

CRUNCH Seminars at Brown, Division of Applied Mathematics

Friday - July 10, 2020

Data-Driven Continuum Dynamics via Transport- Teleport Duality

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In recent years, machine learning methods have been widely used to study physical systems that are challenging to solve with governing equations. Physicists and engineers are framing the data-driven paradigm as an alternative approach to physical sciences. In this paradigm change, the deep learning approach is playing a pivotal role. However, most learning architectures do not inherently incorporate conservation laws in the form of continuity equations, and they require dense data to learn the dynamics of conserved quantities. In this talk, I will introduce an inversion transform to represent the classical dynamics as a point-wise process of disappearance and reappearance of a quantity, which dramatically reduces model complexity and training data for machine learning of transport phenomena.

I will show that just a few observational data and a simple learning model can be enough to learn the dynamics of real-world objects. The approach does not require the explicit use of governing equations and only depends on observation data.