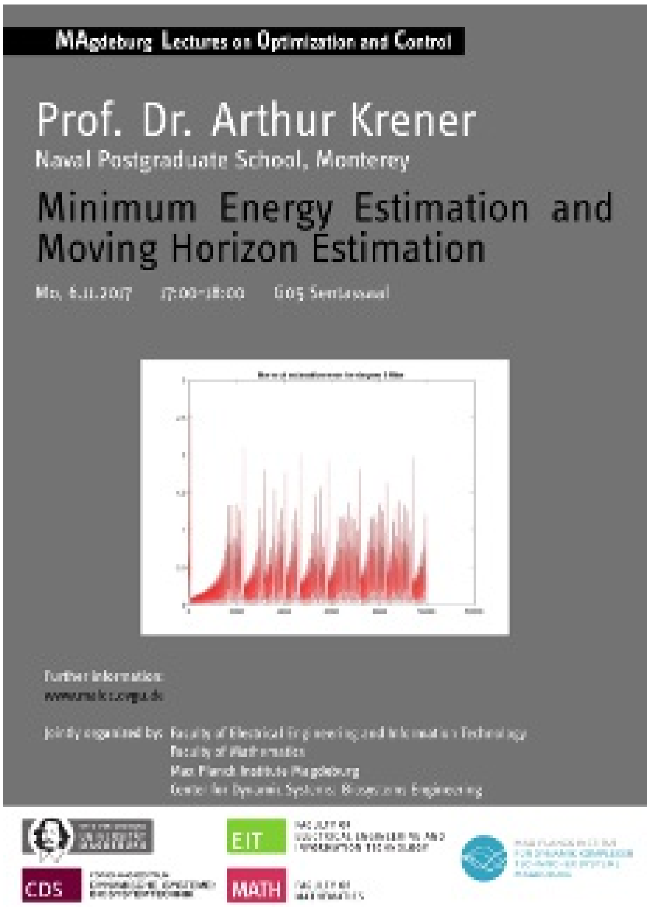
OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

MAGDEBURG LECTURES ON OPTIMIZATION AND CONTROL

Arthur Krener



27.10.2017 - **Minimum Energy Estimation and Moving Horizon Estimation**

› Prof. Dr. Arthur Krener (https://www.math.ucdavis.edu/research/profiles/?fac_id=krener)
Naval Postgraduate School, Monterey

Time & Place

The presentation on November 6, 2017 will be given in the Senatssaal (G05) and starts at 5.00 p.m..

Abstract

Minimum Energy Estimation is a way of filtering the state of a nonlinear system from partial and inexact measurements. It is a generalization of Gauss' method of least squares. Its application to filtering of control systems goes back at least to Mortenson who called it Maximum Likelyhood Estimation \cite{Mo68}. For linear, Gaussian systems it reduces to maximum likelihood estimation (akaKalman Filtering) but this is not true for nonlinear systems. We prefer the name Minimum Energy Estimation (MEE) that was introduced by Hijab \cite{Hi80}. Both Mortenson and Hijab dealt with systems in continuous time, we extend their methods to discrete time systems and show how power series techniques can lessen the computational burden.

Moving Horizon Estimation (MHE) is a moving window version of MEE. It computes the solution to an optimal control problem over a past moving window that is constrained by the actual observations on the window. The optimal state trajectory at the end of the window is the MEE estimate at this time. The cost in the optimal control problem is usually taken to be an L2 norm of the three slack variables; the initial condion noise, the driving noise and the measurement noise. MHE requires the buffering of the measurements over the past window. The optimal control problem is solved in real time by a nonlinear program solver but it becomes more difficult as the length of the window is increased.

The power series approach to MME can be applied to MHE and this permits the choice of a very short past window consisting of one time step. This speeds up MHE and allows its real time implementaion on faster processes. We demonstrate its effective on the chaotic Lorenz attractor.