THE WSU-PNNL ADVANCED GRID INSTITUTE

DIFFERENTIABLE PROGRAMMING FOR DATA-DRIVEN MODELING, OPTIMIZATION, AND CONTROL

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ABSTRACT

This talk will present a different programming perspective for physics-informed machine learning (PIML) of dynamical system models, learning to optimize, and learning to control methods. We will discuss the opportunity to develop a unified PIML framework by leveraging the conceptual similarities between these distinct approaches. Specifically, we introduce differentiable predictive control (DPC) as a sampling-based learning to control method that integrates the principles of parametric model predictive control (MPC) with physics-informed neural networks (PINNs). We also show how to use recent developments in control barrier functions and neural Lyapunov functions to obtain online performance guarantees for learning-based control policies. We demonstrate the performance of these PIML methods in a range of simulation case studies, including modeling of networked dynamical systems, robotics, building control, and dynamic economic dispatch problem in power systems.

BIO

Jan is a senior data scientist and the principal investigator in the Physics and Computational Sciences Division at Pacific Northwest National Laboratory (PNNL). Jan has a PhD in Control Engineering from the Slovak University of Technology in Bratislava, Slovakia, and before joining PNNL, he was a postdoc at the mechanical engineering department at Katholieke Universiteit (KU) Leuven in Belgium. His current research is focused on physics-informed machine learning for dynamical systems, constrained optimization, and model-based optimal control with applications in the energy sector.