Lecture 1

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Contents:

1. **Introduction**. Intuitively control can be done using feed-forward control. The output y of a system represented with a model $y = h_p u$ where u is the control input may simply be controlled with a feed-forward controller $u = h_p^{-1} r$. This gives the goal $y = r$ when we have a perfect model. However, remember that models is models and there will always be uncertainties.

   Often the goal is to control the error $e = r - y$ to zero or at least to bound it, i.e. manipulate the control input such that $0 \leq |e| < \infty$. Due to model uncertainties or cases when we do not have a model we have to introduce **feedback**.

2. **Reasons for using Feed-back**

   - Model uncertainties or when we do not have models.
   - System disturbances v, i.e. other variables than the control input u influencing upon the output y. Se Sec 6.2.
   - Unstable systems. This usually involves state feedback, i.e. feed-back from the state vector x. Not option in this course.

   Notice Figures 3.1, 3.2 and 3.3.

3. **Read from Ch. 1** Non-linear and linear continuous time state space models. Sec. 1.1 and Example 1.1. Sec 1.2. Solution of the state equation $\dot{x} = Ax + Bu$. Both continuous time and discrete time models. Sec 1.6. Time constant. Sec 1.7. Matrix exponent and transition matrix. Sec 1.9 Transfer function models. Time $t \to \infty$ equivalent with putting $s = 0$. sec 1.10 Zero polynomial $\rho(s)$ and pole polynomial $\pi(s)$.

4. Introducing Exercise 1b.