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A New Methodology for the Design of Adaptive Controllers Using State-Strict Passivity: Application to Neural Network Controllers.

Sesh Commuri; Frank L. Lewis

Abstract: The notion of passivity has played an important role in extending stability results to systems based on the input-output properties of the system. This approach was also utilized to study the stability properties of interconnected passive systems. In the control of unknown nonlinear dynamical systems, however, passivity properties were studied only as an off-shoot of the resulting controller. In this paper, it is shown that a stronger form of passivity, namely *state-strict passivity*, is required to prove guaranteed tracking performance and internal stability for a class of nonlinear systems without standard observability (i. e. "persistence of excitation") conditions. It is shown that this property can be made a design objective in the design of neural network controllers for the control of unknown nonlinear systems that satisfy certain assumptions on the system structure. This yields "robust" neural network controllers that do not require persistency of excitation or the often tedious computations of the regression vector.

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