SCHOOL OF ENGINEERING
JÖNKÖPING UNIVERSITY

Professor Staffan Sunnersjö

Intelligent Computer Systems for Design Automation
Intelligenta datorsystem för automatiserad konstruktion

ProViking course No: PV15

General information

Course of 7.5 HP for PhD students given at the School of Engineering, Jönköping University. Course will be held in two sessions during November and December 2012 with a total of six days of lectures and tutorials.

Student eligibility

Students should have a MSc in Mechanical Engineering, specializing in product development related topics. Students who have corresponding knowledge obtained from experience or study of other disciplines will be considered on an individual basis.

Scope and educational objectives

The purpose of the course is to study what tasks in engineering design that can successfully be automated and how this can best be realised. Traditional and emerging computer technologies will be introduced and an understanding of their underlying theory and working principles will be given. The main focus will be on the potential for matching existing computer technologies for automation purposes to different design tasks.

After finishing the course the participants will have a theoretical foundation for design automation systems and will be knowledgeable in solution strategies and available computer tools. They will also have furthered their understanding of how to plan, build, operate and maintain intelligent systems for automation of engineering design.

Teachers

Professor Staffan Sunnersjö, School of Engineering
Professor Lars Hvam, Technical University of Denmark
Docent Fredrik Elgh, School of Engineering
Dr Joel Johansson, School of Engineering
Dr Roland Stolt, School of Engineering
Dr Peter Johansson, School of Engineering

Course contents (preliminary)

Presentation of the research group for "Computer supported engineering design" at JTH. *Fredrik Elgh*

Course introduction. *Staffan Sunnersjö*

Design automation as an engineering science. Motives for design automation, visions for scientific and industrial future. Research questions and research methods. *Staffan Sunnersjö*

Introduction to design automation. Survey of field. Knowledge used in engineering design. Classification of design tasks, knowledge categories, design methods. The design process and how this is simulated. *Professor Staffan Sunnersjö*

Knowledge management for design automation. How can the knowledge base of design automation systems be managed to support quality assurance and the creation of a corporate knowledge repository? *Fredrik Elgh*

Analyzing problem structure
Graph theory and DSMs provide powerful tools for deciding how existing design knowledge should be processed to solve a given problem. *Staffan Sunnersjö*

Representation and processing of explicit knowledge. Principles for procedural systems, inference based systems, constraint based systems. Demo of inference based system for automated finite element analysis. *Staffan Sunnersjö, Joel Johansson*

Representation and processing of implicit knowledge.
Principles for Case Based Reasoning, optimization, neural networks. Demo of a CBR based system for design of attachment of roof racks. *Staffan Sunnersjö, Peter Johansson, Joel Johansson*

Automated product configuration.
     -Specification systems and product models.
     -Success factors for product configurators.
     -A five step procedure to implement configurators in industry.
     -Product analysis – Design for Variety.
     Lars Hvam

Design automation in practical applications. Planning design automation. Tools and methods. Implementation and maintenance. Examples of industrial systems: Demo of a generative system for design of wire lay-outs for car seat heaters (Kongsberg); Demo of feature recognition for manufacturability of sintered components (Järnkontoret); Demo of a CBR system for design of roof rack attachments (Thule). *Staffan Sunnersjö, Fredrik Elgh, Joel Johansson, Roland Stolt*

Tutorials

The following three tutorials are mandatory

1) Write a short essay (10-15 p) about **"Planning a design automation system"** for a chosen product. The students are advised to discuss their choice of application with the supervisor. *Staffan Sunnersjö*

2) Tutorial on **parametric design** based on Catia V5 Knowledgeware**. *Fredrik Elgh*

3) Tutorial on **configuration design** based on Tacton**. *Fredrik Elgh*

Computer facilities and supervision for tutorials 2) and 3) will be available the 5th and 6th of December at JTH. Students who wish to do their tutorials elsewhere are free to choose other comparable software.

Course literature

- Adrian Hopgood, *Intelligent systems for engineers and scientist*. CRC Press, 2001.

- Lars Hvam, Niels Henrik Mortensen, Jesper Riis, *Product Customization*, Springer-Verlag, 2008.

- Staffan Sunnersjö, *Automated Engineering Design – Principles and Applications*. Handouts of Manuscript

- Slides

Time schedule

First session of lectures is the 7th, 8th and 9th of November 2012 and the second session of lectures is the 4th and 5th of January 2012. There will be computer resources and supervision available for work with the tutorials the 5th and 6th of December 2012. Lectures are between 9.00 and approx 16.00. The first lecture of each session starts at 10.00.

Examination

Three tutorials with grades passed or failed.

Examiner and teacher responsible for the course

Staffan Sunnersjö, professor, Dep Mech Eng, JTH

tel: 0704 175 113; email: Staffan.Sunnersjo@jth.hj.se

Registration

Registration by email to Staffan Sunnersjö asap but not later than October 15th, 2012