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Eawag Seminar Invitation

Is gradient descent a better modeler? Deep learning to offer a full suite of services for hydrologic and water quality modeling.

Speakers **Prof. Chaopeng Shen, Department of Civil and Environmental Engineering, the Pennsylvania State University, University Park, USA**

When **April 15, 16.00 – 17.00, CET**

Where **Online via Zoom, contact seminars@eawag.ch for access details.**

Abstract The 2017-2020 era marked a proof-of-capability phase for deep learning (DL) in hydrology and saw a rapid expansion of DL in the field. DL is evolving from a niche tool to a mainstream choice for many prediction tasks with multiple physics. DL starts to offer the full suite of services commonly provided by traditional hydrologic models, including dynamical modeling, forecast, inverse modeling, and uncertainty quantification, at higher performance and lower cost. Moving away from domains with extensive data, here I show that DL can help to solve some of hydrologists' nemesis problems. While models trained on a widely-accepted dataset may perform poorly in settings different from the benchmarks, we show that DL models can be conditioned to make forecasts in data-scarce regions by either migrating knowledge across continents or integrating “soft” data and use careful strategies to suppress overfitting. Eventually, DL might offer reliable hydrologic predictions in vast regions with scarce information. I also propose a new parameter learning scheme that turns the traditional parameter calibration problem into a machine learning problem, thereby leveraging the machine learning paradigm for unobserved variables. The new parameter learning scheme rides a virtuous scaling curve as data grows and exhibits superiority over the traditional method on multiple fronts and alleviates the parameter non-uniqueness (equifinality) problem. With continued innovations, it is likely that deep-learning models will be able to handle more and more cases so there will be fewer and fewer dead corners.