, increase production, reduce fatigue and reduce the incorporation of error. The ongoing development of our workstations will be presented.

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No Static At All: Using Radiofrequency Memory Tubes Without (Human) Interference

The synthesis of small molecule libraries on the order of 10,000 members will soon be a standard job expectation in the medicinal chemistry laboratory. In addition to the obvious equipment requirements for miniaturization and chemical compatibility, the sheer numbers involved demands that reaction vessel handling become automated. Miniature *radiofrequency memory tagged reaction vessels* that are readable electronically are being developed. Even with a short memory bit string, enough tag codes exist to uniquely identify all tags ever likely to be manufactured. Engineering benefits include near nondirectionality in the label reading frame, and the tag's impervious nature towards organic reagents. Chemistry benefits include the facilitated synthesis of discreet compound libraries in sufficient number, amount, and purity for both screening and archival purposes.

Work has focused on the association of tags with two different polymeric supports for synthesis: loose resin held in a rigid, porous can (MicroKan™) and an inert tube onto which synthesis resin is grafted (MicroTube™). In most instances, the tube approach appears to yield advantages in reaction agitation and washing steps, as well as in the purity of final products.

The movement of reaction vessels can occur at many stages of the library synthesis process: initial reading of all tagged vessels, placement of tubes in initial reaction pots, washing, movement to subsequent reaction pots, and cleavage of products from the reaction vessels. In this talk, we will describe our work using a fully manual system, as well as the development of an automated sorter capable of moving thousands of reaction vessels to individual reaction pots.

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A New Approach to Automated Solid Phase Organic Synthesis

The principle of solid phase synthesis has emerged as an enabling technology in the drug discovery process. Fueled largely by the pharmaceutical industry and their quest for more compounds, this mode of synthesis has been adapted to numerous organic transformations. In concert with this renewed interest is an opportunity for technology development, i.e. de novo design of automated instrumentation and new solid supports tailored to handle the demands of organic synthesis. We will describe a new instrumentation system capable of automating numerous synthetic organic chemistry transformations. We will describe our novel valving technology, fluidics, temperature control, agitation/mixing capabilities and present an operating software component that ties these elements together creating a functional and efficient instrument platform. Additionally, a new solid phase support will be described. This is a material that has been designed for synthetic organic chemistry. We will conclude be providing examples of automated synthetic chemistry carried out using these technologies developed by Argonaut Technologies, Inc.

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Modular Automation for High Throughput DNA Sequencing

We are developing an automated system for DNA sequencing at the rate of ten thousand samples per day (about one million bases of assembled sequence) and at a cost of approximately $0.01 per assembled base. Our system is composed of separate modules for each of the main steps in the process and is therefore composed of a plaque/colony picker, an incubator shaker, a template preparation robot, a thermal cycler, and a capillary electrophoresis device. Samples are moved between modules in cassettes of microtiter plates so each module can stand alone if necessary. I will discuss peformance and design issues of the operational modules (picker, shaker, and template prep) and briefly discuss plans and designs for the thermal cycler and electrophoresis instruments under development.

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Design, Development and Implementation of a General-Purpose Enzyme-Based Robotic Screening System

Realization of the potential of high-throughput screening (HTS), and eventually ultra-high-throughput screening (UHTS), continually requires advancements in assay methodology, reagent/consumable cost reductions and faster, higher capacity automated systems. The enzyme-based assays used in the Biomolecular Screening department vary widely in their complexity, some being relatively easy to automate whereas others are all but impossible to automate using presently available equipment. Our challenge was to design, develop and implement a new automated system capable of performing a wide variety of homogenous and non-homogenous assays in a high-throughput mode.

To accomplish our goal a variety of standard laboratory automation equipment was utilized. The system comprises primarily equipment obtained from Zymark Corporation : a stationary XP robot, another XP robot on a 9' track, a reagent addition station (RAS/RAM), a plate washing/filtration unit, and two microplate storage carousels (one of which is temperature controlled). Other equipment used included a Hamilton MPH2200 liquid handling unit, a custom reagent cooling station built by TOMTEC, Packard's Discovery Homogenous Time Resolved Fluorescence (HTRF) plate reader and a customized microplate shaker. These instruments provided us all the basic operations required to automate almost every step of multiple distinct enzyme assays as well as assays based on homogenous interactions (e.g. HTRF and fluorescence polarization). All of the system design, integration and programming was performed in-house by the Automation & Robotics Group. In addition, a custom Visual Basic graphical user interface (GUI) was developed to control the system as an alternative

to Zymark's DOS-based proprietary controlling software.

This presentation will cover the design, development and implementation of this automated system in greater detail, focusing on the equipment and programming used to accomplish our goal. Time will be given to a discussion of the advantages of using more than one robot and the scheduling/programming complexity involved. The problems encountered will be highlighted and the methods we used to remedy them will also be discussed.

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Future Laboratory Automation: Lessons from Drug Discovery

A wide range of laboratory applications require automation to enhance capabilities ranging from throughput to accuracy, repeatability and reliability. Whereas clinical laboratories demanded a “fixed” automation solution, research laboratory automation demanded a more flexible approach to take into account the broad range of assay technologies. Researchers in Drug Discovery or more specifically High Throughput Screening (HTS) were the early leaders in developing different automation approaches to solve their needs for high throughput assays. Much can be learned from the evolution of HTS so that implementing automation in other scientific applications need not experience the same growing pains that early HTS projects experienced. By evaluating the productivity of different approaches to HTS, we have developed a model for automating existing and future technologies. It is our objective to present this evaluation and propose an approach to automation that takes into account the lessons from HTS and can be applied to other technologies and laboratory applications.

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John Wiley & Sons Publications in Automation

John Wiley & Sons is an international publisher of scientific and technical books and journals. John Wiley has made a major commitment to laboratory automation and this talk will describe the Journal of Laboratory Automation as well as the Wiley-Interscience Laboratory Automation book series. Other plans for the future will be described.

Publishing information and instructions will be presented for future authors. Attendees will be invited to offers their comments and suggestions for useful topics and future directions.

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Automated Systems for HTS at AMGEN

AMGEN is a biotechnology company focused on finding novel therapeutics based on cellular and molecular biology. Recent advancements in both assay methods and robotics have allowed the development of HTS applications relating to genome work and bioassays. Consequently, AMGEN has formed internal groups responsible for automation, assay development and HTS. Recent collaboration between these groups has led to a number of novel HTS systems at AMGEN. Custom gantry workstation robots and integrated ORCA systems will be discussed.

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Automation for Genotyping and Sequencing at Sequana Therapeutics

Sequana Therapeutics is engaged in identifying the genes responsible for common diseases such as asthma, diabetes, osteoporosis, and others. Sequana's approach involves several distinct stages: DNA collection; genetic mapping (genotyping); physical mapping; DNA sequencing and mutation analysis; and gene characterization and assay development.

Sequana has invested heavily into using automation wherever practical. Most of the past automation has been “off-the-shelf”. We are currently entering a new stage of our automation efforts by developing more complex systems in house. These projects include a custom user interface for our Packard MultiPROBE™ robots, a work cell for pooling PCR product based on a CRS arm and a Sagian MultiPette™, a work cell for sequencing reactions also based on the CRS and Sagian, and other projects.

At this meeting I will present some of the installed and on-going efforts in automation development and system integration that are being undertaken at Sequana.

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Integrating Vision-Guided Motion in Biotechnology

Machine vision, a mature technology in manufacturing automation, is rapidly finding increased utility in the biotechnology laboratory for number of applications. One of these includes the use of vision systems for robot guidance and process control. Vision-guided motion can be used to develop automated systems that have the capacity to execute more complex tasks in environments which cannot be fully described prior to execution. However, the process of designing, calibrating, and implementing a vision-guided motion system has historically been one involving significant programming and has not been robust to changes in robot or vision configuration or in the physical layout of the robot workspace.

In this talk we will present recent developments by Acuity Imaging in the area of vision-guided motion, with specific application to the MPI picker/spotter robot, a five axis gantry system capable of picking 0.5 mm colonies at speeds of approximately 3000+ colonies per hour unattended. The colony picking function of the system makes use of a head-mounted camera connected to a machine vision system for location and sortation of colonies. In addition, the Vision-Guided Motion utilities are used to develop position goals which in turn are communicated to a popular third-party robot controller to be converted into motion commands. A Task Editor utility allows the complete development of the application, including system calibration and position teaching, in a point-and-click environment. Additional enhancements to the VGM utilities allow the end user to develop custom tasks which, like macros, can be used to implement frequently-used procedures in the same point-and-click environment. The system is capable of connecting to a variety of third-party robot controllers and provides a novel and simplified way to integrate machine vision and motion control for many laboratory tasks.

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New Directions in Laboratory Automation Software

CRS Robotics has developed new state-of-the-art software for laboratory automation.

The new software has two major elements.

The first element is a Windows NT-based user-interface which provides the end-user with an easy-to-use single point of contact for all of his or her method-related programming --- i.e. specifying methods, scheduling methods, running and monitoring scheduled methods and handling errors if any occur.

The second element of CRS' new lab software is the modular architecture with which systems are built and extended in a "plug and play" manner. The modular architecture consists of a Windows NT front-end user-interface communicating with CROS (CRS Operating System) under which multiple RAPL-3 processes run to control different parts of the system --- the robot, track, instruments, timing, data collection and storage, etc. The CROS operating environment runs on both the C500 controller (CRS' robot controller) and a PC (running Windows NT) in such a way that the C500 and PC inter-operate seamlessly.

The new architecture provides true multi-tasking capability and is designed so that well-integated interfaces to almost any third party instrument can be created with a minimum of time and effort.instrument.

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The QBot® MkIII: A Multi-Tasking Robot For High Throughput Genome Research

The highly successful Q Bot multi-tasking robot has been optimised for large scale genome based library screening applications. Our system allows colony picking, gridding, rearraying, and replicating to be carried out on one machine. The robot revolves around an extremely accurate triple axis linear drive system which is capable of 1 mm accuracy on the x and y axes and 10 mm accuracy on the z axis. The benefits include increased speed, control, and reliability.

The picking head has been completely re-designed to achieve picking speeds in the range of 4000 colonies per hour, enabling a library of 200,000 clones to be picked in two weeks. Samples are gridded from up to 72 microplates (96 or 384 well format) onto 15 nylon filters (22 x 22 cm) placed on blocks that are held to the bed. Samples can also be gridded on filters placed directly on agar-filled Genetix Q Trays. The gridding rate is approximately 100,000 samples per hour, enabling a complete library of 200,000 clones to be gridded out in just a few hours.

The new MKIII rearraying software allows positive clones to be selected from a 96 or 384 well source plate and rearrayed into a 96 or 384 well destination plate. Source plates are loaded into the plate hotels, whilst destination plates are placed in holders on the Q Bot bed. Over 9,000 clones can be rearrayed at one time in a completely automated fashion. Information is easily transferred between the rearraying database and a user's existing database. The current rearraying rate is approximately 1000 clones per hour.

Replication software allows the user to make multiple copies of 96 or 384 well plates. The program allows for direct copying of plates (i.e. 96 to 96 or 384 to 384) as well as compression of samples from 96 to 384 well plates and expansion of samples from 384 to 96 well plates. Source plates are loaded into the plate hotels and destination plates are laid out on the bed.

The Q Bot MKIII offers the flexibility and speed required to make high throughput genome based research simple and routine.

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High Throughput Screening for Discovery of Robust Biocatalysts

There is an increasing need in the chemical industry for efficient catalysts for the practical synthesis of optically pure materials; enzymes can fill this need. Enzymes have a number of remarkable advantages which can overcome various problems in chemical catalysis: they act on single functional groups, they distinguish between similar functional groups on a single molecule, and they distinguish between enantiomers. Moreover, they are biodegradable and function at very low mole fractions in reaction mixtures. Because of their chemo-, regio- and stereospecificity, enzymes present a unique opportunity to achieve selective transformations. Selectivity, the elimination of protection groups, the ability to carry out multi-step transformations in a single reaction vessel, and the concomitant reduction in environmental burden, has led to the increased demand for enzymes in the chemical and pharmaceutical industries.

Organisms isolated from the earth's diverse environments represent a source of enzymes which can stand up to the rigors of industrial process chemistry. Using sophisticated molecular cloning techniques, scientists are beginning to access this untapped pool which consists primarily of microorganisms in the Eubacterial and Archaeal domains. Many of these organisms have been isolated from environments at the extremes of temperature, pressure, pH, ionic strength, and chemical concentration.

A strategy is being utilized by Recombinant BioCatalysis (RBI) to increase the efficiency of biotope exploration and enzyme commercialization. This methodology begins with the isolation of nucleic acids directly from environmental samples, from primary enrichment cultures, and from purified microorganisms across the ever-broadening spectrum of microbial diversity. To date RBI has constructed over 200 gene banks from Archaea as well as from other

extreme environmental isolates. Next, gene libraries are constructed from purified nucleic acids and are subjected to high-throughput, automated activity screening. Positive clones identified in this procedure are sequenced, recloned and expressed.

This process has resulted in the discovery of over 250 unique enzymes with industrial application. The enzymes discovered by his process are characterized according to chemo-, regio- and stereospecificity as well as stability under various conditions. For example, more than 20 new esterases have been cloned and purified. These enzymes have been extensively characterized with regard to substrate specificity for hydrolysis, resolution of racemates as well as for their ability to catalyze transesterification.

Enzymes, which naturally evolved over 2-3 billion years, provide unique starting points for application of non-natural directed evolution techniques for optimizing specific enzymatic activities. In this approach the activity of a chosen enzyme under specific conditions is altered through multiple rounds of mutagenesis and high throughput screening. By using screens instead of selections, enzymatic activity can be tested under conditions incompatible with the life of the host organism. The power of directed evolution is realized through the cumulative effect of mutations and selection which can be achieved in the laboratory in a three to six month period. The effects of long periods of evolutionary time are mimicked through the use of iterative rounds of screening at steeply increasing selective pressure. By combining the best mutations discovered in each round before rescreening one can obtain a highly accelerated evolutionary timeline. In this manner variant enzymes can rapidly be selected which function in organic solvents for example, or other conditions under which the bacteria cannot grow and consequently have never been accessible in nature. The combination of natural diversity, directed evolution and the associated screening methods forms the basis of enzyme discovery at RBI.

Poster Abstracts

(Listed Alphabetically by Author)

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The Swiss Blood Testing Unit (STU): An Innovative Project To Prevent Transfusion Transmitted Diseases

The transfusion of blood and products is in many clinical situations an essential or even lifesaving therapeutic measure. Amongst the steps to offer the highest possible safety of blood products, namely the careful recruiting and selection of blood donors, the state of the art testing of each individual blood donation is of particular importance. Due to the scientific and technical complexity of this endeavor, all efforts have to be made to facilitate and standardize test methods. This is particularly true in situations, where new Blood Transfusion Services have to start their operations, e.g. in developing countries.

With this objective, we started to develop the Swiss Blood Testing Unit. On top of that, the newly developed unit offers the following advantages:

- Fully equipped testing unit for the validated, automated and standardized infection marker screening based on microplate technology, including blood group serology
- Connection of all relevant instruments for the test processing via network to a host computer
- Worldwide support for instruments, software and application guaranteed by a built-in satellite communications system using the latest technologies
- Requirement of minimum space whilst offering maximum throughput

We provide an open system (1) allowing free selection of test kits of different manufacturers, (2) improving the reliability by positive identification of samples, microplates and reagents, (3) reducing the error rate for tests to a minimum, (4) increasing the productivity by maximizing the standardized operations and allowing fast availability of test-related information, and finally (5) reducing costs by fully automated microplate ELISA.

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Custom Engineered Automation for Scientific Research

Midwest Research Institute (MRI) has been providing contract scientific research for over 50 years, in fields such as energy, environmental, health, and transportation. We have provided automation solutions for the laboratory research scientist for 120 years. The automation group is a multi-disciplinary group with backgrounds in mechanical engineering, engineering design, artificial intelligence, computer programming, machine vision, analytical chemistry, and biology.

Our automation specialists have developed robotics systems to increase the throughput and precision of such tasks as natural pesticide screening, oncogene inhibitor screening, biological matrix extraction, and food product analysis. Highlighted are some of the custom systems developed by the automation group at MRI.

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Studies on Contamination Risk of PCR by a New Automation Concept

A pipetting stattion for automated pipetting of closed PCR tubes with single-shaped lids has been developed. The pipetting station consists of a modified MSP 9000 from Cavro/TECAN with two x, y, z-arms: one arm is dedicated to pipetting with disposable tips and the other arm to opening and closing the single lids of the PCR tubes with a special "lid-handler" developed by Boehringer Mannheim (1).

The purpose of this pipetting station is to automatically load the lidded PCR tubes with a sample and PCR mix. The user loads samples on the instrument with the PCR mix and closed PCR tubes. After automatic pipetting, the user transfers PCR tubes (96 in a plate system) on a thermocycler equippedwith a 96 well block (e.g., Perkin-Elmer 9600).

This automation concept is the basis of some first studies on contamination issues. We compared manual applications with our automated version. Within the automation concept, we investigated different kinds of PCR tubes (i.e., tubes totally open, tubes with strips of 8 lids in a row, and PCR tubes with single lids).

Even for microfabricated devices the problem of contamination exists and must be solved. The downscaling of the current sizes could be possible.

(1) German patent publication DE 44 12 286 A1 12.10.1995.

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Automated Solution Preparation and Distribution of Chemical Compounds at Merck using the Packard MultiPROBE®

The Merck Research Laboratories (MRL) sample repository currently consists of more than 150,000 unique chemical entities of biological interest. Each year, approximately 40,000 novel compounds are added to the collection for broad screening. The rate at which compound resources were being depleted from the repository raised concerns for the future of this invaluable resource. This concern led to the establishment of a New Sample Distribution Policy to ensure long term availability of the collection. Beginning In 1995, forty nine thousand (49,000) compounds requested for biological assay have been solubilized in Dimethyl sulfoxide (DMSO). In addition to sending an aliquot of the solution for biological assay, portions were sent to other MRL facilities in the United States, Canada, England and Italy. The goal is to replicate the repository at these research sites. In order to accomplish this task, it is necessary to automate as much of the procedure as possible. The first stage in this dynamic process involves utilizing the Packard MultiPROBE robotic sample processor to act as a compound solution preparation and distribution station. The MultiPROBE EasyPrep software readily integrates with Microsoft® EXCEL® to facilitate a flexible, efficient means to transfer solution volumes based on molecular weight and dry compound weight. The automated procedure allows for over 1,200 compounds to be processed weekly.

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Off-the-Shelf Robotics for Nucleic Acid Sequencing and Detection

Many procedures in molecular biology, such as cycle sequencing and in vitro selection (SELEX), require thermal cycling and repetitive manipulation of nucleic acids. A Beckman Biomek® 2000 pipetting robot has been interfaced with an MJ Research DNA Engine thermocycler to perform these tasks with minimal human intervention. Our first goal was to perform all the steps of a standard cycle-sequencing reaction. Sequencing reactions for up to 24 DNA samples can now be carried out in parallel in a 96 well microtiter plate. The in vitro selection of nucleic acids from random sequence pools is a similar, but more complex, task. For selection experiments, nucleic acid binding species are extracted from a random sequence pool by affinity separation on magnetic beads or by microtiter plate panning. The selected RNA or DNA species are then eluted and amplified in pre-set reaction mixes. Automated iteration of the selection and amplification cycles can result in the isolation of high-affinity binding species. Automation of the in vitro selection process required that filtration and centrifugation steps normally carried out by hand be replaced with tools and protocols more amenable to the robot.

The significance of these results is that modular, off-the-shelf units can now be interfaced to create specific workstations that perform specific tasks designed by individual researchers. The automation of the in vitro selection process is expected to speed the acquisition of nuclei acid aptamers (binding species) that can be used as lead compounds for therapeutics or drug validation.

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The Implementation of Matrix Codes in the Clinical Laboratory

This study focuses on applying novel 2-dimensional matrix data code technology to the process of acquiring and accessioning blood specimens. The matrix code is well suited for blood specimen processing and accessioning and other identification applications in the laboratory and health care environments. It is believed that implementation of these 2-dimensional matrix codes will streamline the accessioning process, reduce errors, facilitate point-of-care testing, and lower cost to the health care institution.

A study showed that up to 21% of analysis time for a stat specimen and up to 43% of analysis time for a routine specimen is spent handling, labeling and logging a specimen [1]. Increased pressure to run an efficient and cost-effective laboratory have forced laboratories to find ways to streamline these processes.

A 2-dimensional matrix code is designed to be a small database. It can contain much more data than an ordinary bar code label, up to 75 characters in a 13mm square (0.5in). In addition to specimen and patient information, it is possible to store cap color, blood volume, test requests, and aliquot information. Unlike a bar code, it may be placed on the cap of a testtube. The matrix code can be printed with inexpensive ink jet technology on a paper label or directly on glass and plastic tubes.

This poster will present some of our experiences at the University of Virginia Health Sciences Center with the matrix code technology in use in our clinical laboratories. We believe that the 2-dimensional matrix code can significantly improve the entire specimen handling and labeling process.

1. Godolphin W, Bodker K, Uyeno D, Goh LO. Automated blood-sample handling in the clinical laboratory. Clin Chem 1990;36:1551-5.

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The Amgen Boulder Sample Bank: Data Handling, Automated Sample Handling, and Storage Functions

The Amgen Sample Bank was created to provide a centralized system of compound storage, an intelligent electronic compound registration system, a sample processing system that could provide compounds in arrays directly screenable in HTS formats, and a dispensing and retrieval operation for all secondary screening and evaluation needs. All compounds are electronically registered in user friendly programs that allow for rapid compound structural and biological review.

The Amgen Sample Bank employs extensive automation to facilitate the rapid and efficient processing of the high numbers of compounds being generated through combinatorial chemistry and available from commercial sources. These stations are based on modified robotic devices available from Packard and Gilson as well as custom processing stations created for Amgen by Bohdan Automation. These automation workstations will be detailed and their impact on the overall efficiency of compound processing will be presented.

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An Inexpensive Multiplexer of Video Signals for Automated Detection of Abnormal Events in Laboratory Systems

A PC-controlled multiplexer that outputs one of eight video signal inputs is described. The in-house built unit is used in conjunction with a low-cost frame grabber and commercially available image analysis software to detect abnormal events in an automated laboratory setup.

One example illustrates the use of two multiplexed CCD cameras to determine if a robot can place a vial in an empty position of an autosampler carousel without obstruction. The image processing software and the event-driven multiplexer software run in a Windows 3.1 operating system. The configuration presented here can be an inexpensive alternative to systems that require more than one frame grabber in combination with multiple cameras, or that use commercially available multiplexing frame grabbers.

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High Throughput Automated Plasmid Purification on the Biomek® 2000

The increased use of automated fluorescent sequencing has created a need for high-throughput purification of high-purity plasmid templates. Conventional methods usually require precipitation or costly column chromatography stops. The 96-Plasmid Purification Kit was created for use with the Biomek 2000 Laboratory Automation Workstation (or for manual use) to address this need. After an initial centrifugation step to pellet the bacteria, all separation steps are subsequently performed with filtration, using the Beckman 96-Filtration System. For full automation of the method (no user intervention steps), the Biomek Gripper Tool is used to move labware and the Beckman Vacuum Manifold Collars on the worksurface. The purification process is an adaptation of the alkaline lysis plasmid mini-prep protocol. High purity is achieved through binding the plasmid DNA to Ultrasphere® Resin from Beckman in the presence of a chaotrope. Subsequent proprietary wash procedures remove salts, detergents and other contaminants. The purified DNA is eluted in water or low salt buffer and is ready for use in cycle sequencing reactions without the need for ethanol precipitation or further purification steps. Typically, a DH5α® culture aerobically grown in TB media for 22 hours yields at least 1μg of high copy number plasmid per 1 ml of culture. 9 templates can be purified in 3.5 hours, and partial plate methods in less time. Data including automated fluorescent cycle sequencing results, yields, concentration and volume recovery for various method runs will be presented.

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A Custom User Interface for Packard MultiPROBE® Robots

Sequana Therapeutics is engaged in identifying the genes responsible for common diseases such as asthma, diabetes, osteoporosis, and others. Sequana's approach involves five distinct stages: DNA collection; genetic mapping (genotyping); physical mapping; DNA sequencing and mutation analysis; and gene characterization and assay development. Sequana at this time has several Packard MultiPROBE® robots.

In the genotyping and assay development efforts the MultiPROBE® 204 robots are used to set up the PCR reactions (followed by off line thermal cycling), to create the stock aliquots of reagents used in the PCR set up, and to develop and optimize the PCR assay and reaction.

We have created a proprietary Visual Basic user interface program which runs the processes in the "C" computer language based HAM (High-level Application Method) script environment provided by Packard. This program provides the user with a more intuitive user interface by simplifying the entry of sample and volume information and by showing the rack layout sin greater detail, thus eliminating pipetting errors. It allows us easier integration into our Laboratory Information Management System via Windows® ODBC. In this talk we will present the user interface, HAM issues, development and support issues, and a qualitative assessment of the program's day to day use.

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Architectural Considerations For Laboratory Automation System Integration

Recent advances in computer science and technology make it possible to choose from several models when integrating laboratory automation systems.

This presentation will examine two different approaches--the classical "Master Slave"concept and the newer "Distributed Intelligent System" architecture. The NIST CAALS concept will be used to demonstrate the hierarchical master-slave architecture and the "Wiesbadener Computerintegriertes Labor (WICIL)" will serve as an example of the peer-based "Distributed Intelligent System" design. It is important to understand the similarities and differences in these two paradigms, which go beyond their underlying communication schemes, to select the best solution for a given set of circumstances.

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Automation of Multiple Kinase Assays on an ORCA Rail System

Glaxo Wellcome is actively pursuing regulators of protein kinases (PKs) for the treatment of diseases such as cancer. Because signaling pathways are complexly interrelated, we are studying a large panel of Pks.

We have developed assay methods and robotics to screen four different PKs simultaneously against approximately 1000 chemical samples in a 16 hour period. The kinase reaction mixture is made by mixing enzyme, which is prediluted on the robot just prior to use, a cocktail containing biotinylated peptide substrate and [g-^{33}P] ATP, and a chemical sample. This reaction mixture is then incubated, quenched, and transferred to a neutravidin-coated microtiter plate to allow the ^{33}P-radiolabelled peptide to bind. Each binding plate is incubated, washed, and then counted.

This assay method was modified to ELISA and

DELFIA® (Wallac Oy: Dissociation Enhanced Lanthanide FluoroImmunoAssay) formats for studying tyrosine kinases. Both assays are non-radioactive, have higher throughput and use less enzyme. Under comparable conditions, we observed a signal to noise ratio of approximately 20 for the ELISA format and 400 for the DELFIA. This poster will review optimizing DELFIA for economical screening given its remarkable dynamic range.

These assays were developed on an ORCA track system and scheduled using Scitec's WinCLARA. We obtained the flexibility to run simultaneous kinases by implementing custom arrays in the ORCA MDS software. This robot is integrated with a Tecan Genesis, Cavro syringe dispensers, Zymark RapidPlate, UV/ Vis spectrophotometer, a fluorometer, and is controlled by software developed in-house as well as software from outside vendors.

These assays were developed on an ORCA track system and scheduled using Scitec's WinClara. We obtained the flexibility to run simultaneous kinases by implementing custom arrays in the ORCA MDS software. This robot is integrated with a Tecan Genesis, Cavro syringe dispensers, Zymark RapidPlate, UV/ Vis spectrophotometer, a fluorometer, and is controlled by software developed in-house as well as software from outside vendors.

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New Pharmaceutical Robotics System Developed for Performing Cell-Based Screening Assays

Ligand Pharmaceuticals' New Leads Discovery department adopted a workstation approach to automating its screening assays in order to increase productivity. This approach stressed optimizing assay work flow and implementing stacking workstations, which allowed capacity to increase tremendously. However, this approach required operator intervention, therefore ultimate capacity was limited by head count and available hours for operating the equipment. A fully automated robotics system for performing the cell-based screening assays would allow for increased capacity without an increase in labor. In effect, the new system would provide an operator-less second shift.

After an extensive vendor evaluation, CRS Robotics Corporation was selected to build the system. Key factors in the decision were the proven reliability of the CRS robotics arm, their reasonably flexible software and Ligand's confidence in the ability of CRS to build or customize peripheral devices to meet the assay requirements. At the time of purchase, CRS was the only vendor to offer a field tested pipettor capable of 1-ul delivery. CRS was also willing to guarantee on-time delivery, which was particularly important since this was Ligand's first robotics system.

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Automated Extraction of Antisense Oligonucleotides from Animal Tissues in the 96-Well Format

Antisense oligonucleotides have evolved as a new class of therapeutic agents against a variety of human diseases. The clinical development of this family of drugs necessitates definition of their toxicology and pharmacokinetic properties. Investigation of different formulations and routes of administration requires the preparation and analysis of an enormous number of samples from animal studies. An existing analytical method involves the manual extraction of samples through two types of solid phase column followed by capillary electrophoresis analysis. This sample processing step is the rate limiting step in the procedure. The extraction process has been automated on a robotic workstation using a 96-well filterplate format. Sample quantitation, precision and accuracy were determined and compared to values obtained by the manual procedure. Automation of the extraction process resulted in a five-fold increase in throughput. In addition, the extraction efficiency was improved compared to that obtained in the manual process. The automated technique was utilized to analyze oligonucleotides from several types of tissues including plasma, cerebrospinal fluid, liver and kidney.

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Glass and Chemically Resistant Polymer Plates and Closures for HTS

The development of chemically resistant polymer and glass plates for doing HTS and combinatorial chemistry will be reported.

Glass plates for use in HTS have been made by a variety of manufacturing processes. The well size of these plates ranges from 150 microliters in the 96 well plates to 1 microliter in 1536 well plates. New formats such as a 250 well 1 inch by 3 inch slide have been developed. The surface chemistry of the glass can be varied using silane chemistry or sol-gel coating.

The data obtained from the development of plates with clear bottoms in the visible range, clear bottoms to be used at 340 nm, and UV transparent bottoms capable of reading to 220 nm will be presented.

Data from polymer plates made from black and white thermoplastic polymers which are chemically resistant will be discussed. The surface chemistry variations will be given ranging from NOS for nucleic acid binding to covalently grafted ultra low binding surfaces.

The need for closures for short and long term storage using well plates as containers is another important issue. Data from some of the research work on closures will be presented.

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Expert System for Dynamic Scheduling Supporting Sample Preparation Constraints

Processing samples on a lab workbench is a typical multi-resource scheduling problem. In manual operations, chemists try to optimize their workflow in such a way that correctness and safety are fulfilled. Throughout ranks lower in most cases. In a fully automated environment, correctness and safety are primary design criteria of the system. Now throughout and resource utilization become an essential issue. In this case, scheduling algorithms are essential. The poster describes a dynamic scheduler implemented in C++ which integrates many constraints typical for sample preparation in an analytical laboratory (e.g., non-interruptable sequences, branched execution of samples and standards, etc.). Multi-position instruments such as shaking tables can be used for identical and different samples in parallel. Processing times of different samples on those instruments may be different. The user is free to define the number of intermediate unloading and loading events and the maximum time for them. The quality of the optimization may be checked by a Gantt Chart. The system takes care of user definable sample priorities and ad-hoc analyses. Additional optimization criteria are maximum throughput per time unit or fastest throughput per sample. The package runs under MS Windows 3.11 of Windows NT stand alone or integrated in the “Wiesbaden Computer Integrated Laboratory (WICL)”.

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The Flexchem® Solid Phase Chemistry System: A Modular System For High Throughput Synthesis

Efficient parallel, solid phase synthesis of large numbers of compounds is severely limited by the lack of appropriately designed, commercially available reaction vessels and liquid handling equipment. Flexchem is a new modular system for high throughput chemistry designed in cooperation with several leading pharmaceutical companies for preparing libraries of discrete compounds by directed synthesis. There are five components to the Flexchem system that combine to provide a high speed but flexible compound generating system:

1) Reaction Block - a unique, disposable reaction block* containing 96, discrete 2.0 ml chambers in a standard microplate array
2) Reaction Block Covers - reusable metal covers with solvent resistant gaskets that lock onto the sides of the block and seal the chambers top and bottom
3) Vacuum Manifolds - two vacuum manifolds for removing reagents from the synthesis block; one for removing solvents and one for collecting cleavage products into 96 well plates
4) 96 Channel Dispenser - an automated, 96 channel dispenser for simultaneous transfer of hydrated resin and solvents into all well of the reaction block
5) Rotating Incubator - an environmentally controlled, rotating incubator capable of simultaneous mixing while heating or cooling up to four Reaction Blocks or 384 reactions simultaneously.

A detailed description of the components of the Flexchem system and a step-by-step guide to how syntheses are performed using the system will be presented.

* Patent Pending

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Microdevices for a New DNA Test Platform Utilizing Existing Lab Equipment

Miniaturizing DNA test platforms for clinical diagnostics necessitates reducing sample size without introducing statistical errors in sampling. New devices are discussed for scaling down sample collection to replace standard blood collection tubes and microscope slides in order to integrate specimen collection and eliminate nucleic acid extraction before amplification. The new collection devices interlock with compatible components to form microchambers and enable automated, multi-step processing that will bypass making any sample transfers. DNA test platforms require immediate flexibility to utilize new target information as polymorphisms relevant to disease management and drug-screening are identified. Integrating these new devices with existing liquid dispensing equipment makes them highly customizeable for HTS, clinical and reference laboratories. The new devices are also designed for positioning microprobe detection arrays on an inner surface where signals can be viewed through a clear planar microchamber wall in order to interpret signals with existing imaging instrument readers. The new microchambers have proprietary design features that overcome microfluidic and closure barriers associated with precise temperature control, thermocycling and managing small reagent volumes.

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Modular Automation for Filtration Receptor Binding Assays

Several homogenous techniques including scintillation proximity, fluorescence correlation spectroscopy and depolarisation have been used to measure ligand binding to G-protein-coupled receptors. These techniques, theoretically applicable to low receptor concentrations, depend on physical characteristics of the ligand, including hydrophilicity, intrinsic fluorescence, etc. In contrast, traditional heterogenous binding assays are remarkably independent of such constraints, being confined largely by abundance of receptor and logistic issues. Accordingly, we have used a combination of recombinant receptors and modular automation to develop precise, high capacity assays for ligands for the human prostanoid receptor subtypes EP_1 and EP_3.

The preferred ligand for these receptors (activation of which has been associated with nociception, pyresis and inflammation) is prostaglandin E_2, a hydrophobic oxidative metabolite of arachidonic acid, with minimal opportunity for fluorescent labelling. Cloned human EP_1 and EP_3 receptors were expressed in mammalian cells, and membrane saturation binding assays developed using pipetting workstations and a 96-well filtration apparatus. These procedures were then transferred to the identical modules of a robotic microplate assay system to increase capacity to a maximum of 30 plates/day whilst maintaining the accuracy of the semi-automated assay. Cross validation revealed a correlation of 0.93 between semi-automated and robotic assays, with less than 2-fold total variation in multiple IC_{50} determinations of PGE_2 and PGE_1 replicated across plates. Actives in random screening assays with as little as 30% inhibitory activity could be reliably detected in replicate determinations, and such assays detected a variety of novel ligands with physical properties which might have precluded their detection with less conservative techniques.

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Competition Binding Assay for Evaluation of SELEX-Derived Oligonucleotides to Human L-Selectin

An automated competition binding assay was developed for analysis of SELEX derived oligonucleotides to human L-Selectin. The SELEX procedure is an in vitro exponential enrichment technique that allows selection of high affinity oligonucleotides from a large random library, 10^{12} - 10^{14} molecules, to a specific target molecule. The competition assay utilizes a truncated version of human L-Selectin, containing the entire extra cellular domain, immobilized on 96 well plates. Tracer oligo-biotin-strepadvidin-alkaline phosphatase complex (OBSAP) and competitor oligo are incubated in each well. Unbound oligo is removed by washing. The concentration of protein bound tracer OBSAP is determined by alkaline phosphatase generated chemilumuinescence. The precision of this assay shows EC50 values with intra-day CV of 9.4% and inter-day CV of 15.4%. This assay has potential uses for oligo product characterization and oligo screening. In addition, this assay can be utilized in complex matrices such as plasma and can be used in conjunction with pharmacokinetic studies to determine the amount of oligo capable of binding to L-Selectin within a plasma sample.

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Automation Of The Polymerase Chain Reaction (PCR) Using The Packard Multiprobe® 104DT

The polymerase chain reaction (PCR) has become an indispensable tool in basic research and laboratory medicine. Through the use of specific primers, the PCR reaction allows billion-fold amplification of DNA fragments in biological fluids and tissue. PCR is becoming more widely used in clinical laboratories; however, the laborious nature of the PCR procedure has made it technically challenging and cost prohibitive. Robots and the peripheral devices with which they interact can be used to automate the entire PCR assay.

A fully automated nested reverse transcriptase PCR assay for patients infected with the hepatitis-C RNA virus was studied using clinical samples from the University of Virginia Health Sciences Center, Clinical Molecular Biology Laboratory. Identical hepatitis-C nested PCR assays were performed manually and by automation. The automation consisted of a Packard MultiPROBE 104DT Packard Instruments, Meriden, CT), an integrated onboard thermal cycler, and a computer controller. The MultiPROBE performed all of the pipetting steps required in the assay, including both first and second stage master-mix assembly, master-mix reagent and patient sample dispensing into reaction tubes, and transfer of first stage products to second stage reaction tubes. The fully automated computer-controlled onboard thermal cycler eliminates the need for a technician to perform any tube manipulation until the assay is completed. Final products, normally transferred to an agarose gel for gel electrophoresis analysis, were robotically dispensed into a specially coated microtiter plate, and color allowed to develop to indicate positive or negative hepatitis-C samples. The entire PCR assay requires no manual intervention. The automated assay gave identical results as the manual assay. No onboard cross-contamination has been discovered to date, indicating that robotics can provide a means to inexpensively automate amplification based molecular diagnostics.

Randy A. Turner

Robin Felder

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A Unique Automated Approach To Clinical HDL Analysis Using The Gilson 215 Pipetting Station

Analyzer advances in the past fifteen years has provided for a remarkable degree of automated analysis in the clinical laboratory environment. However, some assays performed in the clinical laboratory still require a significant amount of technician manipulation. Centrifugation, precipitation, incubation, and reagent addition may be required before the assay tubes are placed into an instrument for analysis. Some of this labor may better accomplished with a robot dedicated to pipetting. One widely used clinical laboratory assay requiring extensive manual intervention is the quantitation of high density lipoproteins (HDL). The presence of HDL has been shown to have a protective effect against hypercholesterolemia, and a decreased HDL titer may be the single most powerful predictor of coronary heart disease.

The Gilson M215 Pipetting Station was used to automate the preparation of patient blood samples prior to HDL analysis. Patient sample aliquots are placed on the robot along with reagent supplies and empty reaction tubes. The Gilson M215 assembled the proper volumes of sample and reagent for each of the patient samples into reaction tubes for precipitation of low density lipoproteins. The precipitated LDLs are magnetically removed, leaving only HDLs in the sample. Precipitated and non-precipitated patient samples are then analyzed on an Vitros 950 (Johnson&Johnson, Rochester, NY) for cholesterol, yielding both HDL and LDL levels. HDLs performed by robot were not significantly different than those performed manually. The use of the pipetting station allows for much easier integration into the existing laboratory flow, with minimal changes in the analysis procedure. Acceptance of the robot by technologists is much higher than in previous scenarios, since the technologist is freed from the drudgery of manual pipetting, aliquoting, and

precipitate removal. The same pipetting station can be inserted into any likely step in a clinical procedure where specimens are aliquoted and reagents are added before the samples are analyzed, saving a substantial number of FTE's.

Randy A. Turner

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Automatic Pick Up And Delivery By Mobile Robot

Mobile robots are vehicles which have been equipped with a drive system under computer control which allows for autonomous guidance between two locations. Initially, mobile robots were used in industrial plants, and they have now become an obvious choice for moving material over greater distances than conveyer belts could reasonably perform. However, there has been relatively little progress toward using mobile robots to deliver laboratory supplies or participate in the process of laboratory analysis. A significant portion of laboratory technician time is occupied by delivery of "stat" patient samples to various analytical stations within the laboratory without delay. The RoboCart (CCRI, Inc., Lake Arrowhead, CA) mobile robot has been adapted for such use in the University of Virginia Clinical Laboratories. Samples arrive at a separate "stat" receiving station at the entrance to the clinical laboratory. The samples are processed and immediately delivered to their required locations within the laboratory. The delivery duties are performed by the RoboCart™ mobile robot. Samples are placed in carriers on the robot, and then the robot is sent to the proper analytical station. The robot automatically unloads the carrier using a device called the Pic&Place™, and retrieves (if present) an empty carrier from a previous delivery. The robot then returns to the "stat" station and resets for another delivery with the recycled empty carrier. Technicians are not required to divert their attention from their analytical duties in order to remove the new samples from the mobile robot. In addition, the "stat" receiving technicians may continue their work uninterrupted while the deliveries are being made. Automated delivery takes under 2 minutes. The system has allowed for non-continuous staffing of the pick up and delivery locations.

Technologists gain an additional 20% efficiency through the use of mobile robots. This can be further enhanced through the use of automatic pick up and delivery.

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The Use Of Reactive Fragment Structure Transformations For Automated Structure Generation In Automated Combinatorial Chemistry With Applications To Diversity Analysis

Dramatic changes in healthcare delivery sytems have taken place over the past decade, aimed at maximizing the efficiency of delivery of services such as laboratory diagnostics. One of the areas in which a considerable amount of growth has been observed is the alternate site testing. Increased complexity at this level has promoted the movement of "conventional" and/or modified "laboratory instruments and systems". In order for that process to be effective, issues such as training, certification procedures,and compliance with regulatory requirements need to be documented. Conventional methods are usually labor intensive and time consuming. We have developed a self paced, multimedia, interactive, PC-based system, that allows for training, certification, and recertification of personel for alternate site testing.

The core of the system is a custom designed windows based software program that resides in a hospital based network. The system is pasword protected, and utilizes a unique PIN to identify the users. The system allows multiple options to the users such as: training and certification for a specific system. We are currently formatted for whole blood glucose monitoring, including automated data management. Once logged-on, the system navigates the user through a variety of possibilities which include recertification procedures with "test-out" options, online references for technical questions, troubleshooting, QC, and QA issues. This is presented in a digital sound capable environment. Still images were inputed by utilizing a Kodak photo CD and a Kodak DC40 digital camera(Eastman Kodak Corp, Rochester N.Y.).

Besides its flexibillity the system is widely available through a number of network based nodes in a standard PC-based workstation format. The system is hardware independent, and can be published in a Mac (Apple Computers Cupertino,CA) or windows format, and is also CD-ROM capable. This last feature allows for offsite use. Because of its ease of use, and availability this format has the potential of being utilized for other near patient testing tasks and procedures such as: coagulation, patient instruction, offsite training, and in-home application through the Internet. Systems such as the one described will allow laboratories and other areas responsible for alternate site testing to promote good laboratory practices and document compliance with regulatory requirements in a paperless fully automated environment.

Alan J. Wyatt

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Automated High Throughput Screening: A State of the Art Approach

The paper describes the development of a high throughput screening system, utilizing Thurnall's SPRINT software package: a flexible Windows-based scheduling environment.

The system allows for both isotopic and non-isotopic assays and handles 384 in addition to 96 well microtiter plates. The system was designed to provide a high degree of flexibility and an "industrial" level of reliability and robustness.

Short Courses

Introduction to Barcode Technology

Mr. Bruce Sharf

Catalina Room - West Tower

Course Description:

This course presents information needed for a top-down design of an automated identification system. Throughout the course, examples from the automated clinical environment will be used. The first section of the course discusses what types of information are important in creating an identifier for an automated system. Specific examples will include patient, tray, and reagent identifiers. After the pertinent information is selected, choosing the best symbology (out of over 3000) to encode that information will be discussed. Linear, stacked, and 2D codes will be all covered along with their advantages and disadvantages.

The second section of the course details the types of scanners that are available to read and decode the different types of identifiers. Wand, CCD, Laser, and Vision systems will all be discussed; both as hand held, and fixed mount options. The capabilities and limitations of each technology will be detailed.

The final section discusses integration of the scanner into the automated system. Placement of the scanner in the system depends on the type of scanner used. Size, weight, and position with respect to the label are all important factors. In addition, communication protocols, and customization for specific applications will be discussed. Some types of scanners can provide information beyond reading the code. Object sensing and corrupt label detection are among the additional pieces of information that can make an automated system more robust.

Instructor:

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Bruce Scharf earned his BS degree in Electrical Engineering from the University of Colorado in 1988. He continued his studies at the National Science Foundation's Center for Opto-Electronic Computing Systems and was awarded his MS degree in 1989. From 1989 to 1995 he was a Specialist Optic Engineer at the Boeing Company developing optical systems for flight controls. He joined Microscan Systems Inc. to develop new optical systems for Data capture.

Mr Scharf has taught physics at Pacific Lutheran University and continues to give seminars on emerging optical technologies. His most recent seminar at the AACC conference dealt with using specular reflections to determine the presence on an object in a laser scan beam. He has published several papers and is a member of the IEEE.

Hands-On Training in Combinatorial Chemistry

Dr. Sheila DeWitt, Dr. David G. Nickell and Ms. Ela M. Hogan

Coronado B - West Tower

Course Description:

An informal workshop designed to provide chemists an opportunity to evaluate and implement alternative methods in combinatorial and automated synthesis. The workshop will focus on hands-on experiments, explanations of enabling technologies and commercial systems.

Instructors:

Dr. Sheila DeWitt
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and
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Sheila DeWitt is one of the original developers of the DIVERSOMER® Technology. She has been instrumental in the design and implementation of proprietary equipment, automated synthesis methods, and high-throughput synthesis. In addition, she actively pursues the identification and coordination of projects related to molecular diversity among a wide variety of disciplines. Sheila received her B.A. from Cornell University and her Ph.D. from Duke University in Synthetic Organic Chemistry. Following two years in process research at FMC Corporation, she joined the Medicinal Chemistry Department at Parke-Davis, and then in 1991, was a founding member of the BioOrganic Chemistry Group. Sheila has been the recipient of Michigan Leading Edge Technologies Award (1993) and Pioneer in Laboratory Robotics Award (1995).

Dr. David G. Nickell
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David received his Ph.D. from the University of Utah in Synthetic Organic Chemistry under Dr. Gary Keck . After completing two years as a postdoctoral fellow with Dr. Robert K. Boeckman, Jr. at the University of Rochester, he began work as a medicinal chemist at Parke-Davis. David then began a career in chemical information management after working on the bench for six years. He is currently involved in the design and development of the DIVERSOMER Technologies, Inc. information management system.

Ms. Ela M. Hogan
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Eleonora received her B.S.E. from the University of Michigan in Chemical Engineering in 1994. She then joined the BioOrganic Chemistry Group at Parke-Davis and began working on the DIVERSOMER project. Her initial responsibilities were laboratory information management and automated methods development for liquid handling and industrial robots. Her responsibilities have increased to include: information management software development, and design and validation of the DIVERSOMER Technologies, Inc. Reaction Station. During her stay at Parke-Davis, Eleonora has earned two Colleague Recognition Awards for automating parallel purification methods and selection of equipment for high throughput synthesis.

Introduction to Clinical Laboratory Robotics

Drs. Robin A. Felder, James C. Boyd and John Savory

Point Loma A & B - West Tower

Course Desription:

Robotics and automation technology can improve the efficiency of health care delivery. However, laboratory directors must set reasonable automation goals for their laboratories. Based on a high return on investment, there are two basic choices for automating the laboratory, central receiving and point-of-care. This workshop will focus on discussion of the issues involved with considering, planning, implementing, and justifying laboratory automation.

CENTRAL RECEIVING AUTOMATION

Central receiving is presumably the most likely area of the laboratory to automate since labor costs are highest for sample processing. Recent technology has become available for specimen labeling, sorting, centrifuging, aliquotting, and transportation. In order for automation to be cost effective we must understand the benefits and limitations of pre-analytical processors. Recent progress will assist with their success such as new developing defacto standards for sample conveyance, laboratory information/automation system (LIS/LAS) software, interfaces which provide the necessary control data, and high reliability which should allow unattended operation. Limitations of sample tube variety and the ability of automation to handle exception specimens may compromise the cost savings of pre-analytical automation.

Three approaches to laboratory automation include 1. the use of modular devices (e.g. Autolab Autoquot, BDC universal tube labeler, and LabInterlink conveyor system), 2.the use of a modular conveyor system (e.g. the LAS from Coulter/IDS), 3. the use of a full turnkey system (e.g. the CLAS from Boehringer Mannheim/Hitachi). The benefits of each of these systems will be discussed.

POINT-OF-CARE AUTOMATION

Point-of-care testing has traditionally been reserved for analytes which are necessary for rapid assessment of critically ill patients. Only limited menus of tests have been offered at point-of-care due to high costs and the lack of tests available on whole blood specimens. The ideal point-of-care system would utilize commercially available instruments, offer blood gases, electrolytes, chemistry, coagulation and hematology tests, provide rapid turnaround on whole blood specimens, be operated by nurses and ward clerks yet maintain control in the hands of laboratory professionals. We have developed the Remote Automated Laboratory System which provides these features at a cost less than that of performing the same test in the central laboratory. Our clinical outcomes studies have demonstrated that automation of point-of-care analysis reduces the time patients spend on mechanical ventilation.

SUMMARY

The need for central Laboratory Automation Systems will increase in the near future as laboratories consolidate into regional laboratories. Point-of-care automation will remain an expanding necessity during this consolidation process. Eventually, 80% of laboratory testing will be performed at point-of-care with the remainder split between small on-site automated laboratories and a few large commercial laboratories. Therefore, laboratories should develop both central laboratory as well as point-of-care automation in order to be comptetive in the upcoming medical marketplace.

Instructors:

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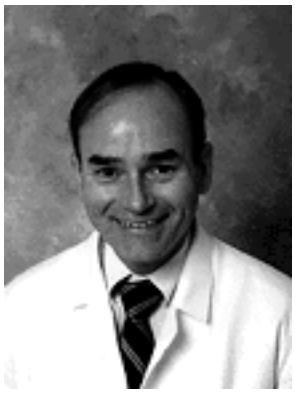
Robin Felder, Ph.D. received his B.S. in Chemistry at the College of William and Mary in 1977. In 1983 he received his Ph.D. in Biochemistry at Georgetown University. In 1983-84 he completed a post-doctoral fellowship under John Kebabian and the National Institutes of Health in which he examined the hormonal regulation of the biosynthesis of proopiomelanocortin. In 1984 he was appointed to the medical faculty at The University of Virginia Health Sciences Center in Charlottesville, Virginia. Dr. Felder is currently Professor of Pathology, and Associate Director of Clinical Chemistry and Toxicology, and Director of the Medical Automation Research Center. He is Chairman of the International Conference, LabAutomation which is now 7th year and annually attracts over 700 registrants and 50 exhibitors of laboratory automation products. Dr. Felder has served as Chairman of the Oak Ridge Conference, he is on the editorial board of Clinical and Experimental Hypertension, Laboratory Robotics and Automation, Laboratory Information Management, and Advance News. Dr. Felder founded the Association for Laboratory Automation and currently is Vice President and editor of its newsletter, Laboratory Automation News (LAN). He has published over 74 basic and clinical research articles, 30 robotics research articles, and over 15 chapters and reviews and has received the awards such as the Fogarty International Fellowship, the Young Clinical Investigator Award from the Association for Clinical Scientists, and the Young Investigator Award from both the American Federation for Clinical Reserach and the American Physiological Society.



Dr. James C. Boyd
University of Virginia
Charlottesville, VA 22908
USA

James C. Boyd did his undergraduate studies in Applied Mathematics at the University of Colorado. He received his M.D. from Washington University School of Medicine in St. Louis, Missouri. His residency and fellowship training in Laboratory Medicine were carried out at Barnes Hospital in the Washington University Medical Center. His current positions include Associate Professor of Pathology, Director of Systems Engineering, and Associate Director of Clinical Chemistry and Toxicology at the University of Virginia Health Sciences Center. He is a member of the curriculum committee for the AACC Professional Practice in Clinical Chemistry review course, the NCCLS Subcommittee on Interference Testing, and is an Associate Editor of Clinical Chemistry. In 1985 he received the Young Clinical Scientist Award of the Association of Clinical Scientists. He has served on the Editorial Boards of Annals of Clinical and Laboratory Science and Clinical Chemistry, and on the Scentific Council of the Association of Clinical Scientists. He is a member of American Association for Clinical Chemistry, the Academy of Clinical Laboratory Physicians and Scientists, the Association of Clinical Scientists, and the Institute of Electrical and Electronic Engineers. His clinical and research interests fall into three areas: the use of mathematical and statistical approaches for aiding the evaluation and clinical interpretation of laboratory tests; automation (particularly robotics) in clinical chemistry; and risk markers for vascular disease.

Dr. John Savory
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Dr. John Savory received his B.S. in chemistry in 1958 and his Ph.D. in 1961 from the University of Dunham, Durham, UK. He is a Diplomate of the American Board of Clinical Chemistry. Dr. Savory is currently a professor of Pathology and Biochemistry at the University of Virginia in Charlottesville, VA.

Electronic Laboratory Notebooks

Dr. Rich Lysakowski and Dr. James Currie

Point Loma A - West Tower

Course Description:

Organizations are struggling to find competitive advantages to increase sales, stay profitable, and make the most effective use of their employees and their knowledge. Technology and re-engineering can provide some solutions. Scientists are starting to take advantage of "The New Automation" in laboratory automation and scientific computing systems: collaborative electronic lab notebooks, groupware and real-time collaboration tools, workflow, document management, project data management systems, and advanced object-oriented LIMS. However, requirements are sometimes unclear and bewildering because of the broad array of offerings. Understanding and evaluating them is very expensive in human effort. There are better ways to quickly learn and implement these systems!

This course reviews the vocabulary and full range of concepts and requirements for electronic notebooks and recordkeeping, groupware, workflow, object-oriented data management, and document management systems. It gives case studies for how these systems are being applied in R&D and manufacturing labs today.

The legal and regulatory requirements for fully electronic recordkeeping to be accepted by federal agencies and patent offices will be covered, including recently released regulations for software systems.

Technologies still present significant barriers, though a few commercial systems can now be used to pilot and benchmark systems against your application needs. You will learn about the innovative capabilities and differences between systems. Leading products will be discussed and compared, along with their optimum applications areas. People, usability, and operational issues also present great challenges in applying these systems. Helpful knowledge and strategies for enrolling people will be given, along with other useful information to demystify the process.

A brief review of some available software and hardware tools is given for electronic notebooks; electronic signatures and notary services; groupware and information sharing; document and workflow management; interfacing to WWW, LIMS and R&D databases, molecular structure databases and modeling systems, and other traditional lab automation systems will be given in an easy to digest format.

- Understand cost/benefit analyses that identify the key business benefits of electronic notebooks, groupware, document management, and World Wide Web systems for collaborative computing in scientific organizations.
- Learn about the easiest ways to get started with these systems, individually, organizationally, politically and legally.
- Learn how to select viable vendors who can give you the best tools and service so that you can best succeed in your projects.
- Learn about the critical strengths and weaknesses of some dominant vendors.

- Learn from Web specialists about World Wide Web tools as a technology foundation for Global Intranet Notebooks (GINs)

Gain actionable information and new methodologies to "hit the ground running" as soon as you return home.

This course provides the fastest and most practical detailed introduction to the legal, regulatory, technical, and social aspects of this brave new world of Collaborative Electronic Laboratory Notebooks and R&D Team Computing Systems. It also gives you an appreciation of the state of the art and shows you how to make "The New Automation" systems succeed in your organization.

Instructors:

Dr. Rich Lysakowski
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Dr. Rich Lysakowski has over 15 years professional experience working with computers and laboratory instrument vendors in various scientific, software engineering, marketing, and project management roles. He has a Ph.D. in Physical and Analytical Chemistry studying under Dr. Ray Dessy at Virginia Tech with a specialization in laboratory automation.

In 1989, while at Digital Equipment Corporation, he created the Analytical Data Interchange and Storage Standards Program (The ADISS Program) that has led the establishment of worldwide data sharing and data archival standards for chromatography, mass spectrometry, infrared, and someday NMR and atomic spectroscopies. These data standards are now available from all major manufacturers selling software for these analytical instruments through the Analytical Instrument Association's ANDI standards program. Dr. Lysakowski left Digital Equipment Corporation in March 1994 to found TeamScience, Inc., which specializes in scientific software research, engineering, training, consulting, and publishing.

In 1995, he was a founding partner in The Collaborative Computing Institute, which provides training in document management, groupware, Internet / Web and other technologies to advance the state of the art for collaborative systems.

In 1996, he founded The Electronic Notebook Research Institute, which specializes in private and public studies to advance the state-of-the-art of electronic recordkeeping, records management, and collaborative notebooks for R&D and related areas of industry.

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James T. Currie, Jr. is a lab automation consultant and principal of Currie & Associates. He holds a B.S. in chemistry and a Ph.D. in analytical chemistry. Since 1978, he has specialized in computer applications in laboratory sciences. He has worked as an instructor and consultant to numerous corporations, standards bodies, consortia, and government organizations. His areas of expertise includes:

- Designing and implementing in-house and commercial instrument interfacing software systems.
- Developing of over 25 laboratory database applications (LIMS) and their application to the chemical, pharmaceutical, clinical, and environmental sciences.
- Developing and delivering of training curricula in LIMS, instrument interfacing, GLP/GMP/GALP compliance, ISO 9000 validation, electronic lab notebooks, and other specialty areas.
- Providing project management functions to major corporations for company-wide lab-based development.
- Developing and applying a unique people-oriented, cultural-based approach to project planning that stresses business needs and human considerations to specify, procure, and implement successful solutions to laboratory problems.

n 1985 Dr. Currie was employed by Digital Equipment Corporation to provide LIMS and instrument interfacing experience to the Laboratory Data Products Group. Until 1992 he represented Digital on industry standards groups and consortia. He also worked to create products for Digital and to provide solutions integrating Digital and other vendors' products to meet customer needs.

In 1988 he founded Currie And Associates to begin approaching laboratory business needs in which Digital chose not to engage. In 1992 he left Digital Equipment Corporation to pursue management of Currie And Associates on a full-time basis. Since then, Dr. Currie has developed numerous specifications and software packages for standards organizations and government agencies.

Dr. Currie is the co-leader of the R&D Team Computing and Electronic Lab Notebooks Consortium. He also consults and provides project management responsibilities to other companies and organizations.

Internet I: Introduction

Introduction to the Internet and Untangling the World Wide Web

Mrs. Lisa Gardner and Mrs. Vicki Brown

Terrace C - West Tower

Course Description:

The Internet has become a vast information source with a growing network of people, ideas, resources and markets. More than 100 million users world-wide utilize it's interconnectivity, send and receive E-mail, access forums and databases, send and receive client, vendor and remote staff information. It is estimated that by the end of 1997, more than 1 million new domains will pop up. With this enormous explosion of information becoming readily available, now is a perfect time to learn about this amazing - and ever-popular - technology.

This course provides comprehensive hands-on experiece with the Internet, geared to the needs of scientists. The content will be geared to the LabAutomation'97 attendee who is not necessarily a software expert.

A short history of the Internet will be provided. You will learn how to choose and implement the Internet connection most appropirate for you needs, install and configure Internet access tools, comunicate text and data worldwide, locate and retrieve information using FTP, Gopher and the World Wide Web, utilize the various search engines and directories available on the Web, establish an on-line information service, protect you internal networks and data from unauthorized instrusion, and exploit the full range of Internet resources and services.

Internet II: Intermediate

HTML Basics and Setting Up A Web Server

Mrs. Lisa Gardner and Mrs. Vicki Brown

Terrace C - West Tower

Course Description:

With the enormous explosion of information now available on the Web, there is no time like now to learn how to weave your own web space. This course provides comprehensive hands-on experiece with HTML (HyperText Markup Language), the language of the Web. Participants must have at least an understanding of the Web or had attended Introduction to the Internet and Untangling the World Wide Web.

A brief overview of what HTML is will be provided. Students will learn how to create a homepage using basic HTML, including adding lists, hyperlinks, anchors, and images. Time allowing, students will also learn HTML 3.0, including tables. A presentation will be given in the afternoon on how to set-up and manage a Web site.

Instructors:

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Lisa Gardner is a Computer Information Specialist for the Computing, Information, and Communications Division's Training, Development and Coordination Team at Los Alamos National Laboratory. Lisa has been utilizing the Internet for seven years, with emphasis on the Web for the last three years. Lisa is LANL's Web Trainer, providing hands-on training on the Internet, Netscape, HTML and JAVA for non-programmers to LANL employee's. Along with Web training, Lisa is also on the team that provides training for the LANL Labwide Business Information Systems. Lisa has a M.A. in Organizational Learning and Instructional Technologies from the University of New Mexico.

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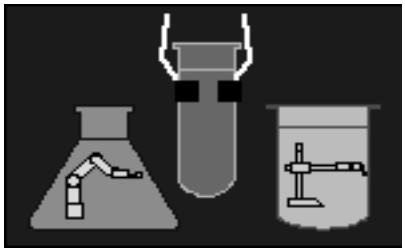
Vicki Brown is a Computer Information System Specialist and Team Leader of the Training, Development, & Coordination Team in the Computing, Information, & Communications Division at Los Alamos National Laboratory (LANL). This team is responsible for the training for all Laboratory personnel in the use of dozens of Lab-wide Business Information Systems developed in-house. In addition, this team provides training for externally developed applications and languages as deemed necessary such as Internet, WEB, HTML, JAVA, Lotus Notes, etc. Vicki has been at the Laboratory for eight years and has designed, developed, & delivered nearly twenty different courses for these systems. Before coming to LANL, Vicki spent twelve years in the education field. Vicki has an M.M. from the University of Colorado.

An Introduction to Laboratory Automation and Robotics

Drs. Gary W. Kramer, Steve D. Hamilton and Mark F. Russo

Coronado A - West Tower

Course Description:



Today's increasingly competitive business environment continues to emphasize on the use of automation technology to improve laboratory productivity, to accelerate discovery, and to maintain quality. With the proper planning and implementation, robotics can be a highly flexible tool for laboratory automation.

This is an introductory course, aimed at those considering automating their laboratory operations and those managing increasingly automated laboratories. The topics covered will be:

- Reasons for employing laboratory automation.
- An overview of current laboratory automation and robotics technology and usage, from workstations to fully integrated systems.
- Planning, implementing and maintaining successful automation applications.
- Automation specific issues involving documentation, validation, open systems and standards.
- A review of specific automation-related technologies, such as automatic ID, sensors, vision systems, and software for system control and scheduling.
- Understanding the relationship of automation and informatics, and the various options, tools and strategies that may be employed to manage automation-generated data.
- A preview of emerging technologies that may have an impact on laboratory automation.

Instructors:

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Gary W. Kramer received his Ph.D. from Purdue University in organic chemistry working with Professor H. C. Brown on the synthesis and reactions of allylic organoboranes. After serving as the head post-doc in the Brown organization, he joined Purdue's Chemistry Instrumentation Facility, where he designed analytical instruments and instrument interfaces and consulted on measurement problems. From 1984 until 1990, he was co-director of a project to automate the way organic synthesis development is carried out in the laboratory. In 1990, he joined the National Institute of Standards and Technology and was Project Manager of the Consortium on Automated Analytical Laboratory Systems (CAALS-a U.S. industry/Government joint venture to foster the development of laboratory automation for analytical chemistry) from 1991 until 1996. In 1995, he was named Group Leader for the Chemical Sensing and Automation Technology Group in NIST's Analytical Chemistry Division.

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Steve Hamilton received his Ph.D. in Analytical Chemistry from Purdue University in 1983. He served as the Team Leader of Fermentation Automation Development at Eli Lilly from 1983-1992. From 1992-1994, Steve was the R&D Manager, Scitec Inc. Steve is currently Director of Automation and Information Services, Amgen Inc. Steve was honored with the Pioneer In Laboratory Robotics Award in 1986 and is a member of the Editorial Board of Laboratory Robotics and Automation.

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tel: (609) 252-6230
email: russo_mark_f.prilvms3@msmail.bms.com

Mark Russo received a Ph.D. in Chemical Engineering in 1989 from Rutgers University. He has spent six years working in Laboratory Automation and Laboratory Robotics in the Pharmaceutical and Biotechnology industries. His accomplishments include the development of several laboratory computer applications for instrument control and data storage in addition to custom laboratory robot systems for high-throughput screening and other applications. He has published on a number of laboratory automation-related topics. He is a new member of the Editorial Board of the journal Laboratory Robotics and Automation published by John Wiley and Sons. He is the author of a number of Laboratory Robotics columns in the LASF Forum, published by the Laboratory Automation Standards Foundation. Mark is also a member of the adjunct faculty in the Mathematics and Computer Science Department of Drexel University where he has taught Object-Oriented Programming, Object Modeling and Logic Programming. Mark is currently with Bristol-Myers Squibb in the Combinatorial Drug Discovery Group.

LIMS in the Organization

Dr. Robert D. McDowall

Point Loma B - West Tower

Course Description:

Laboratories are under increasing pressure to increase productivity and reduce costs. The implementation of a LIMS is one way of achieving these goals. However, the success rate of LIMS implementations is not high and organizations do not usually get payback from the investment they make in time, equipment, and human effort.

The aim of this course is to give participants the information and tools to implement a LIMS effectively. The course will cover:

- Defining the scope and boundaries of a LIMS: what functions in an organization should a LIMS automate and where are the benefits realized? The targets the LIMS must hit should be defined before the project starts. The LIMS Matrix is the tool for this purpose.

- The LIMS model and benefits of instrument connection: The LIMS model is a means of explaining the user functions of LIMS. One neglected feature of LIMS is instrument connection, less that 30% of systems have instruments connected. Why?

- Performance metrics to measure success of the project: How can you convince yourself and senior management that your project is a success? Use performance metrics to provide solid data for an objective assessment of the project.

- Change management implications: involving the users: Unless the users are involved in the project, the LIMS will fail. The success of a project lies not in the technology but in getting the users to change their ways of working. Human factors for success and failure will be outlined.

- End-user validation of LIMS: The end users of a system are responsible for validating the LIMS in quality or regulated environments. A practical and common sense way of validation will be promoted.

- Risk Assessment of a LIMS project: Be more proactive in managing the LIMS project and consider the risks that you face from the comfort of this course. Common risks at various stages of the project will be discussed.

There will be an open forum to discuss problems raised by the participants. Target audience: Laboratory managers and senior analysts, computer scientists and quality assurance personnel involved in a LIMS project.

Instructor:

Dr. Bob McDowall
73 Murray Avenue
Bromley, Kent, BR1 3DJ
UK

tel: +44 181 313 0934
fax: +44 181 313 0934
email: 100411.1142@compuserve.com

Dr. Robert D. McDowall is an analytical chemist with over 20 years experience in forensic toxicology and drug development measuring drugs in biological matrices. He has used automation in various forms to improve laboratory performance and has over 16 years experience with LIMS.

Bob edited the first book on LIMS in 1987 and has published extensively on the sibject (over 30 publications). He writes the Questions of Quality column for LC/GC Magazine.

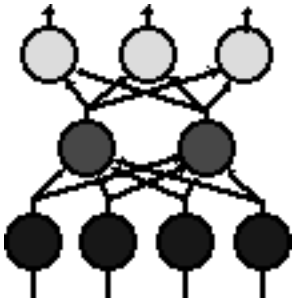
Bob is Visiting Senior Lecturer in the Department of Chemistry at the University of Surrey and Principal of McDowall Consulting.

Neural Networks - A Hands-On Computer Workshop

Dr. Charles T. Butler

Terrace D - West Tower

Course Description:



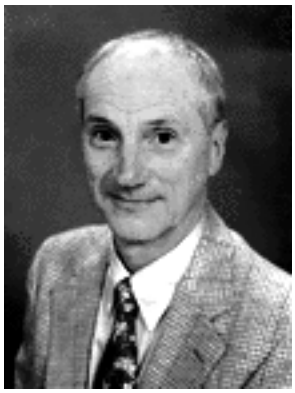
This course is a two-day hands-on workshop in neural networks and their applications. Three other computational intelligence methods - knowledge-based and fuzzy systems and genetic algorithms - will be introduced and their areas of usefulness and overlap with neural systems discussed. On both days attendees will perform experiments, the first day using specially written software that allows them to watch a network as it learns a task, the second day using commercial professional software. A copy of the specially written software is included with the course textbook.

Neural networks are information processing systems modeled after the structure of the brain and are among the most innovative problem solving methods in use today. Unlike traditional computers, neural networks are trained to solve problems, learning appropriate solutions from examples rather than forcing the developer to provide detailed algorithmic instructions. They are often successful in problem domains that have not yielded to algorithmic or expert-system approaches. Neural networks can be applied to both spatial and temporal problems, including classifying patterns, controlling complex processes, providing expert-level advice, clustering unknown data, and mapping functions. They are especially appropriate for applications in which human expertise is the current usual solution, typically performing as well or better than their human counterparts at lower cost.

The hands-on nature of this workshop allows all participants to gain practical experience with these innovative systems. In the first day's sessions, Dr. Butler will introduce neural networks, then cover the two most useful application networks, backpropagation and Kohonen self-organization. Attendees will train their own backpropagation and Kohonen networks and learn the effects of several of the important parameters governing their operation. Dr. Butler will then introduce three complementary methods, expert systems, fuzzy systems, and genetic algorithms, and compare their areas of usefulness to those of neural systems.

On the second day, Dr. Butler will lead attendees in applying commercial professional simulator software to data from actual applications to help them gain experience in using backpropagation networks to solve difficult "real-world" problems and to illustrate the need for and methods of proper data preparation. If time permits, the day will close with an open question-and-answer session on topics related to neural networks.

Instructor:



Dr. Charles Butler
Computational Intelligence
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Dr. Charles Butler has held positions at the Caltech Jet Propulsion Laboratory, Oak Ridge National Laboratory, Oklahoma State University, Virginia Commonwealth University, BDM International, and Physical Sciences Incorporated. In addition to twelve years in neural network applications, he has performed research in fundamental and applied solid-state physics and has worked and taught in such areas as satellite and laboratory instrumentation and digital and analog electronics. He was publications chairman of the first International Joint Conference on Neural Networks, helped organize the first conference on Neural Information Processing Systems, and is a charter member of the International Neural Network Society. He is on the editorial board of the International Journal of Computational Intelligence and Organizations. He has many papers and publications in neural network applications, owns a neural-network process-control patent, and has given invited papers at several international neural network conferences.

Dr. Butler has taught a number of hands-on short courses in neural networks and is coauthor of Naturally Intelligent Systems, which introduces neural networks to a general technical audience, and the two-volume workbook, Understanding Neural Networks; Computer Explorations, the text for this course. He and his coauthor are currently working on a second edition of those books. Since 1994, he has consulted in neural network applications and taught short courses as Computational Intelligence. Dr. Butler has applied neural networks to many problems, including retrieving atmospheric and surface parameters from satellite sounder data, communications network monitoring and control, psychometric analysis and prediction, investment portfolio management, recovery of very noisy waveforms, acoustic quieting, several process-control problems, disease-outbreak prediction, and classification of battlefield laser threats. He has taught the ICAR neural network short courses at Montreux in 1995 and San Diego in 1996.

Visual BASIC for the Laboratory

Dr. Martin M. Echols and Dr. Mark F. Russo

Terrace A - West Tower

Course Description:

The Visual Basic programming system for Microsoft Windows has become one of the most prominent custom application development tools for the automated laboratory. Visual Basic (VB) combines a simple programming language and an intuitive graphical user interface development environment with a wide range of built-in and third-party software libraries. This ease-of-use and continually increasing number of available software libraries make VB attractive for developing custom software components for automated laboratory systems.

This short course will introduce the Visual Basic programming system (version 4.0) and cover the features that make VB an invaluable tool for the laboratory. Several relevant sample programs will be examined. Hands-on sessions will provide the opportunity to work with VB and sample programs. Topics to be covered include:

- The VB approach to graphical user interface development
- Dynamic Data Exchange (DDE), Object Linking and Embedding (OLE) and OLE Automation
- Instrument communication and control using RS-232 and IEEE protocols
- Visual Basic for Applications (VBA)
- Network application development with VB
- Database application development with VB
- Advanced topics

This class will provide a sufficient background to begin successful development of a wide range of custom laboratory applications using Visual Basic.

Instructors:

Dr. Mark Russo
Bristol-Myers Squibb.
P. O. Box 4000 Mailstop E14-08
Princeton, NJ 08543-4000
USA

email: russo_mark_f.prilvms3@msmail.bms.com
tel: (609) 252-6230

Mark Russo received a Ph.D. in Chemical Engineering in 1989 from Rutgers University. He has spent six years working in Laboratory Automation and Laboratory Robotics in the Pharmaceutical and Biotechnology industries. His accomplishments include the development of several laboratory computer applications for instrument control and data storage in addition to custom laboratory robot systems for high-throughput screening and other applications. He has published on a number of laboratory automation-related topics. He is a new member of the Editorial Board of the journal Laboratory Robotics and Automation published by John Wiley and Sons. He is the author of a number of Laboratory Robotics columns in the LASF Forum, published by the Laboratory Automation Standards Foundation. Mark is also a member of the adjunct faculty in the Mathematics and Computer Science Department of Drexel University where he has taught Object-Oriented Programming, Object Modeling and Logic Programming. Mark is currently with Bristol-Myers Squibb in the Combinatorial Drug Discovery Group.

Dr. Martin M. Echols
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Martin Echols graduated from the University of Denver with a bachelor's degree in biology in 1976. Since then he has worked in a variety of positions in both academic and industrial settings. He first began writing interfaces for laboratory data acquisition in 1983. Since that time he has written numerous interfaces for instruments, developed robotic systems for a variety of applications and later managed a group of scientists and technicians dedicated

to laboratory automation and robotics. Martin has worked with Visual Basic since it first appeared, developing instrument interfaces, robotic control systems, instrument network interfacing and database connectivity. Martin is currently with SmithKline Beecham where he is responsible for technical leadership and consulting on laboratory automation issues.

Machine Vision For Laboratory Automation - Fundamentals and Applications

Dr. John E. Agapakis and Dr. Sarath Krishnaswamy

Terrace B - West Tower

Course Description:

Over the last fifteen years, machine vision - the extraction of useful symbolic descriptions from video images - has matured as a technology and is now considered an indispensable tool for manufacturing automation. Manufacturing applications of machine vision include part presence/absence detection, part location/orientation determination, part recognition, quality inspection, precise two-dimensional (2D) or three-dimensional (3D) gauging, robot or other machine guidance, and process control.

As the use of robotic automation in the laboratory becomes more widespread, the need for and application of machine vision technology has also expanded. Machine vision is now finding increasing utility in pharmaceutical research laboratories, in DNA mapping/sequencing automation applications, and in the clinical laboratory. Applications of machine vision include labware inspection, dissolution testing, procedure validation, colony picking, machine guidance, and quality control.

In this short course we will cover the basics of machine vision and image analysis and examine examples of these emerging applications of machine vision in the automated laboratory. The course will start with examples of laboratory applications of machine vision and will include interactive sessions for setting up sample applications. We will then detail the parts of the machine vision system and briefly cover some of the theory behind image processing and analysis. The latter segment of the course will be free time in which course participants will have access to state-of-the-art machine vision workstations on which they may explore and experiment with different image analysis algorithms and vision-guided motion applications. Participants are encouraged to bring their own ideas and lab consumables or other apparatus for mocking up applications on these development stations.

Instructors:

Dr. John E. Agapakis
Acuity Imaging
9 Townsend West
Nashua, NH 03063
USA

tel: (603) 598-8400
fax: (603) 577-5964
email: jea@acut.com

Dr. John E. Agapakis is the Vice President of R&D of Acuity Imaging, responsible for all externally sponsored R&D and internally funded development of Acuity Imaging machine vision and image processing/analysis products. He has previously served as Director of Engineering, R&D Program Manager, Senior Engineer, and Systems Engineer involved with R&D on vision-guided adaptive robotic welding systems, precision 3D gauging, welding process monitoring and control, robot programming and control, and knowledge-based system applications in manufacturing. He has acted as Principal Investigator in several Acuity research programs sponsored by NIH (on laboratory automation and robotics), the Department of Energy (on vision-aided weld process monitoring and control), NASA (on macro- and task-level robot programming), and the US Navy (on expert vision-guided robotic systems). As a key member of the development team for the Automatix Vision-Guided Seam Tracking System, he has been responsible for the development of machine vision techniques used for the model-based recognition of object features in noisy images and the determination of 3D surface descriptions using structured lighting. He has also been involved with the development of turnkey adaptive robotic systems and 3D vision gauging applications. Dr. Agapakis has also served as a Lecturer at MIT and Adjunct Professor of Computer Science at Boston University. He holds a Ph.D. in Robotics and Fabrication Systems from MIT.

Dr. Sarath Krishnaswamy
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USA

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Sarath Krishnaswamy is a Systems Engineer at Acuity Imaging. He is a member of Acuity's Vision Solutions Group and Principal Investigator for the company's laboratory automation research programs. In this role he has been responsible for the development of several laboratory applications of machine vision and vision-guided motion, including colony picking, microwell plate applications, and clinical sample handling. This last work resulted in being awarded the 1995 Boehringer Mannheim Award for the year's most innovative research in clinical laboratory automation. He has also worked on several Phase I and Phase II SBIR research projects for NASA (on robot macro- and task-level programming), DoD , and DoE (on telerobotic applications). He holds M.S. and B.S. degrees in Mechanical Engineering from MIT, where he worked as a researcher in the Artificial Intelligence Laboratory developing robot kinematic and dynamic models for assembly and force controlled systems. He is a charter member of the Association for Laboratory Automation.

List of Exhibitors

Abbott Diagnostics personnel will be on hand to discuss Abbott's lab automation philosophy. They will also discuss the ability current Abbott instruments have to interface with any LAS vendor.

100 Abbott Park Road, Abbott Park, IL 60064, USA, Tel: (847) 937-9558, Fax: (847) 935-2440

Advanced ChemTech is the recognized leader in automated synthesis technology, pioneering the development of the world's first automated systems for multiple peptide, combinatorial peptide & multiple organic synthesis. Now Advanced ChemTech offers the BenchMark series, the world's first series of systems for combinatorial organic and ultra high throughput organic synthesis.

5609 Fern Valley Road, Louisville, KY 40228, USA, Tel: (502) 969-0000; Fax: (502) 968-1000

American Clinical Laboratory is a tabloid publication that serves the field of clinical testing in the U.S. Subscribers are laboratorians working in independent and hospital laboratories, private laboratories, and physicians offices. The editorial covers a broad range of topics relating to advances in instrumental and diagnostic technology and has a special focus on the interests of laboratory managers.

Argonaut Technologies, Inc. believes that you should "Do the chemistries you design, not those to which you are limited." The Nautilus 2400 enables the automation of the widest range of chemical synthesis, while maintaining high purity and control through individual temperature regulation and solution/solid phase reactions. ArgoGel is the highest loading commercial resin used for solid phase synthesis**.**

887 Industrial Rd. Suite G, San Carlos, CA 94070, USA, Tel: (415) 598-1350 X234, Fax: (415) 598-1359

AutoLab Systems provides modular laboratory automation technologies from loading, centifuging, aliquotting, and sorting. Offering hardware and software technology, as well as process refinement, AutoLab Systems allows you to focus on delivering efficient and cost effective laboratory services - with improved qualty and safety.

100 International Blvd., Etobicoke, Ontario M9W 6J6, Canada, Tel: (416) 675-6777, Fax: (416) 213-4086

Beckman Instruments, Inc. displays the Biomek Integrated Laboratory Automation System for ELISA applications. This High Throughput Screening (HTS) system can be configured for Receptor Binding and Cell-Based Assays, as well. It is a turnkey solution that combines teh Biomek 2000 Laboratory Automatoin Workstation with robotics and systems integration expertise of SAGIAN, Inc.

Beckman will also show a video highlighting the AccelNet Laboratory Automation Network, which represents the new symbol for laboratory efficiency. It automates the most labor intensive part of any clinical laboratory-sample handling, and combines two SYNCHRON CX7 DELTA clinical analyzers with

2500 N. Harbor Boulevard, P. O. Box 3100, Fullerton, CA 92834-3100, USA, Tel: (714) 871-4848, Fax: (714) 773-6652

Becton Dickinson Vacutainer Systems (BDVS) is the world wide leader in specimen collection and transport devices. BDVS is committed to delivering innovative solutions to challenges in pre-analytical through post-analytical operations. Rooted in BD's excellence as a high volume manufacturer of quality medical devices, these product and service solutions will translate into improvements in safety, work flow, and TAT of clinical information.

1 Becton Drive, Franklin Lakes, NJ 07417, USA, Tel: (201) 847-4598, Fax: (201) 847-4862

Behring Diagnostics presents a paperless inventory tracking system that improves the efficiency of your laboratory by automatically tracking patient reportable results. The Behring Universal Interface provides a cost-per-reportable program so that your laboratory pays only for the number of patient results you report, not the amount of reagents that are in your inventory.

P. 0.B. 49013Y MIS El-228, San Jose, CA 95161-9013, USA, Tel: (800) 227-9948, Fax: (408) 239-2206

Boehringer Mannheim Corporation (BMC), the world leader in total laboratory integration, invites you to explore our wide range of options to meet your reengineering needs. From simple robotics to comprehensive workstation consolidation and integration, BMC will partner with you to determine the best fit for your business.

9115 Hague Road, Indianapolis, IN 46256, USA, Tel: (317) 845-7071, Fax: (317) 845-7129

Bohdan Automation, Inc. will display Automated Laboratory Workstation Solutions for Sample Preparation. Workstations to be displayed include an Automated Organic Synthesis Workstation, Dilution Workstation, Chromatography Sample Preparation Workstation, Capping/Decapping Workstation with optional Bar-Code Labeling, and an Automated Weighing Workstation. Representatives will be on hand to discuss your particular sample handling needs in areas including solid-phase extraction, filtration, powder dispensing, pH measurement, liquid dispensing, and many other common laboratory practices.

1500 McCormick Boulevard, Mundelein, Illinois 60060, USA, Tel: (847) 680-3939, Fax: (847) 680-1199

Brandel is exhibiting its fully robotic harvesting system and high-capacity plate carousels. Further, Brandel is able to integrate your equipment into a fully robotic workstation and provide any ancillary equipment your workstation may require. All Brandel systems are available with machine vision to monitor your samples through every step.

8561 Atlas Drive, Gaithersburg, MD 20877, Tel: (301) 948-6506, Fax: (301) 869-5570

California Computer Research, Inc., will display the CCRI RoboCart which is used for material transfer in a hospital environment. The task of moving material around the laboratories occupies 25-35% of a technologist's time. Designed to increase productivity, the RoboCart transports materials to and from various locations.

P.O. Box 1772, Lake Arrowhead, CA 92352, USA, Tel: (909) 336-5000, Fax: (909) 336-4367

Cartesian Engineering, Inc. will be demonstrating the A/D3000 sub-microliter dispensing system. This System can aspirate a programmed amount of fluid (as low as 100 nanoliters) and quantitatively dispense onto target substrates. Drop volumes as low as 8 nanoliters can be dispensed in lines or dot arrays. Multiple head arrays are also available.

17781 Sky Park Circle, Irvine, CA 92714, USA, Tel: (714) 440-3680, Fax: (714) 440-3694

Charybdis Technologies, Inc. presents the debut of the Calypso System for high throughput organic synthesis. Featuring the Calypso 96 Reaction Block which utilizes disposable microplate technology, the Calypso System provides an economical solution for rapid chemical discovery. Calypso is a versatile platform capable of solution/solid phase synthesis, controlled reaction conditions, and is adaptable to integrated automation.

2131 Palomar Airport Rd., Suite 300, Carlsbad, CA 92009, Tel: (619) 431-5160, Fax: (619) 431-5163

Corning CoStar Corporation manufactures a complete line of plastic laboratory ware for the Life Science Market. Corning CoStar will be featuring new and innovative products for use in the areas of Cell Culture, Assay, Molecular Biology, Liquid Handling and Laboratory Filtration. In addition, Corning Costar will feature products for use in the High Throughput Screening environment.

1 Alewife Center, Cambridge, MA 02140, USA, Tel: 1-800 492-1110, Fax: (617) 868-2076

Coulter Corporation is the worldwide leader in total laboratory automation. Coulter designs flexible systems to meet the needs of laboratories of all sizes. Functions include, sorting, self balancing centrifugation, decapping, serum measurement, aliquoting, secondary tube labeling, recapping, positive sample tracking, analyzer loading, refrigerated storage, reflex testing, and sample retrieval**.**

11800 S.W. 147th Avenue, P.O. Box 169015, Miami, FL 33116-2500, Tel: (800) 944-3333 Fax: (305) 380-5177

CRS Robotics Corporation is a supplier of robots and turnkey robot systems which automate a variety of processes in the drug discovery laboratory (automated storage and retrieval, combinatorial chemistry, compound dissolution and high throughput screening), the food quality control laboratory and the clinical laboratory.

5344 John Lucas Drive, Burlington, Ontario, L7L 6A6, Canada, Tel: (905) 332-2000, Fax: (905) 332-1114

Cyberlab sells robotic workstations for sample preparation and liquid handling, among other uses. The patented Cyberlab design features up to 5 Z-axis tools. The working surface can include stations for bar code reading, bar code labeling, uncapping/recapping, mixing heating, cooling, plate reading, etc. Applications programs are easily written for specific methods and protocols. Cyberlab has standard workstations for microwell plate handling, urine pipetting and protein crystallization, to name a few.

36 Del Mar Drive, Brookfield, CT 06804, USA, Tel: (203) 740-3565, Fax: (203) 740-3566

Dawning Technologies, Inc. provides interface components and systems. The Dawning software library currently boasts more than 300 applications. Dawning will feature current interface products, and introduce a new interface product capable of secure encrypted interface communications to an interconnected device over public and private networks.

409 Mason Road, Fairport, NY, 14450-9542, USA, Tel: (716) 223-6006 Fax: (716) 223-8615

Gilson will exhibit their Model 215 Liquid Handler for automation of sample handling procedures to improve accuracy and increase throughput over manual techniques. Fully, programmable, the 215 is easily adaptable to a wide variety of applications in pharmaceutical high throughput screening, clincial laboratory medicine, combinatorial chemistry, and environmental analysis.

3000 W. Beltline Hwy., P. O. Box 620027, Middleton, WI 53562, USA, Tel: (800) 445-7661, Fax: (608) 831-4451

C. A. Greiner und Sohne, GmbH manufactures an extensive line of high quality products for automated systems and robotics in the clinical and research laboratories.

Greiner will exhibit Vacuette®-evacuated blood collection system, EasyLoad® pipette refill system, disposable and conductive tips, Microtiter plates, 384-well plates and Thermoquick PCR plates.

Bad Haller Str. 32, Kremsunster, Austria A-45502. Tel: (43) 7583-6791 Fax: (43) 7583-6318

Hamilton Company will demonstrate the fully automated microplate processor, Microlab F.A.M.E. and the ultra low volume, high throughput pipettor, Microlab Low Volume MPH. Information on these products and other robotic microplate and solid phase extraction instrumentation will be available.

P.O. Box 10030, Reno, NE 89520-0012, USA, Tel: (702) 858 3000, Fax: (702) 856 3227

HelpMate Robotics Inc. will display the HelpMate, a trackless robotic courier designed to perform material transport tasks throughout the hospital environment. Available on a rental basis, HelpMate can be put to work immediately improving productivity while at the same time reducing your operating costs.

Shelter Rock Lane, Danbury, CT 06810, USA, Tel: (203) 798-8988, Fax (203) 791-1082

Hewlett Packard will display the PrepStation System.

2850 Centerville Road, Wilmington, DE 19808, USA, Tel: (302) 633-8264, Fax: (302) 633-8916

Hudson Control Group, Inc. is a leading supplier of automated products and integrated automation systems using highly reliable industrial quality robots in pharmaceutical and chemical laboratory applications. Hudson's workcell control software, Total Control® for Windows® (TCW) enables a user to control and monitor the operations of every device and instrument in a workcell with one computer. TCW's multi-tasking capability supports simultaneous dispensing, pipetting, vortexing, centrifuging and other processes along with real time sample tracking and data management required in all sample preparation and screening procedures.

44 Commerce Street, Springfield, NJ 07081, USA, Tel: (201) 376 7400, Fax: (201) 376 8265

Immucor, Inc. markets a complete family of automated, walkaway systems for hospital blood banks, reference laboratories, and donor centers. The AB2000 and ABSHV utilize Immuncor's patented Capture® techology to perform antibody screen, RBC crossmatch, platelet screening/cross match, CMV, syphilis, and ABO/Rh.

3130 Gateway Drive, P.O. Box 5625, Norcross, GA 30091, USA, Tel: 800-829-2553, Fax: 770 441-3807

Intelligent Medical Imaging Inc. will be highlighting the latest version of the MICRO21 automated walk away microscopy system designed to provide improved image quality, faster sample processing and increased flexibility of the user interface and hardware options. The combination of state-of-the-art imaging hardware technology and enhanced software algorithms has led to major image quality refinements.

4360 Northdale Blvd., Palm Beach Gardens, FL, 33410, USA, Tel: (561) 627-0344, Fax: (561) 627-0409

ISYS/Biovation is now beta-testing a revolutionary Laboratory Operating System and API called Messenger®. Messenger® is a fully CORBA and OLE compliant implementation of HL7 and all relevant ASTM standards. All Messenger® data access will be implemented using SQL. The result of our strict design initiative to comply with all relevant standards has resulted in an open system which scales in both size and price, and embraces almost all third party ancillary and robotic systems. Messenger® supports multiple facilities and has the most robust security architecture available today. Additionally Messenger® is being developed in accordance with FDA and GMP.

40 Vreeland Ave., Totowa, NJ 07512, USA, Tel: (201) 256 5858, Fax: (201) 256-5506

J-KEM will be introducing a line of custom robotic work stations starting at $10,000. J - KEM is a manufacturer of combinatorial synthesis equipment including programmable syringe pumps, heated reaction blocks which heat (or cool) and stir 100 reactions in parallel. Data acquisition system logs 96 sensors to computer hard drive. Digital temperature controllers regulate the temperature of any volume or insturment to 0.1 C.

6970 Olive Blvd., St. Louis, MO 63130, USA, Tel: (314) 863-5536, Fax: (314) 863-6070

Johnson & Johnson Clinical Diagnostics will showcase how VITROS Chemistry and Immunodiagnostic Systems can fit into your lab automation strategy. VITROS Systems feature direct sampling and open architecture providing maximum flexibility to interface with any major automation vendor.

100 Indigo Creek Drive, Rochester, NY 14650, USA. Tel: (800) 555-5234, Fax: (716) 543-3537

John Wiley & Sons is a publisher of quality chemistry educational materials, professional references, and journals. Titles on display include the Laboratory Robotics and Automation journal. The journal covers the latest developments in the automation of analytical, environmental, synthetic, and clinical laboratories. Also on display will be the books in the Wiley Series in Laboratory Automation, including Laboratory Scientific Computing, by Joe Liscouski; Handbook of Clinical Automation, Robotics, and Optimization, edited by Gerald J. Kost; and information about ordering the upcoming book, Automation Technologies for Genome Characterization, edited by Tony Beugelsdijk.

605 Third Avenue, New York, NY 10158, USA, Tel: (800) 225-5945, Fax: (212) 850-6264

Julabo USA, Inc. will exhibit its full line of "TopTech," "HighTech," and "LowCost" series of heating and refrigerated circulators. The product lines offers modern features designed to make work easier while maintaining the highest standards of quality and performance. Units cover temperature ranges of -90 C to +350 C, and are suitable for all constant temperature applications.

600 D Noble Street, Kutztown, PA 19530, USA, Tel: (800) 458-5226, Fax: (610) 683-6316

Kaplan McLaughlin Diaz (KMD) is an architecture and planning firm specializing in the design of sophisticated laboratories and technical facilities. With offices worldwide, KMD has been at the forefront of architectural design and solution management, winning over 100 design awards, for the past thirty years. Visit KMD's exhibit booth to both discuss your current laboratory needs, and ways to implement your lab automation equipment within new or existing facilities.

222 Vallejo Street, San Francisco, CA 94111,USA Tel (415) 398-5191 or 1-800-822-5191

This year **Labcon** is displaying a family of disposable pipet tips in cartridges for automated liquid handling stations as well as methods to quickly re-load pipet tip racks. Also being shown are new methods to pre-loaded pipet tip racks to automated pipettors.

700 Du Bois Street, San Rafael, CA 94901, USA, Tel: (415) 456-2815, 1-800-227-1466, Fax: (415) 457-7041

LAB-InterLink Inc. offers a comprehensive automation solution for the clinical laboratory. We develop, install and support Specimen Transportation Systems, Automated WorkCells, Expert Software Systems and system interfaces to most instruments and major LIS providers. Our transportation system is installed overhead, out of the way, and requires virtually no structural modifications to your laboratory. Our LAB-Frame®Product Line provides you with the flexibility to automate the entire laboratory or one section at a time, we offer custom systems and islands of automation. As part of our service we have developed a computer simulation model. This very comprehensive study allows you to evaluate Laboratory Automation by WorkCell and will assist you in making valuable purchase decisions to avoid costly mistakes.

1011 S. Saddle Creek Rd., Omaha, NE 68106, USA, Tel: (402) 595-3767, Fax: (402) 595-2951

Labotix manufactures pre and post analytical specimen tube automation modules for clinical laboratories. These stand-alone automated workstations include specimen transportation, routing and sorting, aliquoting, robotic centrifuge storage and retrieval and instrument interface (mechanical and software). These integrated modules are a cost-effective solution for laboratories of all sizes.

2015 Fisher Drive, P.O. Box 897, Peterborough, ON K9J 7A2, Canada, Tel: (705) 876-1220, Fax: (705) 876-1499

Marsh Biomedical Products, Inc. offers a variety of products intended for the life science research laboratory. We specialize in the design and fabrication of racking and storage systems. We will display a variety of robotics-compatible tube and vial racks. We also will introduce our new 250 ml pipet tip designed for use with 96 well automated liquid handling systems.

565 Blossom Rd., Rochester, NY 14618, USA, Tel: (800) 445-2812 Fax: (716) 654-4810

Matrix Technologies Corporation will display their unique manual and portable electronic Single and Multi channel pipettors, an automated pipettor for use with 96 and/or 384 well plates, sealers, cap mats and various plates and tubes for High Throughput Screening, and high quality filter tips.

44 Stedman Street, Lowell, MA 01851, USA, Tel: 1-800-345-0206

Microscan Systems, Inc. designs and manufactures laser scanners providing automatic data capture solutions for clinical diagnostic systems and automated laboratory equipment. The company works directly with the OEM modifying Microscan products so that they will accommodate specific application requirements.

1201 SW 7th Street, Renton, WA 98055, USA, Tel: (206) 226-5700, Fax: (206) 226-8250

Nature America is a publisher of the world's leading sources of news in basic, applied and medical research. Including Nature, the world's most frequently cited weekly scientific journal; Nature Biotechnology, the premier monthly covering applied industrial research; Nature Genetics, Structural Biology, Lab Animal, and the new Nature Medicine, bridging the gap between molecular science and clinical medicine. Nature America's scientific publishing group covers, for research, product information, conferences, and recruitment opportunities.

345 Park Avenue South, New York, NY 10010-1707, USA, Tel: (212) 726-9260, Fax (212) 696-9481

Olympus America, Inc.will be demonstrating the complete line of standardized chemistry systems and laboratory automation systems.

Two Corporate Center Drive, Melville, NY 11747, USA, Tel: (516) 844-5654, Fax: (516) 844-5692

The **Packard Instrument Company** MultiPROBE® Automated Liquid Handling Systems with VersaTip are capable of automatically changing from fixed, washable sampling tips to a variety of disposable tip sizes or types. Robotic-compatible TopCount® microplate scintillation and luminescence counters analyze up to 12 samples at a time using beta, gamma and luminescence labels in 24-, 96-, and 384-well microplates. The FluoroCount® is the only research grade microplate fluorimeter that provides ultrahigh sensitivity at an affordable price.

800 Research Parkway, Meriden, CT 06450, USA, Tel: (800) 323-1891, Fax: (203) 639-2172

PEVCO Systems, Inc. designs, manufactures and services state-of-the-art pneumatic tube transport systems for healthcare. Founded in Baltimore in 1978, the company offers the industry's most technologically advanced and flexible product line, ranging from basic systems to advanced networks, all tailored to meet clients' specific needs.

9610 Pulaski Park Drive, Baltimore, MD 21220, USA, Tel: (410) 574-2800, Fax: (410) 574-6377

Polyfiltronics will display intelligent microplates and filter devices.

100 Weymouth St., Rockland, MA 02370, USA, Tel: (617) 878-1133, Fax: (617) 878-0822

Precision System Science will display the following products: Compact DNA Sampling System SX-2G, and Robotic Select Dispenser RX-500.

341-1, Nakawakura, Matsudo-City, Chiba Pref, Japan 270, Tel: +81 473 49 4004, Fax: +81 473 49 4931

Rixan is the North American Distributor of Mitsubishi Robots. These robots are widely used in laboratories to do sample preparation, dissolutions, machine tending and material movement. Programming is simple using Rixan's Roboware® Windows® programming software. Complete robots/parts are in stock along with the industry's best engineering support.

7560 Paragon Road, Dayton, OH 45459, USA, Tel: (937) 222-0011, Fax: (937) 278-1233

Highlighted will be **Robbins Scientific's** Hydra®-96, a high-speed precision 96 channel microdispenser and Plate Positioners for innovative "split well" 384 and 192 CyclePlates® for high throughput PCR and DNA sequencing. Also shown will be the Microscreen® Trays with 50 ul well volume for micro-volume assays and microcell culture.

814 San Aleso Avenue, Sunnyvale, CA, USA 94086, Tel: (408) 734-8500, Fax: (408) 734-0300

Robocon presents the Fully Automated Robolab 9600 Microplate Laboratories: Robolab 9600 is directed by an automated scheduler and programmed by an "iconic browser" in Windows. Its work stations for HTS (1000 microplates per week) and combinatorial synthesis include microwave reactors, evaporators, incubators, microplate replicators, filterplate harvesters (receptor binding), microplate centrifuges, pipetting robots, washers, photometers, luminometers, fluorometers and scintillation counters.

Geiselbergstrasse 26-32, A-1110 Vienna, Austria, Tel: +43 l 748 1420, Fax.: +43 1 748 1419

Roche Diagnostic Systems is pleased to announce the availability of the COBAS Integra Clinical Laboratory and advanced PCR Systems. The COBAS Integra will be on display featuring a patented internal robotic system that will allow over 100 Chemistry, Drugs of Abuse, TDM, Specific Protein, and Diabetes assays to be performed all on one integrated platform.

1080 US Highway 202, Branchburg, NJ 08876-3771, USA, Tel: (800) 526-1247, Fax: (800) 544-6130

roSYS will exhibit the PLATO series of robotic liquid handling and robotic microplate instruments. The PLATO 3XXX includes modules for positive sample ID, stacker/incubator for up to 30 plates, robotic arm for transfer of plates to/from the worksurface, plate washing/reading and precision sample prep. The PLATO 1000 is designed for lower throughput/price sensitive markets. The PLATO 1000 mimics its senior relative as a complete microplate analyzer. Rosys will also introduce a stand-alone reader, washer, 96-well pipetting station, the ACCESSIONER (serum splitting or aliquotting) and the new Robotic DNA Thermal Cycler for PCR technology.

1309 Veale Road, Suite 21, Wilmington, DE 19810, USA, Tel: (302) 479-5227, Fax: (302) 479-5223

SAGIAN will be showing the ORCA Robot System along with the graphical user interface for Windows 3.x - 95 SAMI Software System.

5601 West 74th Street, Indianapolis, IN 46278, USA, Tel: (317) 328-3588 ext 288, Fax: (317) 328-358

SAIC will feature the ALLEKTO line of laboratory automated products for clinical testing, high-throughput screening, DNA preparation for sequencing, and combinatorial chemistry. These high-performance robotic systems use three robust robotic arms and a sophisticated software that allow rapid sample preparation and analysis.

130 Fifth Avenue North, Seattle, WA 96109, USA, Tel: (206) 728-1455, Fax: (206) 728-2440

Take a minute, save an hour at *<http://sciquest.com>*. The key feature of the **SciQuest** interactive World Wide Web site is our search engine and SciMail (a smart email system) which saves you time by allowing you to find, qualify, and communicate with multiple vendors in just a few minutes. Our database has over 13,000 domestic and international suppliers of analytical, biotechnology, biomedical, clinical, and critical environment equipment, supplies, software, and other services. Win a SciQuest Hourglass by visiting out booth, and test driving this new exciting productivity tool!

P.O. Box 12156, Research Triangle Park, NC 27709-2156, USA, Tel: (919) 786-1770, Fax: (919) 782-3123

SCITEC provides laboratory automation and robotic systems including High Throughput Screening and Combinatorial systems for pharmaceutical, chemical, environmental, clinical, food, cosmetic, and biotechnology; CLARA and WinCLARA software tools for design, simulation, scheduling, and management of real-time robotics systems: incubators, plate sealers, harvesters, shakers, filtration units, carousels, and accessories for lab automation.

5161 W. Woodmill Drive, Suite 14, Wilmington, DE 19808, USA, Tel: (302) 998-2280, Fax: (302) 998-2580

Shimadzu offers a full line of analytical instrumentation. Our unique fiber optically interfaced HPLC lends itself to laboratory automation by offering features such as robotic autosampling, advanced sample preparation functions, flexibility in sampling from various sources including 2 titre plates (micro or deep well), integrated fraction collection and valving to allow automated switching between analytical and preparative configurations.

7102 Riverwood Dr., Columbia, MD, 21046, USA, Tel: 1- 800-477-1227

Sysmex, a pioneer and leader in clinical automation since 1981, will display a fourth generation integrated system, the SE-Alpha II. Sysmex employs cutting edge technology in each of our automation platforms, and backs up our claims of proven performance with greater than 300 placements worldwide.

Gilmer Road 6699 RFD, Long Grove, IL, USA 60047, Tel: (800) 779-7639, Fax: (847) 726-3505

3M will exhibit Empore® high performance extraction disk cartridges and plates for high efficiency solid phase extraction.

3M Center, Building 220-9E-10, St. Paul, MN 55144, USA, Tel: (612) 733-2652, Fax: (612) 736-7149

Tecan offers laboratory automation solutions such as the TRAC robotic system with new dynamic scheduling software. The Genesis with a second arm to move microtiter plates to other devices, provides a flexible stand alone workstation solution. Tecan, with several years of liquid handling experience, offers expert system design, instrumentation, and training.

P. O. Box 13953, Research Triangle Park, NC 27709, USA, Tel: (919) 361-5200, Fax: (919) 361-5201

Titertek Instruments, Inc. will exhibit a variety of equipment for processing microplates and 384 well plates. These include readers, washers and dispensers. All equipment is compatible with the S20 stacker for batch processing of plates. The addition of a robotic arm yields higher throughput.

P.O.Box 1799, Huntsville, AL 35807, USA, Tel: (205) 859-8680, Fax: (205) 859-8698

Tomtec will demonstrate the Quadra 422, a 96-well pipetting system with double plate stacking for microplate automation. A new 384-well pipetting system will be demonstrated along with a variety of automated peripherals for high throughput screening. Incubators, Hotel, BarCode Labeler, Plate Sealer, 96-well Harvester.

1010 Sherman Avenue, Hamden, CT 06514, USA, Tel: (203) 281-6790, Fax: (203) 248-5724

TransLogic Corporation designs, manufactures, and installs automated transport systems for laboratory specimens, pharmaceuticals and supplies. The Computerized Tube System (CTS) is used for delivery of laboratory specimens to the testing area and the Electronic Track Vehicle (ETV) is used for delivery of specimen batches within the laboratory.

10825 E. 47th Avenue, Denver, CO 80239, USA, Tel: (800) 525-1841, Fax: (303) 373-7932

Tri-Continent, "World Class Liquid Handling", presents affordable and complete lines of robotics compatible products for single tube and microplate (96 and 384 well) dispensing, washing and sample handling MultiWash, microplate washers, and BenchMark Series, syringe pumps. All products exhibited are robotics compatible via RS 232.

12555 Loma Rica Drive, Grass Valley, CA 95945, USA, Tel: (916) 274-4291, Fax: (916) 273-2586

Wallac will feature the NEW Victor multilabel counting instrument. The most versatile plate reader available anywhere, Victor allows rapid processing of 24, 48, 96 and 384 well assays and can measure fluorescence, luminescence, colorimetric and DELFIAR applications. Also the Microbeta® TriLux with ParaLux can improve SPA counting efficiency more than 500%.

9238 Gaither Rd., Gaithersburg, MD 20877, USA, Tel: (800) 638-6692, Fax: (301) 963-3200

Zymark Corporation will be exhibiting state-of-the-art laboratory automation robotic systems, workstation and software for pharmaceutical, biotechnology and chemical industries. Using video conferencing, the display will feature live demonstrations from Hopkinton, MA.

Zymark Center, Hopkinton, MA 01757, USA, Tel: (508) 435-9500, Fax: (508) 435-3439

Scientific Committee

The Technical Program is brought to you by the work of our Scientific Committee. The members for 1997-98 are:

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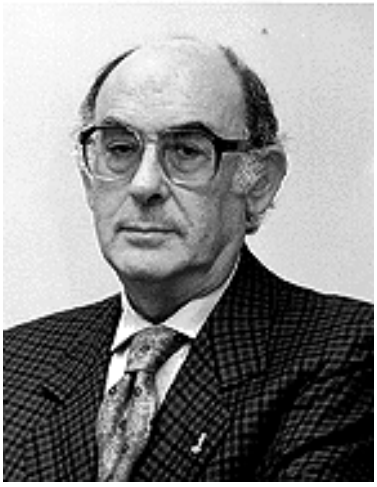
Dr. Tony J. Beugelsdijk received his B.S. from Wichita State University in 1971, and his Ph.D. in Analytical Chemistry from the University of Illinois in 1975. He worked as a senior analytical chemist with Shell Development Company for eight years where he was responsible for method development and automation activities. In 1984, he joined Los Alamos National Laboratory where he currently leads the Lab's robotics program. He has managed the development of more than twenty robotics systems including the only four systems in the nation qualified to handle plutonium samples. Tony has also led the development of automated systems to support the Human Genome Program and has been a champion of robotics technologies in molecular biology and biotechnology. He is the originator of the "Standard Laboratory Module, or SLM, concept for laboratory automation.

Tony has been recognized for his contributions to the field of laboratory automation as a recipient of the 1986 Pioneer in Laboratory Robotics Award and the 1994 Hewlett-Packard Award for Advances in Automated Sample Preparation. He currently serves as the North American Editor of the Journal of Laboratory Automation and as an editor of the Laboratory Automation book series published by John Wiley. In 1992, he completed a Masters in Business Administration from the University of New Mexico.

Prof. Pierangelo Bonini, M. D.



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Prof. Pierangelo Bonini graduated in Medicine and Surgery at the Pavia University in 1963 with full marks. He specialized in Morbid Anatomy, Histopathology and Laboratory Techniques at the University of Milano, (1969) and in Hygiene and Preventive Medicine at the University of Pavia (1977). After 18 years of teaching, he moved to Milano in 1981 as the Director of the Department of Laboratory Medicine (Istituto Scientifico San Raffaele Milano). In 1991, he was appointed as the Scientific Director of Clinical Research of the same Institute, in addition to the Chairmanship of the Department of Laboratory Medicine. Prof. P.A. Bonini has published some 300 papers, (80 of which on Journals included in Science Citation Index), in physiopathology of the endocrine system, biochemical and clinical enzymology of kidney and liver, molecular and catalytic aspects of alpha glucosidase and alpha amylase in men and mammalians, organization and management of clinical laboratory, automatic technologies in clinical laboratory robotics, and the preanalytical phase.

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Dr. Sheila DeWitt is one of the original developers of the DIVERSOMER® Technology. She has been instrumental in the design and implementation of proprietary equipment, automated synthesis methods, and high-throughput synthesis. In addition, she actively pursues the identification and coordination of projects related to molecular diversity among a wide variety of disciplines. Sheila received her B.A. from Cornell University and her Ph.D. from Duke University in Synthetic Organic Chemistry. Following two years in

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Dr. Robin A. Felder received his B.S. in Chemistry at the College of William and Mary in 1977. In 1983 he received his Ph.D. in Biochemistry at Georgetown University. In 1983-84 he completed a post-doctoral fellowship under John Kebabian and the National Institutes of Health in which he examined the hormonal regulation of the biosynthesis of proopiomelanocortin. In 1984 he was appointed to the medical faculty at The University of Virginia Health Sciences Center in Charlottesville, Virginia. Dr. Felder is currently Professor of Pathology, and Associate Director of Clinical Chemistry and Toxicology, and Director of the Medical Automation Research Center. He is Chairman of the International Conference, LabAutomation which is now 7th year and annually attracts over 700 registrants and 50 exhibitors of laboratory automation products. Dr. Felder has served as Chairman of the Oak Ridge Conference, he is on the editorial board of Clinical and Experimental Hypertension, Laboratory Robotics and Automation, Laboratory Information Management, and Advance News. Dr. Felder founded the Association for Laboratory Automation and currently is Vice President and editor of its newsletter, Laboratory Automation News (LAN). He has published over 74 basic and clinical research articles, 30 robotics research articles, and over 15 chapters and reviews and has received the awards such as the Fogarty International Fellowship, the Young Clinical Investigator Award from the Association for Clinical Scientists, and the Young Investigator Award from both the American Federation for Clinical Research and the American Physiological Society.

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Dr. William Godolphin has been a clinical chemist in the Department of Pathology & Lab Medicine at the University of British Columbia since 1974. His research, teaching and hospital service work has ranged from lipoproteins and breast cancer to toxicology and automation. He has been a pioneer user of robotics in the clinical laboratory and an inventor of novel methods for aliquotting and centrifuging blood specimens. His current interests especially involve the automation and enhancement of clinical lab information with an emphasis on bringing the patient into the loop.

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Dr. Gary W. Kramer received his Ph.D. from Purdue University in organic chemistry working with Professor H. C. Brown on the synthesis and reactions of allylic organoboranes. After serving as the head post-doc in the Brown organization, he joined Purdue's Chemistry Instrumentation Facility, where he designed analytical instruments and instrument interfaces and consulted on measurement problems. From 1984 until 1990, he was co-director of a project to automate the way organic synthesis development is carried out in the laboratory. In 1990, he joined the National Institute of Standards and Technology and was Project Manager of the Consortium on Automated Analytical Laboratory Systems (CAALS-a U.S. industry/Government joint venture to foster the

development of laboratory automation for analytical chemistry) from 1991 until 1996. In 1995, he was named Group Leader for the Chemical Sensing and Automation Technology Group in NIST's Analytical Chemistry Division.

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Dr. Sasaki's research interests center of automation system design and construction of Clinical Laboratory using conveyor belt, robotic facilities and computers and make a

Clinical Laboratory Diagnosis using the laboratory data which are measured by the fully automated laboratory system.

He also has an interest in the analysis of blood cell components and has developed his own analytical system using plastic capillaries and specific instruments.

Dr. Sasaki received his M.D. from Yamaguchi Medical School, in Japan. He also holds a Dr. of Med. Science Degree from Yamaguchi Medical School.

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Laboratory Automation News

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LAN Articles

Laboratory Automation News encourages readers to submit articles for publication. We are looking for clear and concisely written articles on current topics of interest in all areas of laboratory automation and robotics. You are invited to submit an article in your field of expertise (articles should be no longer than 1200-1500 words) or if you are involved with a project or product that would be of interest to others in the field, you may submit a shorter feature for consideration. The use of photographs, diagrams or other illustrations is encouraged.

Material should be submitted on floppy disk (PC format) with accompanying hard copy printout and original figures/photographs/illustrations. If these are also provided on disk, please try to submit them as CAD files. Our address for mail/express mail/courier:

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ftp.virginia.edu/public_access/lab97/. Please notify us via email if you ftp a file to our site.

Thank you for your interest in *Laboratory Automation News.*

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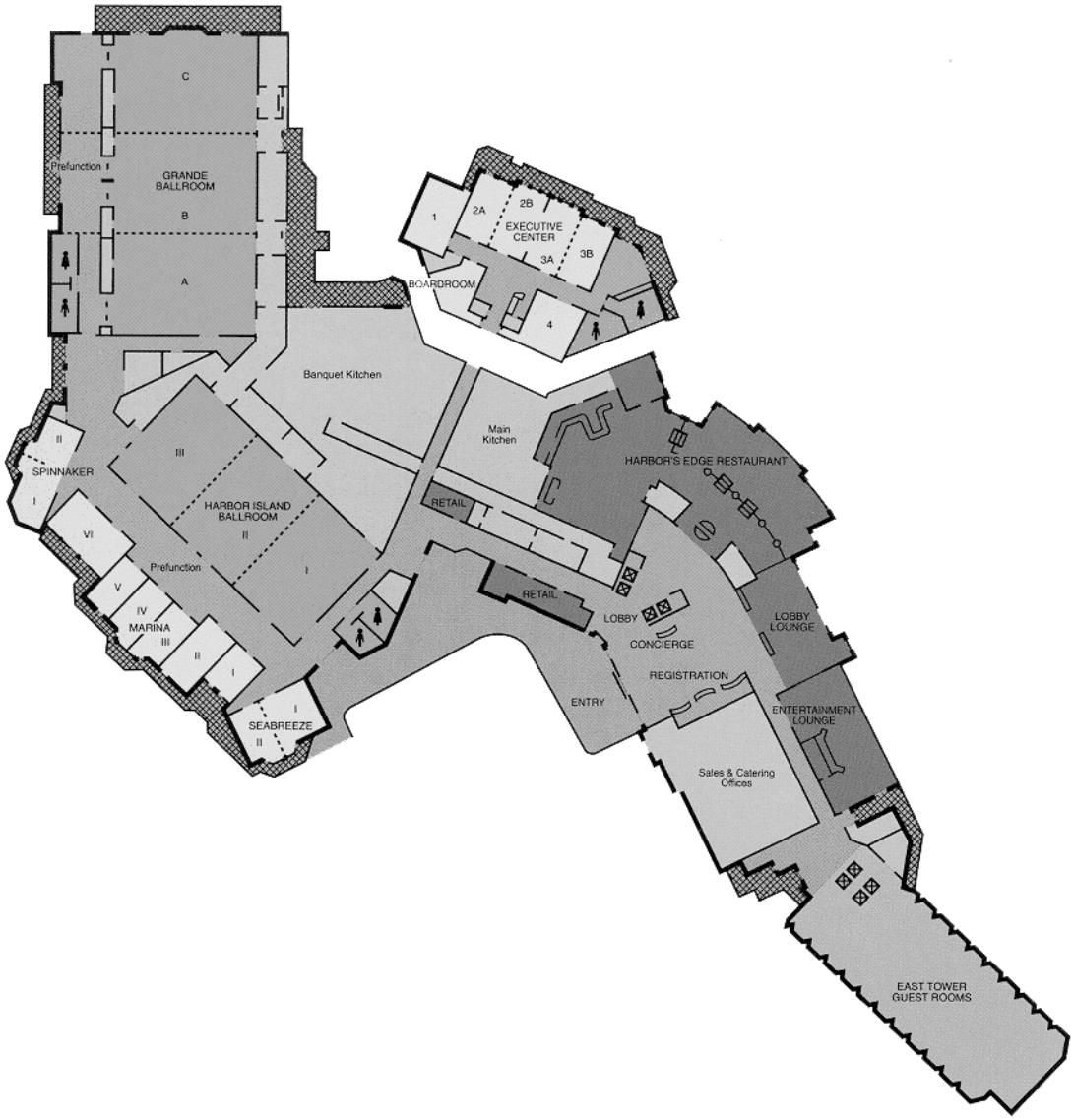
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