
ALEX TOWNSEND, Cornell University
A Mathematical Guide to Operator Learning

A fundamental challenge in modern scientific computing is learning an operator from finite data. In this talk, we offer a mathematical guide to operator learning, drawing a distinction between passive and active observation models and revealing the crucial role this choice plays in sample efficiency. We explore how the nature of the underlying partial differential equation, i.e., elliptic, parabolic, or hyperbolic, governs the difficulty of learning the associated solution operator, and we present recent learning theory that quantifies the number of queries needed for accurate recovery. Diffusive systems, as we shall see, are forgiving; wave-like systems are not. Along the way, we reflect on what it means to learn in infinite dimensions and how mathematical structure can be exploited to tame the curse of dimensionality.