Delay Systems

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Contents

About

Systems of delay-differential algebraic equations (DDAE) – or *delay systems* for the sake of brevity – combine differential and algebraic equations with delayed variables in the right-hand side. A typical example[1] would be:

$$\begin{aligned} \dot{x}(t) &= Ex(t) - FGy(t) \\ y(t) &= e^{TE}x(t-T) - \int_{-T}^{0} e^{-\theta E} FGy(t+\theta)d\theta \end{aligned}$$

Presentations

Introduction to Delay Systems
A MAREVA[2] course.

Delay Equations – A Case for Algebro-Differential Systems.
Mines ParisTech Mathematics and Systems Seminar.

[1] this example describes the interaction between the system

$$\dot{x}(t) = Ex(t) + Fu(t)$$

with a *deadtime* – $x(t)$ is unknown at time t, only the value $x(t-T)$ is available for some delay $T > 0$ – and a predictor-controller designed to stabilize it (with a finite-spectrum assignment for example). Think of it as an improvement of the classic Smith predictor.

[2] MAREVA is the Applied Mathematics Minor of MINES ParisTech "Master's in Science and Executive Engineering" degree.

Design of Algebraic Observers for Brass Instruments
ISMA 2014, with Brigitte d'Andrea-Novel.

Papers

A Core Theory of Delay Systems
Expository paper.

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Design of Algebraic Observers for Brass Instruments
with Brigitte d'Andrea-Novel.

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Growth bound of delay-differential algebraic equations

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