**Miniproject suggestions - Nonlinear Control 2012**

*The miniprojects are supposed to be 2-3 days of job including preparing a short 10 min presentation (does not have to be slides…) to be given for the course members.*

**Monotone Nonlinear Systems**

A linear system with positive (A,B,C) matrices is called ”positive”. There is quite a large theory for such systems. There is a corresponding nonlinear version of this theory, where a mapping f is called positive if x<y => f(x)<f(y). The project consists of presenting an overview of this. For recent advances, ask Anders Rantzer, about some details.

**Density functions**

There is a nice duality to the Lyapunov stability theory, described in

**A dual to Lyapunov's stability theorem, Anders Rantzer**, *Systems & Control Letters,* **42:**3, pp. 161–168,2001.Describe and illustrate the result for instance using an example with simulations.

**Volterra Models**

There is a multilinear representation of nonlinear systems called Volterra-Wiener models, where transfer functions of the form H(s\_1,s\_2,…,s\_n) occur, see e.g. the chapter in Rolf Johansson book used in the system identification course. Described this representation, some rule of calculations, and some example.

**Grobner bases**

In the thesis “Applications to Grobner bases to nonlinear systems”, Liknköping 1991, Krister Forsman illustrates uses of Grobner bases to control. Illustrate some of the ideas on a small example. There is also material available from Enrique Pico.

**Flat Systems**

Some systems are especially easy to analyse and design for, if you can define a special kind of “flat” output. They are well fitted to solve the inverse dynamic problem with application for trajectory generation for nonlinear systems. Describe the system structure and illustrate with some example.

**Parallel Parking with N trailers**

Illustrate how to use the presented nonlinear controllability theory to park a car with N trailers. You will find models if you google “parking a car with N trailers Lie”. Present the models, analysis and do some simulations.

**Modeling Piezoelectric Actuators**

Piezoelectiric acuators are inherently nonlinear. The behavior needs to be understood to utilize them fully. This is related to Björn and Olof’s PhD work**.** Ask us for references/details.

**Moore-Greitzer model of compressor dynamics**

This is related to Alina’s PhD work.Ask us for references/details.

**Your own choice**

We are open for and encourage you to propose your own projects. It can be either theoretical analysis, nonlinear design methods, a lab process etc.