Linköpings universitet
Avd Kommunikations- och transportsystem
Jan Lundgren   2013-05-16

Course information

Quantitative analysis of transport systems

Aim:

The aim of the course is that the participants should develop knowledge and understanding for how quantitative models and tools can be used for analysis and evaluation of traffic systems and logistics systems, with special focus on the system effects of introducing ITS.

Objectives:

After the course the participants should be able to
- describe typical application areas for quantitative traffic models and logistic models
- describe the possibilities and limitations for using traffic models and logistic models
- describe the principles and theoretical background for the models
- discuss and evaluate the possibilities to use quantitative models for analyzing applications of ITS
- perform experiments and analysis with model based commercial software

Target group:

All doctoral students with an interest in ITS and quantitative analysis of transport systems are welcome! The course is part of the curriculum of the National Postgraduate School of ITS.

Course structure

The course includes six parts or modules, each one encompasses 2 hp. The student chooses which modules to follow, based on his/her own background and interest. The size of the course is therefore variable between 2 hp and12 hp depending on the number of modules taken.

For each module there will be lectures during one afternoon introducing problems, models and theory followed by the presentation of the project task. To each module a number of

articles is given describing theory and applications. On the next occasion the project and the articles are presented and discussed in a seminar.

The order of the modules can change compared to what is indicated below. The starting date is around October 1st. The calendar time between the modules will be around 3-4 weeks.

Course content and examination:

The six modules include the following (more information below):

I/ Microscopic traffic simulation (Andreas Tapani)
II/ Analysis of traffic networks (Clas Rydergren)
III/ Supply chains design and analysis (Martin Rudberg)
IV/ Vehicle routing (Stefan Engevall)
V/ Train traffic timetable construction (Johanna Törnquist-Krasemann)
VI/ Positioning systems (David Gundlegård)

The responsible teacher (indicated above) will give detailed information about the content and examination of each module. The grading in the course is "passed" or "not passed". The participants will be assessed based on their project work and their performance on the presentations and discussions.

Literature:

To be announced.

Examiner and information:

Prof Jan Lundgren, Linköpings universitet, email: jan.lundgren@liu.se

Please indicate your preliminary interest of modules when you sign up for the course.

More about the course content

Microscopic Traffic Simulation
The aim of this module is to give knowledge on the use of traffic micro-simulation based models for analysis and evaluation of traffic systems and ITS-applications. The principles of microscopic traffic simulation and the sub-models controlling the movement of vehicles in the simulation are introduced. The software used is AIMSUN. Model application is illustrated through an exercise involving modelling and evaluation of a vehicle actuated traffic controller. The literature associated with the module cover both modelling principles and applications of for analysis of ITS.

Analysis of traffic networks

This module develops the understanding of how quantitative models and tools can be used to analyze and evaluate traffic systems for car trips, in particular with respect to traffic network utilization and the use of ITS systems. The concept of macroscopic equilibrium route choice modeling is introduced, basic supply demand modeling is described and mathematical models and methods for macroscopic simulation are examined in detail. Further, the module includes a case exercise where road charging system designs are modeled and where the effects of the designs are evaluated using the software EMME/2. The module covers literature for the basic modeling as well as the articles on the evaluation of road charging systems.

Supply Chain Design and Analysis

The supply chain design defines the operating basis of a supply chain and thereby naturally affects the strategic and financial performance of a company. The aim of this module is to introduce advanced planning and scheduling (APS) systems and show how such systems can be used to design and configure the supply chain structure, also taking environmental considerations into account. In the laboratory work the software Llamasoft Supply Chain Guru is introduced, which offers the possibility to transfer the optimal design into a discrete event (DES) simulation model to analyze the robustness of the chosen design.

Vehicle Routing

Vehicle routing is a well-studied problem area, central to transportation and logistics. In this module we will look at and discuss a number of different aspects and extensions of vehicle routing. This includes the applicability to real-world problems as well as potential solution procedures. There will be common as well as individual articles to study, present and discuss, and the module will also include a project where some heuristic for solving a vehicle routing problem will be implemented.

Train traffic timetable construction

The aim with this module is to give an insight on how to schedule train traffic by formulating the problem as a job-shop-scheduling optimization problem and solving it with the state-of the-art optimization software AMPL/CPLEX. The participants will be provided with an existing problem formulation that will be modified and extended in different ways in lines with the subtasks.

Positioning systems

The aim of this module is to introduce positioning systems and positioning methods used in ITS. The content of the module span a wide range of positioning systems (e.g. GNSS, cellular and WiFi) as well as the main positioning methods (e.g. ToA, TDoA, AoA and pattern matching). Concepts such as range and angle measurements, accuracy and map matching will also be covered. The module includes a project where positioning methods are implemented and evaluated for a given dataset.