

# Challenges in Reservoir Computing

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In this expository talk, we will review the Echo State Network (ESN), a recurrent neural network that has achieved good results in time series tasks, such as forecasting, classification, and encoding-decoding. However, the lack of a rigorous mathematical foundation makes difficult their application in a general context. On the one hand, strong theoretical results, such as the Echo State Property and Universal Approximation, are non-constructive and require critical simplifying assumptions. On the other hand, usual heuristics for optimal hyper-parameter selection have turned out to be neither necessary nor sufficient. Some connections of ESN models with ideas from dynamical systems and ergodicity will be exposed, together with recent design proposals, as well as a novel application to time series clustering.