Machine learning and science?

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Abstract

Transport phenomena such as fluid dynamics represents one of the many areas of the physical, chemical, and biological sciences that generate large quantities of data and in which it is hoped recent developments in Machine Learning (ML) will help lead to transformational advances. From the other perspective, this area and other scientific areas provide forcing functions to ML methodology that are quite different than the forcing functions that arise from computer vision, natural language processing, autonomous vehicles, etc. I will discuss some recent results we have in this area, on whether it is possible to use physics-informed prior knowledge to improve model quality. Using the perspective of equilibrium stability of a dynamic system, I'll describe how, for a hello-world fluid flow prediction problem, models preserving Lyapunov stability improve generalization error and reduce prediction uncertainty. I'll also describe how this initial result fits into a larger effort on using ML ideas for scientific problems and using scientific ideas for ML problems. Bridging the gap between these two quite different areas is interesting and important, but it is quite challenging, and I'll describe some of the challenges.