Editorial

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Biographical notes: Dominique Michelucci is born in 1959 in France. He obtained a PhD of Computer Sciences in 1987 and a Diploma in Architecture in 1989. He is Professor of Computer Sciences in Dijon, France, since 2001. His research involves geometric modelling, robustness of geometric computations and related arithmetic topics, shape matching and geometric constraints.

David Levin was born in 1947 in Russia. In 1969, he obtained a Diploma in Mathematics and in 1979 a PhD in Computer Science. In 1991–1998 he was a Scientific Deputy Director of the Russian Research Institute for Artificial Intelligence. In 1999 he founded LEDAS and since that time is the CEO of this company, which is working in the field of industrial applications and research projects for PLM.

Today constraints, features and designers' intents pervade all moments of the lifecycle of manufactured products: design, conception, optimisation, manufacturing, assembling, disassembling, maintenance, data exchange and reverse engineering, which constitutes the so called PLM (Product Lifecycle Management). The aim of this special issue of the *International Journal of Product Lifecycle Management* is to present the approaches and results in research and technology that improve the intelligence of market oriented solutions and products in PLM, computer graphics, virtual reality, simulation, computer games, multimedia, and other adjacent domains – with special emphasis on development and application of the constraint based techniques and geometrical solving.

This special issue is based on lectures presented at the first international workshop 'Constraint-based approaches and methods of mathematical modelling for intelligent PLM systems: from methods to applications' (isiCAD-2004) held in Novosibirsk, Russia in June 2004. The isiCAD-2004 workshop was aimed at outlining the relationship between two dimensions: the above mentioned domains and, on the other hand, the methods that are soundly expected to support and improve intelligence for those domains. Bringing together of the domains in question and the relevant methods for improving the

domain's intelligence was fruitful, and enabled establishing of the isiCAD community (http://www.isicad.ru). Another important aim of the event was to bring together researchers, developers, solution providers, distributors and customers of PLM and close domains in order to achieve better mutual understanding about tendencies, requirements, demands, problems, affordability and prospects.

Among about 30 papers presented at isiCAD-2004 or submitted directly for this special issue, the programme committee selected 6, which emphasise the main topics of intelligent PLM systems:

- use of constraint techniques in conceptual, collaborative and configuration design
- symbolic and numeric methods for geometric computation and geometric constraint solving
- interval and optimisation methods for geometry and engineering
- application of these methods to mechanics, geometric modelling, CAGD/CAD, robotics
- optimisation under constraints for resource and workforce scheduling
- declarative approach in intelligent PLM solutions.

The product lifecycle involves an enormous range of information objects that emanate from, and must be communicated between, very different knowledge frameworks: engineering, manufacturing, human resources, suppliers and customers. There is one thing that all advanced engineering and business systems have in common: they each individually embody intelligence and insight. But what are the structural characteristics of an object that has been produced intelligently and insightfully? Michael Leyton in his paper 'Interoperability and object' argues that these structural characteristics form a language (that he called *Generative Theory of Shape*), and this language constitutes a robust language that can satisfy the requirements of interoperability.

Algorithmic motion planning is an upcoming area of research with several already existing and even more potential, applications to PLM. Robot programming, mechanical part assembly and maintenance of operation in industrial facilities are good examples of such applications. The paper by Jean-Paul Laumond 'Motion planning for PLM: state of the art and perspectives' presents an overview of algorithmic motion planning techniques together with their current and potential applications to PLM.

2D geometric constraint solving is arguably a core technology of computer aided design and, by extension, of managing product design data. Since the introduction of parametric design by Pro/Engineer in the 1980s, every major CAD/PLM system has adopted geometric constraint solving into its design interface. Most prominently, 2D constraint solving has become an integral component of sketchers on which most systems base feature design. The paper by Christoph M. Hoffmann, 'Summary of basic 2D constraint solving' reviews basic techniques that are widely available for solving 2D geometric constraint problems.

In large industrial products like cars and airplanes there are millions of components and design parameters, thousands of participants, working on hundreds of distinct design subspaces. The goal of all participants is to produce a complete design with maximal utility value. Thus collaborative design utilities must be developed in order to help participants to produce a complete design. The advantages and key problems of set based

collaborative design and the use of interval techniques and constraint programming as a basis for collaboration are described in the paper 'Interval/Set based collaborative engineering design' by Vitaly Telerman et al.

Scheduling is an important component of PLM since it is needed in almost all phases of a product's lifecycle, from design and prototyping to production and after sales support. Thus, an engine for solving scheduling problems can be integrated in a natural manner into full function PLM systems. Such an engine and its applications are presented in the paper by Alexey Ershov et al. 'A new scheduling engine for PLM'.

The PLM market has been defined clearly and is rapidly growing; it creates new design requirements for the intelligent components; also, it provides long term demand for these products. The paper by Dmitry Ushakov 'Adding intelligence to software solutions for PLM: constraint-based approach' presents a strategy of intellectualisation of traditional PLM solutions with the help of a set of software components – constraint based solvers for different application areas. The experience obtained in the process of project development during interaction with the customers, as well as discussions with business partners, competitors and researchers was used to describe the technical and marketing issues on a conceptual level.

Many people have contributed to the success of the workshop and to the preparation of this special issue of IJPLM. We would like to thank the authors who submitted papers and prepared them for this edition. Special thanks should also go to the reviewers for their invaluable efforts in increasing the quality of this volume.