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Tutorial title: Model-based Problem Solvers - Theory and Applications.

Presenter: Prof. Peter Struss, Ph.D.

Abstract of the tutorial: What is it that enables experts to design, analyze, or trouble-shoot artifacts or to understand, explain, and modify environmental systems? It is their knowledge about the relevant constituents of such systems and their interaction, e.g. about the components and the structure of a vehicle subsystem, about the chemical and biological processes in a water treatment plant, or about the impact of different factors on the environment.

Model-based systems are knowledge-based systems that are grounded in an explicit representation of this kind of 1st principles knowledge in terms of a behavior model of the system which is subject to problem solving. Tasks addressed by this technology include design, diagnosis and fault analysis, testing, and decision support. Important principles are

• representing the knowledge about a class of real-world systems as a library of models with a maximum of versatility and re-use to different system instances and for different tasks,

• providing model-based problem solving engines that support or automate the exploitation of such models.

These objectives meet urgent needs in industry, where complexity and variability of products demand computer support to capturing and applying the corporate knowledge. They also meet the interest of society to represent and share knowledge about social, economical, and ecological phenomena and apply it to solve problems in different contexts.

Consistency-based problem solvers are the most widespread solution to these challenges. Their core is to find solutions to a problem by constructing models that are consistent with some criterion. For instance, a diagnostic solution is given by identifying models that are consistent with the observations of the behavior of a (faulted) device.

This key idea allows for a rigorous formal foundation of such problem solvers with provable properties. Over the last decades, tools and application systems emerged from this approach those satisfy the needs of industrial applications. Examples are automated failure-modes-and-effects analysis and on-board diagnosis of vehicles.

The tutorial will present

• theoretical foundations of consistency-based problem solving,

• principles and techniques of compositional modeling,

• illustrative examples and industrial applications of the technology.

Expected background for the audience: academicians, university faculties, researchers, practitioners, and graduate students

Brief bio-data of the presenter: Prof. Peter Struss obtained a diploma in Mathematics from the University of Göttingen, before he moved into Computer Science and Artificial Intelligence. From 1978 to 1992, he worked in the Corporate R&D division of Siemens Corp., where he was in charge of the knowledge-based systems group. Although the work always aimed at solutions that were relevant to industrial applications, he and his group produced a number of important research contributions, particularly in the fields of Qualitative Modeling and Model-based Diagnosis. Among these are fundamental papers on mathematical foundations of Qualitative Reasoning (which was also the topic of his PhD thesis under the supervision of Jörg Siekmann in Kaiserlautern in 1990) and on model-based diagnosis based on fault models (the subject of his habilitation work at the Technical University of Munich in 1992). He stayed as a guest researcher at the Xerox Palo Alto Research Center several times and also at the International Computer Science Institute in Berkeley.

In 1992, he joined the Technical University of Munich as a Professor of Computer Science. Now in academia, he still maintained a strong link to industrial applications, particularly in the automotive industries.

He was a co-editor of ``Recent Advances in Qualitative Physics", edited books on ``Expert Systems for Technical Applications", on ``Knowledge Representation" and on ``Intelligent Diagnosis in Industrial Applications", and recently was a guest editor of the AI Magazine on Qualitative Reasoning. He was a member of the first editorial board of JAIR, a chair or co-chair of several international conferences and workshops, and served on numerous program committees in his special area (particularly the annual international workshops on Qualitative Reasoning and Principles of Diagnosis) and general AI conferences and workshops. In the German Computer Association (GI), he acted as the speaker of the Knowledge Representation and Reasoning Group (formerly Qualitative Modeling) for over 20 years. He is a fellow of the European Coordinating Committee for Artificial Intelligence, and he promoted organization of work in Model-based Systems as a member of the executive board of the MONET network of excellence.

You can find more details about him, including a list of his recent publications, etc. at: http://wwwradig.informatik.tu-muenchen.de/people/struss/