



## Editorial

## Advanced software engineering in industrial automation

In industrial automation, software gets more and more important in order to provide an efficient operation of automation and control systems. Advanced software engineering solutions have a great impact on the efficiency of automation systems design. The aim of this special session is to present new approaches and methods for the design of automation and embedded control systems software which follows the latest trends from the software engineering domain, where tremendous progress has been made in the last years.

This special section presents articles selected from a special session on “Advanced Software Engineering in Industrial Automation” organised by the guest editors together with our colleagues, Prof. Kleanthis Thramboulidis from Patras University, Greece and Prof. Victor Dubinin from Penza University, Russia, at the IFAC International Symposium on Information Control Problems in Manufacturing (INCOM’09) held in Moscow in June 2009. The session has attracted great interest with 28 papers submitted and 22 presented. The numbers certainly reflect great the importance of this research area. The submitted papers represent the broad spectrum of issues related to software development in automation, briefly listed as follows:

- Development of unified design frameworks integrating all steps from requirements gathering to deployment;
- Distributed sensing and control architectures, in particular IEC 61499, and the ways of their efficient implementation on embedded targets, for example the ones based on real-time Java;
- Harmonisation of standards in software development process in production industries, such as IEC 61499 and ISA 88 and integration with industrial batch management systems;
- Methods of improving quality of automation software, such as refactoring;
- Formal and semi-formal verification and validation frameworks, such as ontology based checking of programs and use of model-checking for distributed, component based and multi-agent software architectures. Software validation frameworks have been reported based on systematic closed-loop modelling, in particular, simulation in the loop;
- Model-based software development techniques, such as automata-based programming and genetic programming, code generation from such models and its applications in various industry sectors, in particular, material handling systems;

- Enablers of automation systems flexibility, for example a communication protocol to support reconfigurations;
- Methods of formal synthesis of programs which guarantee correctness by design.

From the multitude of works presented at INCOM, the authors of most thoroughly developed ones were invited to submit extended versions to this special section. Four of them have made it through the meticulous review process. These works are very representative of the most important trends and developments. They cover model-based software design, advanced validation techniques through formal modelling and verification, aspect-oriented programming and integrated design environments.

The paper “Design Patterns for Model-Based Automation Software Design and Implementation” by Marcello Bonfé et al. presents object oriented modelling approaches and design patterns supporting the implementation of industrial control systems. By applying the presented models and design patterns to two different packing machines they show the fitness and advantages of the developed approaches.

In the second paper “Building Meaningful Timed Models of Closed-loop DES for Verification Purposes” Matthieu Perin et al. discuss the requirements of having a suitable formal model of the plant for system analysis of control applications. In order to reduce the development effort they present a modular approach for building plant models that can be easily refined and connected to the control applications.

Kristofer Bengtsson et al. in their paper “Developing control logic using aspect-oriented programming and sequence planning” present how aspect-oriented programming can be applied to non-object-oriented programming languages like the languages of IEC 61131-3. With the separation of concern approach of aspect oriented programming they show that the pieces of a control application consists of can be programmed faster and easier and can then be combined automatically for the full control programming of a production cell.

Alecio Binotto et al. show how the application of model driven approaches and aspect orientation can enhance reuse and modularisation in their paper “Sm@rtConfig: a Context-Aware Runtime and Tuning System using an Aspect-Oriented Approach for Data Intensive Engineering Applications”.

The methods and technologies described show the potential of advanced software engineering methods applied to the domain of industrial automation, so this special section should be of interest both to the academic community and to industrial specialists in process control.

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