Applied Mathematics Seminar

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

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Parameter estimation and cross-prediction of nonlinear dynamical systems from experimental time series

For many dynamical processes of interest only a subset of all state variables can be measured experimentally. A so-called observer may be employed for cross-predicting unmeasured variables from available time series. If a mathematical model exists for the dynamical process of interest, it can be utilized for cross-prediction by incorporating the model equations into a data-assimilation algorithm. In this approach, one can furthermore use the measured data to estimate unknown model-parameters. As an alternative, black-box machine learning techniques can be applied to infer unmeasured variables of a dynamical system from measured variables. In this talk I will describe two relatively simple experimental systems that were investigated by undergraduate students at Reed College: a Lorentz water wheel that generates chaotic oscillations and an optoelectronic system that gives rise to spatio-temporal dynamics. I will discuss how an adaptive observer and a reservoir-computing machine learning approach performed when given time series generated by those systems.

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