Vladimír Mařík
Valeriy Vyatkin
Armando W. Colombo (Eds.)

Holonic and Multi-Agent Systems for Manufacturing

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Preface

The research of holonic and agent-based systems is developing rapidly, as is the community around this R&D topic. Despite the fact that real-life practical implementations of such systems remain surprisingly rare, the leaders in different branches of industry feel that the holonic and agent-based systems represent the only way to manage and control very complex, highly distributed systems in the future. The relevant R&D gains more and more support from both industry as well as academic sources. Quite naturally, the number of scientific events aimed at the subject field is also growing rapidly. We can see new lines of conferences like INDIN, while we can observe a strong focus of the already well-established conferences, like INCOM or ETFA, being shifted toward holonic and agent-based manufacturing systems. This is a good sign of the increasing recognition and importance of the field.

We are convinced of the worth and importance of the continuation of the HoloMAS events, which have served as pioneering melting pots for ideas connected with distributed decision making and control in industry and which have already gained international reputation. The first five HoloMAS events held under the DEXA-event umbrella (three workshops, particularly HoloMAS 2000 in Greenwich, HoloMAS 2001 in Munich and HoloMAS 2002 in Aix-en-Provence as well as the 1st HoloMAS 2003 conference held in Prague and the 2nd HoloMAS 2005 held in Copenhagen) helped to bring together the research communities focused on agent-based industrial solutions, to realize the joint principles of agent-oriented applications on different levels of manufacturing, factory and supply chain management and to integrate better their research activities and results. Now, with HoloMAS 2007, we would like to document the feasibility and viability of the initial ideas, to show the current trends in the industrial agent-oriented research and to make the progress in the field clearly visible.

The HoloMAS community has started to cooperate with the IEEE System, Man and Cybernetics (SMC) Society, especially with its Technical Committee on Distributed Intelligent Systems (TC-DIS). We have decided to organize the HoloMAS conference bi-yearly, on even years, under the DEXA umbrella and to focus attention on specific IEEE SMC events on odd years. So, the IEEE DIS workshop with a special track covering the "obvious" HoloMAS topics was organized in Prague in June 2006. Similarly, the IEEE SMC Conference on Distributed Human-Machine Systems (DHMS 2008) which has absorbed the HoloMAS field, will be held in Athens, Greece in March 2008 (http://www.action-m.com/dhms2008/). This approach will help the HoloMAS community to be better integrated with both the information society-oriented DEXA community as well as the IEEE Society aimed at human-machine systems and cybernetics.

We are happy to announce that the HoloMAS 2007 conference was held under the technical co-sponsorship of the IEEE SMC Society in cooperation with the OOONEIDA network and the I*PROMS EU Network of Excellence.

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OOONEIDA (http://www.oooneida.info/index.html) is a non-profit corporation incorporated in Canada, registered as O³neida Inc. It operates as a network of networks focused on fostering distributed industrial automation based on open standards. After closing down the activities of the HMS Consortium within the IMS initiative, ending the EU funding of the AgentLink Network of Excellence and the transfer and weakening the influence of the FIPA community, OOONEIDA is becoming the most important and strongest international body in the field.

The I*PROMS EU Network of Excellence (http://www.iproms.org) is aimed mainly at research and development of advanced systems for manufacturing and control. Holonic and agent-based solutions represent one of the latest trends in this area and are a focus of the I*PROMS activities.

We are very glad to declare that there were 63 papers submitted to HoloMAS 2007, prepared by the most important, core research bodies engaged in holonic and agent-based manufacturing and supply chain management world-wide. The PC chose 39 papers to be presented and included in this volume. They contain the most representative results of the corresponding research and provide an excellent overview of what is the current state of the art.

Moreover, there were two invited talks specially tailored for the HoloMAS 2007:

The first one was given by a group of prominent researchers in the area of the IEC 61499 Standard led by Alois Zoitl from the Vienna University of Technology under the support of the PROFACTOR and Rockwell Automation leading experts. This paper can be considered as the key IEC 61499 "summary report" providing an interesting expert view on the past and future of this standard deployment.

The second invited speech was prepared by Peter van Staa, Vice-President of Robert Bosch GmbH. It steps into a completely new area of applying the multi-agent approach in the IC design with the goal of increasing IC design productivity. This talk opened a special session, PIHolS "Performance in Industrial Holonic Systems," within the framework of the HoloMAS 2007 Conference. This session was prepared by Vadim Ermolayev from The Zaporozhye National University, together with Wolf-Ekkehard Matzke from CADENCE Design Systems, GmbH Munich under the strong support of the CADENCE company. This session brought real enrichment of the content and, perhaps, a new stream in agent-based research as the *performance management* domain is a fast growing multi-billion market which drastically lacks reliable means for measuring, assessing, and optimizing the performance of industrial systems.

The HoloMAS 2007 conference created an excellent, highly motivating environment, and helped to continue integration of the community. The conference contributed to a better clarification of the goals and to a more efficient coordination of the research in the subject fields. Furthermore, this conference continued to serve as a display window of holonic and agent-based manufacturing research, offering information about the state of the art to specialists in neighboring, knowledge-processing research fields covered by the DEXA multi-conference event. We are very thankful to the DEXA Association for providing us with this excellent opportunity and to Gabriela Wagner for all her organizational efforts which were of key importance for the success of this event.

We would like to express our thanks to Vadim Ermolayev and Wolf-Ekkehard Matzke for their proactivity in organizing the special PIHolS session.

We would like to thank to IEEE SMC Society for its technical co-sponsorship as well as to both the OOONEIDA and I*PROMS EU Networks for their support and cooperation.

June 2007

Vladimír Mařík
Valeriy Vyatkin
Armando Walter Colombo

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The Past, Present, and Future of IEC 61499

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Abstract. In 1991, Technical Committee 65 (TC65) of the International Electrotechnical Commission (IEC) approved a New Work Item (NWI) for the development of an international standard for the use of software objects known as Function Blocks (FBs) in distributed Industrial-Process Measurement and Control Systems (dIPMCS). The need for this new standard resulted out of several studies and research programs that have been started or conducted in the late eighties and early nineties of the last century. IEC 61499 got finally standardized in January 2005. Before that, since 2000, it was available in the form of a so-called Public Available Specification (PAS). Although IEC 61499 has been available for so long, up to now most published work on it has been academic or resulted only in prototypical test cases. Most activities around the IEC 61499 standard have been in standardization of the execution environment and definition of semantics. Some current research is in pursuing design and coding tools. This paper gives and overview about the past and present activities and implementations related to IEC 61499 and discusses the potential of this new standard for future application scenarios.

Keywords: Holonic Systems, Distributed Control, Next Generation Automation and Control Systems.

1 Introduction

In 1991, Technical Committee 65 (TC65) of the International Electrotechnical Commission (IEC) approved a New Work Item (NWI) for the development of an international standard for the use of software objects known as Function Blocks (FBs) in distributed Industrial-Process Measurement and Control Systems (dIPMCS). The need for this new standard resulted out of several studies and research programs that have been started or conducted in the late eighties and early nineties of the last century. One of the two most famous are the "21st Century Manufacturing Enterprise Strategy: An Industry-Led View" from the Iacocca Institute [4] and the Holonic

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