Final Year Projects at itm

Topics 2010/2011
This document provides a short introduction and an overview of current topics at the Institute of Information Technology in Mechanical Engineering at TU München. This is not meant to be a complete listing. It should give an idea of the institute’s current research projects and possibilities for students to work on their thesis’ within these research projects. Of course, also further topics related to the institute’s research areas are possible.

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1. Institute Characteristics

Prof. Dr.-Ing. Birgit Vogel-Heuser (Head of Institute)
Prof. Dr.-Inf. Frank Schiller (Head of Industrial Automation Group)
Prof. Dr.-Ing. Klaus Bender

Scientific Staff: 31 PhD students
Administration and technical staff: 7 employees

The chair provides eight lectures and three practical training courses for approx. 1600 students per semester.

The institute is part of the department of Mechanical Engineering within the „Technische Universität München“. Approx. 5000 Students are attending the department, so it is one of the biggest in Germany.

2. Overview

The Institute *itm* was founded in 1992 by the full professor Dr.-Ing. Klaus Bender and represents a variety of information technology-based topics within the department of mechanical engineering of the “Technische Universität München”. Since 2009 Prof. Dr.-Ing. Birgit Vogel-Heuser is head of the institute.

With strong technical and methodical approaches, itm works on the development and optimization of software-controlled technical products and production systems. In this area itm focuses on mechatronics (IT within the product), automation (IT within the production system) and engineering (IT within the development process). For detailed information about research projects and lectures visit our website: www.itm.tum.de
3. Topics

3.1. Research Areas: 3D Process data visualization, Agent-Oriented Software Engineering

Current Topic: Implementation of 3D Kiviat Diagrams for Process Data Analysis

Description: Software agents are flexible pieces of software that activate themselves and communicate to other software agents. Current research projects deal with agent-oriented software development for industrial production plants. Because of the independent behavior of the software-agents the future status of the plant is hard to determine. To increase the user’s confidence in the software, a visual representation of the current agent status should be implemented. For this purpose a 3D Kiviat diagram should be developed that shows the agent status in time. Different parameters of the plant could be displayed on the axis (performance, quality, safety, ...). Agent configuration could also be done in the same diagram by dragging the various angles; the change of one of these parameters will affect other parameters and the graphical representation in the kiviat diagram.

Fig. 1 Sample 2d kiviat diagram:
3.2. Research Areas: Alarm data reduction, formal approaches

Current Topic: Pattern recognition in alarm lists and detection of causal chains

Description: Big industrial production plants with a lot of automated devices are usually distributed to a big area and connected via communication bus. Every single device can fire different status messages and errors (alarms). These alarm messages can be monitored in a central control room and usually show up in a list. Big networks produce several messages per minute and messages are often only the logical consequence of previous messages. Formal graph-based approaches should be analyzed for their use to detect causal chains and interrelations between alarm messages. An adequate algorithm should be implemented and evaluated.

3.3. Research Areas: Object Oriented Diagramming, Industrial Software Development, MES

Current Topic: Modeling and Graphical Diagramming of MES Editor

Description: Manufacturing Execution Systems (MES) manage the production in factories and are connected to the real automation plant. They can retrieve data and modify the plant’s behavior. For both systems, the technical system and the production planning, there are several diagramming tools to describe the structure and the behavior. In this Project you will combine two of them in a new editor based on Microsoft Visio and store additional connections between the two diagrams in a database. The result is a complete modeling framework for all the relations between MES and the automation plant.

![Fig. 2 Overview MES](image)
3.4. Research Areas: Synchronous Simulation, Industrial Automation

Current Topic: Simulation Methodology for time discrete simulation systems, Virtual Reality in Industrial Automation

General Description:
The Federal Ministry of Education and Research funds the research project AVILUS (Applied Virtual Technologies in the Lifecycle of Products and Production Facilities) in the context of the High-tech-Strategy by the Federal Government of Germany. Therein, the focus is put on the application-driven development of virtual technologies. Areas of application had been defined with detailed scenarios by the participating industrial partners, e.g. Synchronous and Forward Simulation. Fastening product lifecycles, rising complexity of machines and automation systems and a strengthening competitive environment require the identification of savings potential in time and costs in the lifecycle of automation systems and their efficient realization. Simulation plays a key role in this context. Despite the application of simulation methods mainly in the planning and engineering processes of automation systems, the application of simulation models parallel in time to machines and automation systems opens new savings potential not yet discovered. The development of automation systems is supported by simulation models. Thanks to the adaptation and the extension of detailed simulation models, e.g. applied for virtual commissioning of the control system, the operation phase of automation systems can be strongly supported. Within the scope of this project, a conclusive concept for the optimal support to achieve an economical operation of automation systems is being developed and the required tool support is built.

Project topics:
- Validation of Simulation Models
- Framework enabling synchronous simulation and their analysis
- Supporting the Operation Phase by Virtual Reality

Fig. 3 Demonstrator and Simulation Architecture
3.5. Research Areas: safety, simulation, automatic control

Current Topic: Modeling and Simulation of a bomb defuse manipulator in matlab vr toolbox

Description: For demonstration purposes a factory automation system is currently implemented on a mobile robot. The first attempts for automatic control should take place in a simulated environment. For that purpose the mobile robot has to be modeled in matlab vr toolbox. The automation system should get information about the current position out of the simulink model and should react on several inputs for the motors. Final tests will take place in comparison to the real robot.

Fig. 4 Snapshots robot
3.6. **Special Opportunity from 18.10.10 until 12.02.10**

**Project: Innovation @ CoTeSys**

Description: This project is a joint teaching and research project on developing new consumer products with cognitive capabilities. During the practical course the students will learn more about cognition and how this can be applied to a real product. The students deal with cognitive systems, new product development, prototyping and soft skills, including working in multidisciplinary teams. The project has resulted in both new and innovative cognitive products as well as educating and motivating students in the topics of the CoTeSys research cluster.

Student groups are organized during the first weeks, they will work on the development and prototyping of a product that exhibits some cognitive behavior or/and that can be used by a cognitive system. For each group there are coaches that take the roll of guides. The course consists of lectures explaining the contents of the course to the students, student meetings (with the coaches) and development of a prototype of the product.

The complete course (lectures, meetings, presentations) is held in English.

There are hardware and software kits available, which were selected to accelerate development of the prototypes. Currently we have a very complete set of phidgets http://www.phidgets.com/. We also have a set of swarm small robots, a minicomputer (Sharp Zaurus), netbooks and powerful laptops. Additionally the students can spend up to 2000 Euros in hardware when necessary. Technical coaches are available to help with the hardware/software development. There are lectures explaining the hardware and software kits.

For more information, please find the attached paper “teaching an integrated new product development seminar on cognitive products”

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Fig. 5 Demonstrators developed in Innovation@Cotesys