Deep Operator Networks in Control Theory: concepts and applications

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Resumen. Deep Operator Networks (DeepONets) have recently emerged as a powerful approach for learning nonlinear operators directly from data. Unlike standard neural networks, which approximate functions, DeepONets approximate mappings between function spaces, making them particularly suitable for problems governed by differential equations. This capability is highly relevant for digital twin technology, where one seeks fast, data-enabled surrogates of physical systems that can be queried for prediction, monitoring, and control. In this talk, I will introduce the DeepONet framework and discuss its role in control theory, focusing on how operator learning can approximate control-to-state maps and support the design of feedback laws. I will present two illustrative control applications: a simple case of boundary control for the 1D wave equation, and a more challenging case of backstepping stabilization for a stochastic system. These examples demonstrate how DeepONets can act as digital twins of controlled dynamical systems, enabling real-time emulation of dynamics under varying inputs and offering new opportunities for control-oriented digital twin design.

Palabras clave: Deep Operator Networks; Robust control; Universal approximation; Set-valued maps.

Referencias

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