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Editorial

Medical Imaging Informatics

The 2002 Yearbook of Medical Informatics takes as its theme the topic of Medical Imaging Informatics. The visual nature of so much critical information in the practice, research, and education of medicine and health care would suggest that computer-based imaging and its related fields of graphics and visualization should be central to the practice of medical informatics. Yet, historically, this has not usually been the case. The need for technological sub-specialization on the part of imaging researchers and the frequently opposite tendency towards generality of information systems studied and developed by informatics researchers may have contributed to an increasing separation between the fields in the period from the 1970's to the 1990's.

A trend towards re-convergence, however, began in the early 1990's as important new image database, mapping, registration, and segmentation issues arose in the context of neuro-imaging with the Human Brain Project [1,2], and multimodal, whole body imaging with the Visible Human Project [3,4]. There was early recognition of the need for computer-based knowledge representations, not only of anatomy at the tissue level, but also at the multiple underlying biological levels (cellular, molecular, atomic) leading to the definition of structural informatics [5], and the development of a Foundational Model of Anatomy [6]. Meanwhile, knowledge representations for integrating multimodal image interpretations [7], methods for modeling elastically deformable anatomical objects [8], integrated segmentation and visualization systems [9], knowledge-based methods [10], and model-driven systems for surgery and education [11] have been gradually helping renew connections between imaging and mainstream informatics work. Encouraging further productive collaborations between researchers in imaging and informatics was one of our motivations in the choice of Medical Imaging Informatics as the theme for this Yearbook.

The Yearbook of Medical Informatics is distributed through IMIA's Member and Corresponding Member Societies worldwide. For the 2002 Yearbook we expect that over 7,000 copies will reach the memberships of 45 Member and 8 Corresponding member societies. The Yearbook's editors are grateful for the contributions of distinguished researchers in medical informatics who have prepared five

invited review papers, six research and education papers, and six synopses of papers included in the different disciplinary fields covered. In addition we owe a debt of gratitude to the 49 reviewers who assisted in the selection of papers from the recent refereed literature.

The present Yearbook includes papers selected from the literature for the period April 2000 to March 2001. The criteria for selection include topic significance, representativeness and coverage of research in a given subfield, subject to appropriately high levels of quality in presentation and results. A more detailed description of these quality criteria can be downloaded from http://www.Yearbook.uni-hd.de/quality_criteria.pdf. The referees score and rank the papers, and the final selection is made by the editors with the advice of editorial board members from each of the specialty areas. We expect to publish a description of the quality criteria used in selection in the medical informatics literature in the coming year to help provide more general insight on this process [12].

This year's preface to the Yearbook „From Digital Anatomy to Virtual Scapels and Image Guided Therapy" has been prepared by Nicholas Ayache, Research Director for the Epidaure Project, Medical Imaging and Robotics of INRIA (The French National Institute for Research in Computer Science and Control), Sophia Antipolis, France.

Imaging Informatics and Medical/Health Care Informatics: The Opportunities and Constraints of Interdisciplinarity

Medical informatics researchers have contributed to the development of medical imaging methods and systems since the inception of this field approximately 40 years ago. Starting in the mid-1970's rapid progress in computer-based imaging research and practice came from the increasingly specialized, highly mathematical, biophysical, and engineering models of different imaging modalities (CT, MRI, digital angiography, ultrasound, nuclear medicine imaging, etc.). Various specialties such as radiology, cardiology, and nuclear medicine distinguished themselves by concentrating their efforts on the technologies most effective for their own diagnostic and therapeutic goals. Hospital or enterprise-wide storage and retrieval of large numbers of patient image studies led to the development of PACS systems, but, technological, organizational, and economic constraints tended to divorce them from novel imaging research, and they frequently became just another part of the IT infrastructure for hospitals and clinics. Meanwhile, professional societies and conferences devoted exclusively to biomedical imaging and its subdisciplines proliferated. The number of researchers in the mainstream of medical informatics who remained professionally active in medical imaging began to shrink, and this trend continued until recently.

The combination of more advanced and user-friendly medical image data bases, coupled with improved 2D and 3D reconstruction, visualization and navigation algorithms, is making medical imaging results more accessible to physicians at the point of care. Starting in the early 1990's the Visible Human Project produced a widely available reference set of multimodal images of the whole body. Its wide dissemination has led to much anatomically-detailed education software, but more importantly, it has raised important informatics issues of knowledge representation, modeling, and information retrieval for dealing with large-scale repositories of such multimodal digital image sets. The Human Brain Project initiated at around the same time led to a very large number of projects in brain data mapping, registration and segmentation, all of which made clear the new informatics, biometrics, and computational imaging challenges inherent in integrating massive visual datasets of subject-specific data which needed to be abstracted and summarized into atlases and retrievable maps of the brain. Possibly as result, there has been a re-awakened interest of medical informatics researchers in imaging problems, and the development of what can be identified as a medical imaging informatics subspecialty [13]. This is centered around the problems of image data representation and abstraction, where ontologies for describing the underlying medical knowledge needed to interpret images are now being developed in computationally explicit form [14]. This will not only assist in standardization and interoperability, but will be crucial in making image data more usable for data mining, decision support, and visual modeling and simulation.

Fundamental issues in imaging that are well-known to medical informatics researchers include: standards for image information exchange, communication protocols, underlying computer data and knowledge representations, coding, nomenclature and vocabulary for including imaging information in the electronic medical record, relation to computerized guidelines for health care, information compression, efficient indexing of image databases, security and confidentiality of imaging records, etc.

There are also many informatics challenges that require deeper scientific, technical, and medical expertise as imaging information becomes more integrated and pervasive to the practice of medicine. These include:
· the development of better human-computer interaction models for

health care that rely not only on the increasing power of graphics and visualization but also on good psychophysical and cognitive science studies, given the multiresolution nature of many medical imaging studies, and how this affects perception and interpretation of data;

· developing better techniques for automatic segmentation and registration of medical images in 3D as well as 2D;

· data abstraction, summarization, and graphical (iconic) representation involved in atlas construction;

· representation of biological variability across repositories of bioimaging data to interpret imaging data across populations, and the linking of phenotype to genotype data;

· improving ways of integrating results from automatic image segmentation with expertly derived manual segmentations and annotations - and methods for evaluating the outcomes;

· developing annotation languages for extracting key patient findings found within the massive quantity and great level of detail inherent in medical imaging data;

· creating underlying computer-based representations of knowledge (ontologies, atlases, etc.) to help formalize such communication, while also preserving the flexibility needed for capturing novelty and enabling discovery;

· embedding advanced imaging systems in more general health care delivery software and evaluating their results within health care environments with effective feedback for learning how to modify and update the imaging methods in different clinical contexts.

As researchers in medical imaging informatics begin to address these and other topics, we hope that the 2002 IMIA Yearbook's theme will stimulate greater interaction among imaging and informatics researchers in the development of working systems for the practice of health care, and the improvement of education.

Review Sections

As is customary, the 2002 Yearbook includes a number of original review articles, which focus primarily on this year's theme. An article by Michael Ackerman on "Visible Human Project: From Data to Knowledge" updates the status of this seminal project for the field. "Imaging Informatics and the Human Brain Project: The Role of Structure" by Jim Brinkley and Cornelius Rosse, provides a comprehensive review of how imaging informatics approaches were essential for the Human Brain Project and the development of structural informatics, and have led to the development of a computer-based foundational model of anatomical structure. Wieslaw Nowinski gives a systematic review of the application of different modeling methods for enhancing neuroimaging results. Two papers address other important topics to medical informatics: Bonnie Kaplan and Nicola T Shaw use evaluation processes to review how people, organizations, and social issues impact medical informatics concerns; and Gunnar Klein reviews advances in standards-setting activities in the field.

Education and Research in Medical Informatics

The Yearbook provides an opportunity for highlighting an international selection of current education, training, and research programs in Medical Informatics. This year Russ B. Altman describes the program in Biomedical Computation at Stanford University which increasingly introduces biomolecular as well as clinical applications of informatics. Marius Fieschi,

D. Fieschi, J. Gouvernet, M. Joubert, and G. Soula provide an overview of Research and Development in Health Informatics at the Faculty of Medicine of Marseille, while György Kozman of Veszprem University describes how education in medical informatics is based on an information technology curriculum at his university. Yu-Chuan Li presents the Evolving Biomedical Informatics Program at Taipei Medical University, and Wendy McPhee writes about Education Downunder from the Centre of Medical Informatics at Monash University. Finally Edward H. Shortliffe describes the changes in the program in Bio-Medical Informatics at Columbia University, where he has recently assumed the chairmanship.

Challenges in Medical Informatics

In this section, three papers can be found dealing with the future of Medical Informatics. Incoming IMIA President KC Lun (Singapore) describes important future tasks of IMIA. Mark Musen (Stanford) reports on the outcomes of an IMIA satellite conference on this topic. Finally, the result of a panel discussion on the future impact of information and communication technology on health care, addressed by clinicians, researchers and industrial representatives, is presented.

Guest Editors

After the selection of papers to be included in the Yearbook had been accomplished, guest editors were asked to write Synopses reviewing the papers in the different sections. The section on Health and Clinical Management was edited by Steven Chu of the University of Auckland; that on Patient Records by Michio Kimura of Hamamatsu University, that on Health Information Systems by Sedick Isaacs

of South Africa, the section on Signal Processing by Pablo Laguna of Zaragoza University, and that on Knowledge Processing and Decision Support by Greg Cooper of the University of Pittsburgh. Computer-supported education had as guest editor Jens Dørup of Aarhus University, and the section on Bioinformatics was edited by Ralf Hofestädt of the University of Bielefeld.

IMIA

The Yearbook contains detailed information about IMIA, its Member Societies, Working Groups, and Special Interest Groups. Preparation of the general pages describing IMIA activities received considerable assistance from Steve Huesing, the Executive Director. The section on IMIA Working Groups and Special Interest Groups was greatly aided by contributions from Nancy Lorenzi.

For the first time in this Yearbook, a more detailed report on the activities of IMIA regions is included with the help of Regional Editors. We would like to thank Arie Hasman (for EFMI), Sedick Isaacs (for Helina), Jochen Moehr and Charles Safran (for the North American IMIA Member Societies), and Chun Por Wong (for APAMI) for their support.

The IMIA representatives from the individual countries provided the material for their own national societies.

The 2003 IMIA Yearbook

The theme of the 2003 Yearbook will be on the Informatics Foundations of the Quality of Healthcare. With the increasing automation of health care systems, the more widespread introduction of electronic patient records, and the application of evidence-based medicine guidelines for care, as well as the world-wide concerns for controlling costs in health care systems, there has been growing research on the impact of informatics systems on the quality of health care, and its implications for patients and health care practitioners.

The 2003 Yearbook will continue its coverage of all topics in medical informatics, including the one newly added this year, that of bioinformatics, which, due to its long-term implications for the development of molecular medicine and its methodological connections to medical informatics, will now become a permanent section of the Yearbook.

Advisory Board

The Editors wish to thank the members of the Advisory Board for their invaluable contributions to the planning of this Yearbook. They are: Marion Ball, Vice-President of Health-link, Inc. of Baltimore, MD, Jan H. van Bemmel, Rector of Erasmus University Rotterdam, The Netherlands, and Alexa McCray, Director of the Lister Hill Center of the National Library of Medicine, NIH, USA (Figure 1). Their experience has been essential in helping chart a course of excellence and world-wide coverage for the Yearbook during this period of rapid change in medical informatics.

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Fig.1. IMIA Yearbook Advisory Board Members (Alexa T. McCray, Jan H. van Bemmel, Marion J. Ball)

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