Reservoir Computing Approaches to Parameter Extraction with Applications

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We study the task of determining parameters of dynamical systems from their time series, which we call parameter extraction. We present a series of models inspired by reservoir computing that generate a mapping from some original time series to some static, high dimensional vector or feature. These random (in the sense of arbitrarily selected) feature maps (RFM) allow us to separate signals with different parameter values. We explore a number of RFM variations, presenting models in the time and frequency domain, as well as considering models with and without time series embedding. For simulated systems throughout stable and chaotic regimes we achieve accurate parameter extraction with significant robustness to key hyper-parameters of the models. We then assess the RFM performance on an engineering application; cavitation detection in centrifugal pumps from vibration data. While this application tasks introduces a number of problems for the models, we still observe some ability to separate signals with different underlying parameters (here, tendency for the system to cavitate).

Presentation Link