Karlsruher Institut für Technologie

Seminar@IWG-WB

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Physics-Based and Data-Driven Modeling in Environmental Hydraulics

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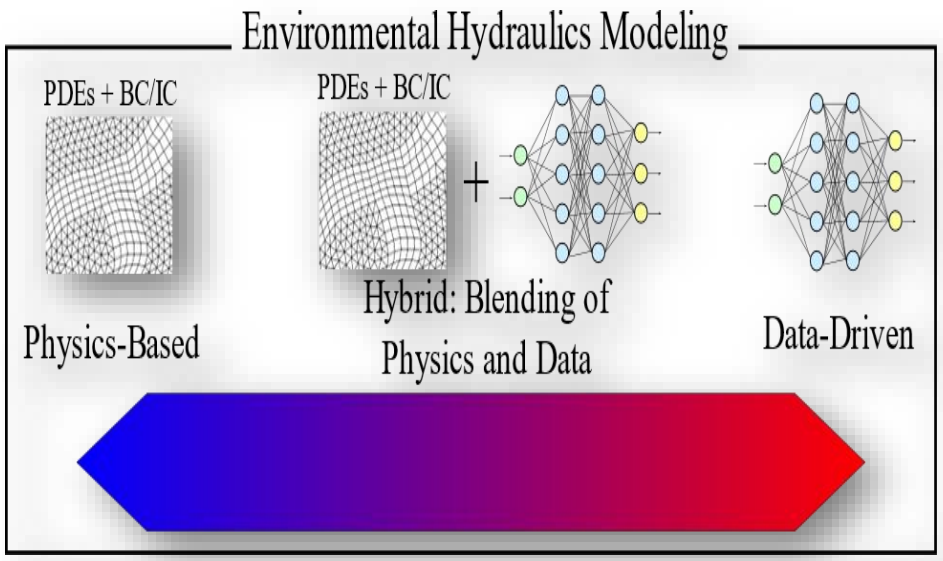
11:30-13:00 Uhr
KIT, Geb. 10.81, Room 305
or online:
https://kit-lecture.zoom.us/j/69015345304

Physics-Based and Data-Driven Modeling in Environmental Hydraulics



Abstract

Physics-based and data-driven models are two different, yet closely related, approaches for capturing processes in real world. The talk will provide a broad overview of both approaches and then showcase several examples in environmental hydraulics. Physics-based models (PBMs) solve governing equations using different numerical schemes. PBMs are predicated on the knowledge of physical processes and their mathematical representations (usually in the form of partial differential equations and constitutive relationships). Examples are models for turbulent flow and sediment transport around structures/objects and fish passages. Data-driven models rely on the representativeness and quality of data to implicitly describe the physical processes. In high-dimensional space, the data should be “big” enough to fully capture the input-output dynamics of a physical system. I will show examples of a deep-learning based surrogate for a 2D computational hydraulics model and its use for parameter inversion. Over time, the boundary between physics-based and data-driven models is blurred in the rapidly evolving arena of ML/AI. Hybrid approaches, such as physics-informed machine learning, have emerged. Some future research topics for environmental hydraulics will be discussed.

Biography

Dr. Xiaofeng Liu is an associate professor in the Department of Civil and Environmental Engineering at Penn State. He got his bachelor's degree in Hydraulic Engineering from Tsinghua University and a master's degree in Environmental Science from Peking University, China. He got his Ph.D. in Civil Engineering from the University of Illinois at Urbana-Champaign (UIUC) and a second master degree in Applied Mathematics in 2008. Dr. Liu’s research interest includes computational fluid dynamics (CFD), sediment transport, and environmental fluid mechanics. His group specializes on the development and utilization of computational models for problems in environmental and water resource engineering. His research has been funded by NSF, U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, USGS, DoD, DoE, DoT, and industry. Dr. Liu received the Harry West Teaching Award from Penn State and the State-of-the-Art of Civil Engineering Award from the American Society of Civil Engineers.

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