Adaptive Nonlinear System Identification with Echo State Networks

Echo state networks (ESN) are a novel approach to recurrent neural network training. An ESN consists of a large, fixed, recurrent "reservoir" network, from which the desired output is obtained by training suitable output connection weights. Determination of optimal output weights becomes a linear, uniquely solvable task of MSE minimization. This article reviews the basic ideas and describes an online adaptation scheme based on the RLS algorithm known from adaptive linear systems. As an example, a 10-th order NARMA system is adaptively identified. The known benefits of the RLS algorithms carryover from linear systems to nonlinear ones; specifically, the convergence rate and misadjustment can be determined at design time.

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