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Model reduction by manifold boundaries MARK TRANSTRUM, Brigham Young University — Mathemtical models of physical systems can be interpreted as manifolds of predictions embedded in the space of data. For models of complex systems with many parameters, the corresponding model manifold is very high-dimensional but often very thin. This "low effective dimensionality" has been described as a hyper-ribbon and is characteristic of systems exhibiting simple, emergent behavior. I discuss a new model reduction method, the manifold boundary approximation method, which constructs a series of models by iteratively approximating the high-dimensional, thin manifold by its boundary. This model reduction method unifies many different model reduction techniques, such as renormalization group and continuum limits, while greatly expanding the domain of tractable models. I demonstrate with a model of a complex signaling network from systems biology. The method produces a series of approximations which reveal how microscopic parameters are systematically "compressed" into a few macroscopic degrees of freedom, effectively building a bridge between the microscopic and the macroscopic descriptions.

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