



Dear Reader,

a lot has happened since our last issue of VIMation Journal.

After five years, the funding period of I\*PROMS Network of Excellence has already ended in September 2009. This network, from

which VIMation emerged, has always been a good platform for collaboration. So we look forward to new possibilities for collaboration in Europe and also “intercontinentally”.

These days, you can directly see how strongly connected and interdependent the countries of Europe are. While people often complain about this fact, as true European researchers we should not too much focus on the downsides of this integration but also see the many positive aspects.

My work in VIMation, I\*PROMS and many European projects has always given me the opportunity to meet and work with very nice and interesting people – such as our editors, our Editorial Board and our guest editor for this Special Issue, Roberto Teti, whom I would like thank for his commitment to making this issue become reality.

Why this issue is about Interactive Systems in Healthcare? Today, an aging population in Europe and diseases spreading faster than ever have become big topics in the media. But we also have new opportunities for helping and curing people that formerly would have died or would have experienced severe restrictions in their daily lives. This is putting healthcare in focus – also in research and development, and especially in our field of Human Machine Interaction.

I wish you a pleasant reading of this Special Issue on Interactive Systems in Healthcare.

Dr. Thomas Schlegel

Editor in Chief, VIMation Journal

## About this Issue

This issue comprises articles about our general topic of Human Machine Interaction and Models in Production as well as papers contributing to this special issue’s topic of Interactive Systems in Healthcare. Some of these articles are based on the findings of IWARD, a European research project in the 6th Research Framework Programme of the European Union. While IWARD project focused on robot teams supporting personnel and helping patients in hospitals and other care facilities, this issue also contains contributions in the general context of Interactive Systems for Healthcare.

## Imprint

VIMation Journal is the journal of VIMation, the European Virtual Institute for Human Machine Interaction and Models in Production. The journal reports on scientific results, innovations and applications in the field of Human Machine Interaction, Information Technology and Production as well as actions of the partners. It aims to reflect the contribution made by VIMation to the I\*PROMS Network of Excellence and the European Research Area as a whole. It provides a forum for the exchange of information between the members of the institute and also the wider scientific community.

## Copyright

Copyright © 2010 by the University of Stuttgart, Institute for Visualization and Interactive Systems (VIS) and Fraunhofer IAO, Stuttgart. All rights reserved. Abstracting is permitted with credit to the source. For copying, reprint, or republication permission, write to editor@journal.vimation.eu. All authors, as identified in each article, retain copyright of their work.

## Editorial

Unless otherwise stated, bylined articles, as well as product and service descriptions, reflect the author’s or company’s opinion. Inclusion in VIMation Journal does not necessarily constitute endorsement by the University of Stuttgart, Institute for Visualization and Interactive Systems (VIS) or Fraunhofer IAO, Stuttgart. All submissions are subject to editing for style, clarity, and space.

## Circulation

VIMation Journal (ISSN 1866-4245) is published biannually by the University of Stuttgart, Institute for Visualization and Interactive Systems (VIS), Germany and Fraunhofer IAO, Stuttgart. This issue is published electronically on vimation.eu. First issue of VIMation Journal: 1 / 2008.

## Funding

The VIMation European Virtual Institute is part of the I\*PROMS Network of Excellence, which has been funded by the European Commission under FP6.

## Submission of Articles

Please find the information about the Submission of Articles for the VIMation Journal on page 91.

## Editor in Chief

Dr. Thomas Schlegel

Institut für Visualisierung und Interaktive Systeme (VIS)

Universitätsstrasse 38

70569 Stuttgart

Germany

Phone: +49 711 7816 209

E-Mail: editor@journal.vimation.eu

WWW: <http://www.vimation.eu>

## Associate Editors

- Prof. Vinesh H. Raja  
University of Warwick | UK
- Prof. Bernard Grabot  
ENIT (l’Ecole Nationale d’Ingénieurs de Tarbes) | France
- Dr. Timo Määttä  
VTT Technical Research Centre of Finland  
Finland

## Editorial Board

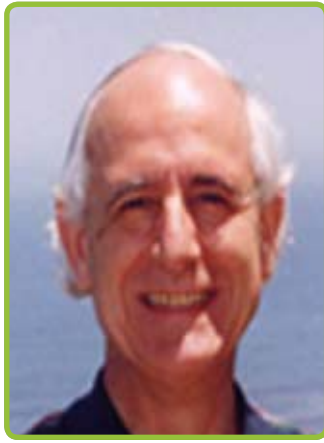
- Maria Papandrafilli | BeOne Stuttgart GmbH  
Germany
- Dr. Timo Määttä | VTT Technical Research  
Centre of Finland | Finland
- Prof. Vinesh Raja | University of Warwick | UK
- Prof. Bernard Grabot | ENIT (l’Ecole Nationale  
d’Ingénieurs de Tarbes) | France
- Jon Agirre Ibarbia | Fundación Fatronik  
Basque Country, Spain
- Dr. Jasmin Franz | Attensity Europe GmbH  
Germany
- Prof. Duc Pham | Cardiff University | UK
- Prof. Nikos A. Aspragathos | University of  
Patras | Greece
- Prof. Goran Putnik | University of Minho  
Portugal
- Dr. Geza Haidegger | Hungarian Academy of  
Sciences | Hungary
- Wolfgang Rolshofen | Technical University of  
Clausthal | Germany
- Prof. Ercan Öztemel | University of Istanbul  
Turkey
- Dr. Thomas Schlegel | University of Stuttgart  
Germany
- George Birbilis | University of Patras | Greece
- Saurin Badiyani | University of Warwick | UK

## Art & Layout

Silke Lotterbach, 5gestalten GmbH, Germany,  
<http://www.5gestalten.de>

## Table of Contents

2	Preface, Imprint, About this Issue
4	Editorial
5	About ViMation
6	T. Szecsi   K.A. Mamun   M.K. Hasan   A. Islam   C. Griffin   A.S.M. Hoque Hospital Robot Module Development in the iWARD Project
13	Simon Thiel   Thomas Schlegel   Dagmar Häbe Cooperative Robot Teams Performing in a Hospital
21	Roberto Teti   Alessandra Caggiano   Vinesh Raja   Saurin Badiyani   Hardik Raja Human Robot Interface Design for Hospital Robot Swarm
33	Massimo Martorelli Virtual Prototyping in the Development Process of Customised Hearing Aid Shells
39	Mattia Oliosi   Francesco Aggogeri   Marco Mazzola An Integrated Approach to Enhance Quality and Reliability of Healthcare Processes
48	M.S. Packianather   D.T. Pham   E.Y.A. Charles   R. Martina   R.Teti   D. D'Addona   G. Iodice Spiking neural network with delay-adaption learning model for decision support in treating dental malocclusions
58	Uwe Laufs   Christopher Ruff   Anette Weisbecker MT4j – An open source platform for multi-touch software development
65	Doriana D'Addona   Roberto Teti Tool Delivery Prediction through Adaptive Neuro-Fuzzy Inferencing
73	Nataliya Popova   Martin Feike   Armando Walter Colombo Modular Control Software for Ambient Intelligence in Production Systems
79	Doriana D'Addona   Roberto Teti Intelligent Material Modelling for Mild Steel Hot Working
84	Jiří Hodík Simulation of Virtual Organization Performance
91	Dates & Conferences
92	Submission of Articles for the ViMation Journal
93	Journal Editors



Dear Reader,

The VIMation Journal Special Issue on Interactive Systems in Healthcare comprises the expanded paper versions, including progress and developments of the related research work, of selected contributions presented at the 6th CIRP International Conference on Intelligent Computation in Manufacturing Engineering (CIRP ICME '08), 23-25 July 2008, Naples, Italy.

The CIRP ICME International Conferences are a series of biannual scientific events, founded and chaired since 1998 by Prof. Roberto Teti, Dept. of Materials and Production Engineering, University of Naples Federico II, Italy, under the sponsorship of the International Academy for Production Engineering (CIRP). The main scope of the Conference series is to provide an international forum for the exchange of knowledge, information, experiences and results, as well as the outline, review of progress and discussion on the state-of-the-art and future trends for research in intelligent computing methods and artificial cognitive paradigms applied to the various sectors of manufacturing technology and systems. CIRP ICME '08 technical programme information and details can be obtained from the CIRP ICME web site: [www.icme.unina.it](http://www.icme.unina.it). The Conference Proceedings (ISBN 978-88-900948-7-3) were published in a hardcover book and in a CD, available by contact-

ing the CIRP ICME Proceedings Editor, Prof. R. Teti, via email ([roberto.teti@unina.it](mailto:roberto.teti@unina.it)).

Through the active collaboration of the International Programme Committee, a high number of contributions were submitted to the CIRP ICME '08, 107 of which were accepted and grouped into 27 Sessions of Research Presentations by authors from 25 countries and 5 continents. The topics dealt with range from innovative production systems issues to advanced manufacturing technology aspects as well as emergent subjects such as human factors, service robots and health care systems.

From the CIRP ICME '08 presentations at the Special Sessions dedicated to Health Care and EC FP6 iWARD Project, six contributions were selected whose subject matters are all related with applications of innovative engineering tools and schemes to the emergent sector of interactive systems for health care: advanced robotics technology, cognitive paradigms for decision making, system quality enhancement methods, and digital manufacturing concepts.

A first group of papers is concerned with the introduction of service robots into the hospital environment: employment of robot swarms to support a whole range of diverse hospital service functionalities; development of suitable human robot interfaces to enable efficient and effortless robot-user communication; implementation of plug-and-play hospital robot service modules for cleaning, delivery, patient guidance, patient condition monitoring, and surveillance.

A second group of papers refers to critical aspects of health care systems analysed through novel engineering problem solving strategies already successfully applied to aerospace and other high-risk industrial fields: root cause analysis, process mapping and failure mode investigation for risk assessment and continuous system

quality improvement; supervised delay-adaptation spiking neural networks to support decision making in treating dental malocclusions; product customisation through virtual prototyping in the design and manufacturing of hearing aid shells.

It will be interesting to verify the progress made in the development and implementation of cognitive and interactive systems for health care at the 7th CIRP Int. Conf. on Intelligent Computation in Manufacturing Engineering (CIRP ICME '10) to be held on 23-25 June 2010, Capri, Italy. Additional details can be obtained by email ([info@www.icme.unina.it](mailto:info@www.icme.unina.it)) or from the CIRP ICME web site [www.icme.unina.it](http://www.icme.unina.it).

Prof. Roberto Teti

CIRP ICME International Conference Series Chairman and Founder

Department of Materials and Production Engineering

University of Naples Federico II, Italy

Guest Editor

### At a glance

The growing importance of integrated research networks and intelligent, adaptive production machines and systems prompted us to establish ViMation, the “European Virtual Institute for Human Machine Interaction and Models in Production”. The institute consists of universities, research institutes and companies from all over Europe. It is based on the I\*PROMS Network of Excellence funded under the EU 6th Framework.

ViMation concentrates specific knowledge in the field of Human Machine Interaction and Models in Production and is supported by four specialised divisions called “VirtuEs” (Virtual Encounters):

- › The VirtuE for “Interaction and Software Engineering” VISE led by Dr. Thomas Schlegel, Universitaet Stuttgart
- › The VirtuE for “Knowledge and Competence Management” VKCM led by Professor Bernard Grabot, Ecole Nationale D’Ingénieurs de Tarbes
- › The VirtuE for “Organisation Models and Systems” VOMS led by Professor Vinesh Raja, University of Warwick
- › The VirtuE for “Virtual Manufacturing” VVM led by Dr. Timo Määtä, VTT Research Centre of Finland

### Goals and Benefits

As an open, virtual institute, ViMation aims to:

- › To establish a community for researchers, manufacturers and users of products, technologies and processes in the field of “Human Machine Interaction and Models in Production” and to benefit from

the advantages of a growing international network.

- › To concentrate specific experience in the field of “Human Machine Interaction and Models in Production” and allow for a diversification of fields of research to cover all future priorities and to guarantee world-class research.
- › To create a strong joint infrastructure to improve collaboration and exchange between universities, research institutes and industrial companies all over Europe.
- › Dissemination and exploitation of knowledge inside and outside the network, for example through conferences, workshops, company visits, student and researcher exchanges.
- › To offer the latest news, comprehensive information, useful tips, links, etc. for everyone interested in this topic.
- › To provide a digital library and appropriate downloads.
- › For the future: A common PhD programme and distributed lectures

### Focus

As the name of our institute suggests, ViMation emphasises the field of “Human Machine Interaction and Models in Production”. Through interdisciplinary collaboration this large area is covered holistically and synergies are generated to compete successfully in world-class research, including both the exchange between scientific disciplines and between science and industry.

At the same time the four pillars of ViMation, the VirtuEs (Virtual Encounters), focus on special issues within this main topic:

## ViMation - European Virtual Institute for Human Machine Interaction and Models in Production

- › VISE – The VirtuE for “Interaction and Software Engineering” stands for integration of both disciplines targeting user-friendly production and industrial applications.
- › VKCM – The VirtuE for “Knowledge and Competence Management” has as its main objective a better integration of human resource characteristics in manufacturing processes.
- › VOMS – The VirtuE for “Organisation Models and Systems” seeks to develop and implement techniques to extract information, knowledge and wisdom from raw data to make informed decisions.
- › VVM – The VirtuE for “Virtual Manufacturing” is based on high-level usage of ICT in Product Processes including simulation-based design and also the implementation of Enterprise Networks and Collaborative Design approaches to develop competitiveness of manufacturing in Europe.



European Virtual Institute for  
Human Machine Interaction and Models in Production