

Time-Delay Systems (0510.7315)

Credits: 2.

Prerequisites: Introduction to Modern Linear Control.

1. *Models of systems with time-delay*: networked-control systems, communication network models, models in biology.
2. *Basic theory*: solution concept and step method. Classification of systems with time-delay (retarded, neutral type systems). Existence of solutions. Linear time-invariant systems with delay: characteristic equation, solution of linear non-homogenous equations.
3. *Stability analysis*. Direct Lyapunov approach: Krasovskii and Razumikhin methods. An LMI approach to stability: delay-independent/delay-dependent conditions. Exponential bounds and L_2 -gain analysis. Stabilization by using delays and discretized Lyapunov functional. Analysis of sampled-data and networked control systems. Input-to-state stability and control under quantization. Switched time-delay systems.
4. *Control design*: predictor-based control, Smith predictor, LMI approach to robust stabilization. Systems with saturated actuators. H_∞ control. Sliding mode control of systems with delay. LQR problem and Kalman Filter.
5. An LMI approach to control of some distributed parameter systems.

Textbooks:

1. K. Gu, V. L. Kharitonov, and J. Chen, *Stability of Time-Delay Systems*. Boston: Birkhauser, 2003.
2. J. K. Hale and S. M. V. Lunel, *Introduction to Functional Differential Equations*, Springer-Verlag, New-York, 1993.
3. S. I. Niculescu, "Delay effects on stability: A robust control approach," *Lecture Notes in Control and Information Sciences*, 269, Springer-Verlag, London, 2001.