

Editor-in-Chief

*A. Joe Turner, Seneca, SC, USA*

Editorial Board

Foundations of Computer Science

*Mike Hinchey, Lero, Limerick, Ireland*

Software: Theory and Practice

*Bertrand Meyer, ETH Zurich, Switzerland*

Education

*Bernard Cornu, CNED-EIFAD, Poitiers, France*

Information Technology Applications

*Ronald Waxman, EDA Standards Consulting, Beachwood, OH, USA*

Communication Systems

*Guy Leduc, Université de Liège, Belgium*

System Modeling and Optimization

*Jacques Henry, Université de Bordeaux, France*

Information Systems

*Barbara Pernici, Politecnico di Milano, Italy*

Relationship between Computers and Society

*Chrisanthi Avgerou, London School of Economics, UK*

Computer Systems Technology

*Paolo Prinetto, Politecnico di Torino, Italy*

Security and Privacy Protection in Information Processing Systems

*Kai Rannenber, Goethe University Frankfurt, Germany*

Artificial Intelligence

*Max A. Bramer, University of Portsmouth, UK*

Human-Computer Interaction

*Annelise Mark Pejtersen, Center of Cognitive Systems Engineering, Denmark*

Entertainment Computing

*Ryohei Nakatsu, National University of Singapore*

## **IFIP – The International Federation for Information Processing**

IFIP was founded in 1960 under the auspices of UNESCO, following the First World Computer Congress held in Paris the previous year. An umbrella organization for societies working in information processing, IFIP's aim is two-fold: to support information processing within its member countries and to encourage technology transfer to developing nations. As its mission statement clearly states,

*IFIP's mission is to be the leading, truly international, apolitical organization which encourages and assists in the development, exploitation and application of information technology for the benefit of all people.*

IFIP is a non-profitmaking organization, run almost solely by 2500 volunteers. It operates through a number of technical committees, which organize events and publications. IFIP's events range from an international congress to local seminars, but the most important are:

- The IFIP World Computer Congress, held every second year;
- Open conferences;
- Working conferences.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is small and by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is less rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

Any national society whose primary activity is in information may apply to become a full member of IFIP, although full membership is restricted to one society per country. Full members are entitled to vote at the annual General Assembly, National societies preferring a less committed involvement may apply for associate or corresponding membership. Associate members enjoy the same benefits as full members, but without voting rights. Corresponding members are not represented in IFIP bodies. Affiliated membership is open to non-national societies, and individual and honorary membership schemes are also offered.

Hiroshi Takeda (Ed.)

# E-Health

First IMIA/IFIP Joint Symposium, E-Health 2010  
Held as Part of WCC 2010  
Brisbane, Australia, September 20-23, 2010  
Proceedings



Springer

Volume Editor

Hiroshi Takeda

Osaka University

2-15 Yamada-Oka, Suita City, Osaka 565-0871, Japan

E-mail: [takeda@hp-info.med.osaka-u.ac.jp](mailto:takeda@hp-info.med.osaka-u.ac.jp)

Library of Congress Control Number: 2010933126

CR Subject Classification (1998): H.4, J.3, H.5.2, H.3, H.2.8, H.5

ISSN 1868-4238

ISBN-10 3-642-15514-6 Springer Berlin Heidelberg New York

ISBN-13 978-3-642-15514-7 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

[springer.com](http://springer.com)

© IFIP International Federation for Information Processing 2010

Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper 06/3180

# **IFIP World Computer Congress 2010 (WCC 2010)**

## **Message from the Chairs**

Every two years, the International Federation for Information Processing (IFIP) hosts a major event which showcases the scientific endeavors of its over one hundred technical committees and working groups. On the occasion of IFIP's 50th anniversary, 2010 saw the 21st IFIP World Computer Congress (WCC 2010) take place in Australia for the third time, at the Brisbane Convention and Exhibition Centre, Brisbane, Queensland, September 20–23, 2010.

The congress was hosted by the Australian Computer Society, ACS. It was run as a federation of co-located conferences offered by the different IFIP technical committees, working groups and special interest groups, under the coordination of the International Program Committee.

The event was larger than ever before, consisting of 17 parallel conferences, focusing on topics ranging from artificial intelligence to entertainment computing, human choice and computers, security, networks of the future and theoretical computer science. The conference History of Computing was a valuable contribution to IFIP's 50th anniversary, as it specifically addressed IT developments during those years. The conference e-Health was organized jointly with the International Medical Informatics Association (IMIA), which evolved from IFIP Technical Committee TC-4 "Medical Informatics".

Some of these were established conferences that run at regular intervals, e.g., annually, and some represented new, groundbreaking areas of computing. Each conference had a call for papers, an International Program Committee of experts and a thorough peer reviewing process of full papers. The congress received 642 papers for the 17 conferences, and selected 319 from those, representing an acceptance rate of 49.69% (averaged over all conferences). To support interoperation between events, conferences were grouped into 8 areas: Deliver IT, Govern IT, Learn IT, Play IT, Sustain IT, Treat IT, Trust IT, and Value IT.

This volume is one of 13 volumes associated with the 17 scientific conferences. Each volume covers a specific topic and separately or together they form a valuable record of the state of computing research in the world in 2010. Each volume was prepared for publication in the Springer IFIP Advances in Information and Communication Technology series by the conference's volume editors. The overall Publications Chair for all volumes published for this congress is Mike Hinchey.

For full details of the World Computer Congress, please refer to the webpage at <http://www.ifip.org>.

June 2010                      Augusto Casaca, Portugal, Chair, International Program Committee  
Phillip Nyssen, Australia, Co-chair, International Program Committee  
Nick Tate, Australia, Chair, Organizing Committee  
Mike Hinchey, Ireland, Publications Chair  
Klaus Brunnstein, Germany, General Congress Chair

# Preface

For the first time in history, the International Federation for Information Processing (IFIP) and the International Medical Informatics Association (IMIA) held the joint “E-Health” Symposium as part of “Treat IT” stream of the IFIP World Congress 2010 at Brisbane, Australia during September 22–23, 2010.

IMIA is an independent organization established under Swiss law in 1989. The organization originated in 1967 from Technical Committee 4 of IFIP that is a non-governmental, non-profit umbrella organization for national societies working in the field of information processing. It was established in 1960 under the auspices of UNESCO following the First World Computer Congress held in Paris in 1959. Today, IFIP has several types of members and maintains friendly connections to specialized agencies of the UN system and non-governmental organizations. Technical work, which is the heart of IFIP's activity, is managed by a series of Technical Committees.

Due to strong needs for promoting informatics in healthcare and the rapid progress of information and communication technology, IMIA President Reinhold Haux proposed to strengthen the collaboration with IFIP. The IMIA General Assembly (GA) approved the move and an IMIA Vice President (VP) for special services (Hiroshi Takeda) was assigned as a liaison to IFIP at Brisbane during MEDINFO2007 where the 40<sup>th</sup> birthday of IMIA was celebrated.

For the first liaison action, the IMIA VP attended the IFIP GA at Addis Ababa in 2007 and discussed future collaborations. In the 2008 IFIP GA in Milan, the IFIP-IMIA joint symposium as a part of WCC2010 was approved and I was nominated as an organizer of the symposium.

The call for paper of the symposium was announced in the beginning of 2009 and the conference topics were described as follows:

Healthcare Computing and Communications (e-Health), as a new interdisciplinary field, address how to enable ICT to help people perform and receive more efficient, effective and safe healthcare services. To foster scientific discussion and disseminate new knowledge on e-Health, we invite you to submit papers and posters describing original research, applications, or practical use cases in any of the areas listed below.

Access control, bioinformatics, biosignal applications, clinical decision support, clinical informatics, consumer health informatics, data and systems integrity, database management, data protection, data mining, data warehouse, e-Health grids, e-Learning, electronic health records (EHR), electronic patient records (EPR), healthcare information models, hospital information systems, human computer interfaces, the Internet and Web, knowledge representation, medical imaging, mobile computing, mobile networks, multimedia databases, nursing informatics, privacy-enhancing technology, patient safety management, security in healthcare, smart cards, healthcare standards, telecommunication, ubiquitous networks.

Peter Croll, Southern Cross University, Australia (HISA), and Hiroshi Takeda, Osaka University, Japan (IMIA), served as Co-chairs of the Scientific Program Committee (SPC) of this symposium. In total, 44 papers were submitted by February 15, 2010 and the Co-chairs of the SPC made their selection with an average of 2.3 reviews per paper. As a result, 22 papers for oral presentation (one paper withdrawn) and 10 papers as posters (two papers withdrawn) were accepted. The remaining 12 papers were rejected.

I hope this symposium will continue to be held at every WCC conference of the IFIP and will form a bridge between basic and applied science of information processing in healthcare.

Finally, I express sincere thanks to Reinhold Haux, Augusto Casaca and Klaus Brunnstein for their overall guidance and encouragement, to Peter Croll and reviewers for deciding the program, to Arie Hasman for the attending IPC meeting, to Jan Shaw, Jon Mason, Michelle Hills and Nick Tate for the administrative assistance, to Mike Hinchey for publication matters, to Qiyang Zhang of Osaka University Hospital for the continuous assistance from the beginning, and to all those who were involved with the program, publication and operations.

July 2010

Hiroshi Takeda

# Organization

## Program Committee Chairs

Hiroshi Takeda  
Chris Avram

Osaka University, Japan (IMIA)  
Monash University, Australia (IFIP)

## Program Committee Members

M.M. Altuwaijri, Saudi Arabia  
D.W. Bates, USA  
A. Geissbuhler, Switzerland  
R. Haux, Germany  
C. Kulikowski, USA  
J. Li, China  
N. Lorenzi, USA  
A. Margolis, Uruguay  
G. Mihalas, Romania  
K. Minato, Japan  
R. Moghaddam, Iran  
L.A. Moura, Brazil  
P. Murray, UK  
H.A. Park, South Korea  
G. Wright, UK  
T. Yamazaki, Japan

## Reviewers

Hiroshi Takeda  
Peter R. Croll  
Enrico Coiera  
Micheal Legg

Osaka University, Japan  
Southern Cross University, Australia  
University of New South Wales, Australia  
Health Informatics Society of Australia (HISA),  
Australia

Lakshmi Narasimhan  
Vitali Sintchenko  
A.R. Bakker  
David Hansen

East Carolina University, USA  
University of New South Wales, Australia  
The Netherlands  
The Australian e-Health Research Centre,  
Australia

Anthony Meader  
Neil Burdett  
Penny Sanderson

University of Western Sydney, Australia  
CSIRO ICT Centre, Australia  
The University of Queensland, Australia



Joan Edgecumbe  
Andrew Georgiou  
Susan Smith  
Fuminobu Ishikura  
Ondrej Krejcar

Health Informatics Society of Australia (HISA)  
The University of Sydney, Australia  
Queensland, Australia  
Osaka University, Japan  
Technical University of Ostrava,  
Czech Republic

# Table of Contents

Updated Topics in Healthcare Informatics . . . . .	1
<i>Hiroshi Takeda</i>	
The HL7 RIM in the Design and Implementation of an Information System for Clinical Investigations on Medical Devices . . . . .	5
<i>Daniela Luzi, Mariangela Contenti, and Fabrizio Pecoraro</i>	
Two Human-Centered Approaches to Health Informatics: Cognitive Systems Engineering and Usability . . . . .	15
<i>Tania Xiao, Wendy Broxham, Cara Stitzlein, Jasmine Croll, and Penelope Sanderson</i>	
A Step towards Medical Ethics Modeling . . . . .	27
<i>Miguel Miranda, José Machado, António Abelha, Gabriel Pontes, and José Neves</i>	
Overview of the Health Informatics Research Field: A Bibliometric Approach . . . . .	37
<i>Hai-Ning Liang</i>	
Testing for Usability Is Not Enough: Why Clinician Acceptance of Health Information Systems Is also Crucial for Successful Implementation . . . . .	49
<i>Jasmine Croll</i>	
Towards Characteristics of Lifelong Health Records . . . . .	61
<i>Eldridge van der Westhuizen and Dalenca Pottas</i>	
Physicians' Concept of Time Usage – A Key Concern in EPR Deployment . . . . .	71
<i>Rebecka Janols, Bengt Göransson, Erik Borälv, and Bengt Sandblad</i>	
Oshidori-Net: Connecting Regional EPR Systems to Achieve Secure Mutual Reference with Thin-Client Computing Technology . . . . .	82
<i>Shigeki Kuwata, Koji Toda, Kei Teramoto, Hiroshi Kondoh, Hiroshige Nakamura, Hirohiko Murata, Noriaki Tamura, and Masahide Ikeguchi</i>	
Information Security Sharing of Networked Medical Organizations: Case Study of Remote Diagnostic Imaging . . . . .	90
<i>Masayo Fujimoto, Koji Takeda, Tae Honma, Toshiaki Kawazoe, Noriko Aida, Hiroaki Hagiwara, and Hideharu Sugimoto</i>	

A Secure Framework and Related Protocols for Ubiquitous Access to Electronic Health Records Using Java SIM Cards .....	102
<i>Reza Hassanzadeh, Tony Sahama, and Colin Fidge</i>	
Capturing and Analyzing Injection Processes with Point of Act System for Improving Quality and Productivity of Health Service Administration .....	114
<i>Atsushi Koshio and Masanori Akiyama</i>	
Analysis on Data Captured by the Barcode Medication Administration System with PDA for Reducing Medical Error at Point of Care in Japanese Red Cross Kochi Hospital .....	122
<i>Masanori Akiyama, Atsushi Koshio, and Nobuyuki Kaihotsu</i>	
Blended Clustering for Health Data Mining .....	130
<i>Arshad Muhammad Mehar, Anthony Maeder, Kenan Matawie, and Athula Ginige</i>	
Flexible Genome Retrieval for Supporting In-Silico Studies of Endobacteria-AMFs .....	138
<i>S. Montani, G. Leonardi, S. Ghignone, and L. Lanfranco</i>	
Medicare-Grid: New Trends on the Development of E-Health System Based on Grid Technology .....	148
<i>Yeh-Ching Chung, Po-Chi Shih, Kuan-Ching Li, Chao-Tung Yang, Ching-Hsien Hsu, Fang-Rong Hsu, Don-Lin Yang, Chia-Hsien Wen, and Chuang-Chien Chiu</i>	
A “Ubiquitous Environment” through Wireless Voice/Data Communication and a Fully Computerized Hospital Information System in a University Hospital .....	160
<i>Eisuke Hanada, Shusaku Tsumoto, and Shotai Kobayashi</i>	
Towards a Diagnostic Toolbox for Medical Communication .....	169
<i>William Billingsley, Cindy Gallois, Andrew Smith, Timothy Marks, Fernando Bernal, and Marcus Watson</i>	
MILXView: A Medical Imaging, Analysis and Visualization Platform ...	177
<i>Neil Burdett, Jurgen Fripp, Pierrick Bourgeat, and Olivier Salvado</i>	
Advanced Telemedicine System Using 3G Cellular Networks and Agent Technology .....	187
<i>Golam Sorwar and Ameer Ali</i>	
User Adaptivity of Biotelemetric System for ECG Measurement and Visualization .....	198
<i>Dalibor Janckulik, Leona Motalova, and Ondrej Krejcar</i>	

Help Me to Understand Your World: A Reflection on the Potential Impact of E-Health Systems on the Prognosis for Asperger Syndrome . . .	210
<i>Rudi G. Harmse and Dalenca Pottas</i>	

## Poster Presentations

How the Usability of a Pen-Tablet System Varies with Response Time Retardation . . . . .	222
<i>Kei Teramoto, Shigeki Kuwata, and Hiroshi Kondoh</i>	
Stress Testing of Web Services Interface . . . . .	224
<i>Leona Motalova, Dalibor Janckulik, and Ondrej Krejcar</i>	
Learning from Pathology Databases to Improve the Laboratory Diagnosis of Infectious Diseases . . . . .	226
<i>Alice Richardson, Fariba Shadabi, and Brett A. Lidbury</i>	
System Design for Automated Time Study of Nursing . . . . .	228
<i>Shohei Nakamura, Ichiroh Kanaya, Yuko Ohno, and Kazuo Kawasaki</i>	
The Impact of Electronic Medical Records on the Work Process of Outpatient Care: Extracting Use-Cases of Paper-Based Medical Records Using a Time Process Study . . . . .	230
<i>Sachiko Shimizu, Yuko Ohno, Hiroko Noda, Shohei Nakamura, Ichiro Kanaya, Kenji Yamada, Atsue Ishii, Satoko Kasahara, Katsumi Hirakawa, Rie Nakagawa, and Yasushi Matsumura</i>	
The Working Process and Time Efficiency of Patient Transportation in Cardiovascular Hospital Using Time Process Modeling . . . . .	232
<i>Hiroko Ojima, Yuko Ohno, Sachiko Shimizu, Shintaroh Oi, Yasuko Inoue, Atsue Ishii, Satoko Kasahara, Katsumi Hirakawa, Shohei Nakamura, Ichiro Kanaya, Kazuo Kawasaki, Atsuko Tanaka, Fujie Motosugi, and Chizuru Okada</i>	
Analysis of Human and System Factors on Errors in ICD Coding with Electronic Discharge Summary System . . . . .	234
<i>Hitomi Yamada, Shigeki Kuwata, Keunsik Park, and Kenji Ohata</i>	
Semantic Interoperability and Health Records . . . . .	236
<i>Hugo Peixoto, José Machado, José Neves, and António Abelha</i>	
<b>Author Index . . . . .</b>	<b>239</b>