Division Highlights

Mission

Biomedical informatics is the rapidly developing scientific field that deals with resources, devices, and formalized methods for optimizing the acquisition, storage, retrieval, communication, and use of biomedical information for problem solving and decision making. The Mission of the Division of Biomedical Informatics is: (1) To provide the core knowledge, skills, and equipment that are necessary for the acquisition, storage and analysis of biomedical data using high performance computational systems; (2) To educate graduate and medical students, residents, and fellows in the theory and practice of biomedical and healthcare informatics; (3) To develop new knowledge and technologies in informatics that support clinical practice and biomedical research, thereby accelerating improvements in human health. Providing expertise in data management and complex computing to clinically relevant research programs is the most common role for informatics faculty at the present time. External support of faculty research is generally through collaboration with other investigators.

Core Services: For the past few years, focus has been upon building the extensive informatics infrastructure
necessary to implement our institution’s Five Year Strategic Plan. Demand for informatics support of both clinical and research programs has grown rapidly, as the world has become more “digital”. To provide state-of-art informatics resources to faculty, the Division is organized into 3 service groups, each headed by a member of the faculty.

Data Management and Software Development

The data management and software development group is headed by Keith Marsolo. He has implemented the i2b2 research patient data warehouse at CCHMC and is a member of the national i2b2 Users Group based at Partner’s Health Care and HarvardMedicalSchool. The CCHMC warehouse contains information on more than 500,000 patients and is essential to support of translational research at CCHMC. Dr. Eric Hall, who has a joint faculty appointment in Neonatology and Biomedical Informatics, has worked with Dr. Marsolo and our i2b2 staff to: (1) identify quality of care improvements associated with the post-surgical management of infants with gastroschisis; (2) examine the regional incidence of several foregut malformations; and (3) provide a confidential centralized repository of baseline and outcome data for all infants and their mothers born in the Greater Cincinnati area. Data will be collected with uniform definitions of prematurity and other morbidities and will be useful for: (1) monitoring time-related changes in neonatal care and outcomes; (2) identifying observational cohorts; and (3) benchmarking of neonatal outcomes. Dr. Marsolo worked with investigators in Adolescent Medicine to determine the incidence of Pelvic Inflammatory Disease in patients seen at CCHMC and in a separate study to examine socioeconomic factors that influenced whether the HPV vaccine was administered to adolescents.

Research IT Services

Research IT Services are directed by Michal Kouril. He manages the ResearchDataCenter (hardware such as servers, computers, data storage) and serves as the primary liaison between BMI and technical groups in CCHMC Information Services and the University of Cincinnati. He is presently working with CCHMC Information Services to upgrade and reorganize our networks and servers with the intent of improving connectivity to the University of Cincinnati, while maintaining security for sensitive data in our medical center. His group is also implementing a new identity management system for research so that a single password will provide an individual with access to the computational resources they are authorized to use. The new network and identity management systems are in response to the need for investigators at CCHMC and the University of Cincinnati to exchange data more readily, as required by the Clinical Translational Research Award (CTSA) the institutions recently received from the NIH.

Faculty Liaison

The key BMI liaison to faculty is Michael Wagner. He works with both BMI and IS to meet needs of individual faculty in all divisions of CCHMC in terms of IT support of their research. In an effort to streamline basic research data management at CCHMC, BMI staff have developed web-based portals for flow cytometry, genotyping and expression microarray data files with enhanced search, permissions management and (cluster-based) processing capabilities. As these tools are rolled out, investigators will have a single web-accessible portal for all their (typically large) primary data files. Furthermore, BMI is providing web-based equipment scheduling tools for various cores (including flow cytometry and confocal microscopy), which facilitate the process of scheduling instrument time greatly and help the cores with capacity planning.

Graduate Education

Currently, the PhD granting graduate program in bioinformatics is based in the UC Department of Biomedical Engineering. The Department is uniquely affiliated with both the UC College of Medicine and the College of Engineering. Dr. Jarek Meller leads the program in close collaboration with other faculty from Biomedical Informatics (Drs. Aronow, Jegga, Wagner and Liu), and Environmental Health (Drs. Rao and Medvedovic). Currently fifteen PhD candidates are enrolled and 2 new students are to be admitted in the Fall, 2009. Courses offered include Introduction to Functional Genomics, Introduction to Bioinformatics, and Advanced Computational Biology They cover basic material such as genomic databases, algorithms and methods in bioinformatics, molecular simulation techniques, as well as their specific applications. In addition, interdisciplinary workshops and multimedia educational materials are being developed for medical students and professionals, building on our cross-institutional efforts in the form of seminar series and journal club, summer workshops and other training initiatives. Thanks to the strength of the program, several Choose Ohio First scholarships have been secured this year for our current and prospective students.

Faculty Members

John Hutton, MD, Professor ; Director, Division Chief
Bruce Aronow, PhD, Professor ; Co-Director, Computational Medicine Center

Research Interests: Gene Expression Analysis, Gene Regulation, Clinical Genomics, Functional Genomics of Development and Disease
Anil Jegga, MS, DVM, Research Assistant Professor
Research Interests: Gene Regulatory Networks, Biomedical Ontologies, Integrative Genomics

Michal Kouril, PhD, Research Instructor; Director, Research IT
Research Interests: Computational Support, High-performance computing, Parallel Programming, High-end Data Storage

Long Jason Lu, PhD, Assistant Professor
Research Interests: Bioinformatics, Machine Learning, Integrative Genomics, Biological Networks, Computational Modeling, Software Development

Jun Ma, PhD, Associate Professor
Research Interests: Development, Transcription, Morphogen Gradient, Embryo, Robustness, Quantitative Studies

Keith Marsolo, PhD, Research Instructor; Director, Software Development and Data Warehouse
Research Interests: i2b2, Data Integration, Data Warehousing and Data Management

John Pestian, PhD, MBA, Associate Professor; Director, Computational Medicine Center
Research Interests: Natural Language Processing, Clinical Decision Support, Suicide Research, Pathology Research, Psychiatric Research

S. Andrew Spooner, MD, FAAP, Associate Professor Clinical; Chief Medical Information Officer
Research Interests: Decision Support, Pharmacy Information Systems

Michael Wagner, PhD, Research Associate Professor; Faculty Liaison
Research Interests: Machine Learning, Proteomics, Genome-wide Association, Parallel Computing, Computational Infrastructure, Bioinformatics

Joint Appointment Faculty Members

Karen Davis, PhD, Associate Professor
UC ECECS
Electrical & Computer Engineering and Computer Science

Eric Hall, PhD, Research Instructor
Neonatology & Pulmonary Biology
Clinical Informatics, Knowledge Discovery Tools, Data Mining and Warehousing

Mario Medvedovic, PhD, Associate Professor
UC Environmental Health
Biostatistics

Jarek Meller, PhD, Associate Professor
UC Environmental Health
Protein Modeling

Yan Xu, PhD, Associate Professor
Pulmonary Medicine

Trainees
- Jacek Biesiada, PhD, University of Silesia, Poland
- Junbo Liu, PhD, Fudan University, Shanghai, China
- Julia Taylor, PhD, University of Cincinnati, Cincinnati, OH

Significant Accomplishments

Studying human diseases using computational approaches
Bruce Aronow, Anil Jegga, and Jason Lu focus on studying human diseases using computational approaches. Jegga and Aronow have developed a unique one-stop suite of online software tools called “ToppGene Suite” and GATACA that enable biomedical researchers to explore, analyze, and hypothesize genetic pathways responsible for disease. Using these tools investigators can also prioritize causal genes for further genetic and biochemical studies. ToppGene Suite and other tools such as GATACA, also developed by this group, permit researchers to both focus their laboratory and clinical research on specific genes and molecular pathways more quickly and productively than would otherwise be possible—and further—to identify underlying regulatory mechanisms that could be exploited to develop new disease treatments or preventives. Lu has developed a novel computational algorithm that can systematically identify a compendium of essential genes in Pseudomonas aeruginosa, an opportunistic pathogen that causes chronic infection of the lungs of
more than 80% of cystic fibrosis patients. These genes are essential to the viability of the pathogen and are the most obvious targets for new drugs designed to kill the organism and to treat infection.

Clinical Linguistic Group

John Pestian has built a Clinical Linguistic Group within the Division of Biomedical Informatics and continues to focus on the analysis of neurological and psychiatric free-text. In collaboration with faculty from the Divisions of Psychiatry and Emergency Medicine, the Clinical Linguistic group is developing a suicide risk index. This index combines biomarkers and thought markers with the intent of measuring the likelihood of repeated suicide attempts. The group has compiled what is thought to be the world’s largest database of notes from those who have completed suicide. These notes have been loaded into the natural language processing framework and initial analyses have been completed. These will provide the preliminary data necessary to apply for NIH funding to support the research.

Studying development of the embryo using computational resources

Jun Ma continues to use computational tools to study development of the embryo, using Drosophila as a model. A remarkable feature of development is its reproducibility, the ability to correct embryo-to-embryo variations and instruct precise patterning. One unavoidable variation is the size of embryos. Ma's group performed quantitative studies to evaluate the properties of a Drosophila gradient protein called Bicoid, a maternally-deposited master control protein that instructs the development of anterior structures including the head. His analyses traced the origin of proportionate development of body parts in early embryos to scaling properties of the Bicoid gradient. These results demonstrate that developmental proportionality, an ability to correct embryo-to-embryo differences in size, can be understood at a molecular level.

Division Publications


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**Grants, Contracts, and Industry Agreements**

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<td><strong>CTSA - Enabling Technologies: Ctr for Translational &amp; Molecular Disease Modeling</strong>&lt;br&gt;National Institutes of Health (University of Cincinnati)&lt;br&gt;UL1 RR 026314&lt;br&gt;04/03/09 - 03/31/14</td>
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<td><strong>Murine Atlas of Genitourinary Smooth Muscle Development</strong>&lt;br&gt;National Institutes of Health&lt;br&gt;U01 DK 070219&lt;br&gt;04/01/09 - 03/31/10</td>
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<td><strong>Digestive Health Center: Bench to Bedside Research in Pediatric Digestive Disease</strong>&lt;br&gt;National Institutes of Health&lt;br&gt;P30 DK 078392&lt;br&gt;06/01/09 - 05/31/10</td>
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<td>HUTTON, J</td>
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<td>SPOONER, A</td>
<td>Step Tools: Developing Web Services for Safe Pediatric Dosing</td>
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<td>WAGNER, M.</td>
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**Current Year Direct** $ 857,549

**Total** $ 857,549