Abstract Submitted
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Understanding the evolution of complex multiscale systems: Dynamic renormalization, non-equilibrium entropy and stochasticity MARC PRADAS, MARKUS SCHMUCK, Department of Chemical Engineering, Imperial College London, UK, GRIGORIOS PAVLIOTIS, Department of Mathematics, Imperial Collge London, UK, SERAFIM KALLIADASIS, Department of Chemical Engineering, Imperial College London, UK — We present a novel methodology that enables the study the complex dynamics of dissipative systems. By means of a generic reduced equation which is also computationally efficient we tackle a fundamental problem in science: Many time-dependent problems are generally too complex to be fully resolved and hence some information needs to be neglected. A central question is then how can one systematically and reliably reduce the complexity of such high-dimensional systems without neglecting essential information. Popular examples of this are models for climate prediction, cell biology processes, or economics. We combine elements from nonlinear science, statistical physics, and information theory to develop a new stochastic strategy that rigorously shows how to replace the non-relevant degrees of freedom of an infinite-dimensional system by a finite random process statistically well defined [1]. A dynamic renormalization group approach reveals that the neglected information can be described in terms of an appropriately defined entropy for dissipative non-equilibrium processes which seems to have universal characteristics, thus providing a rational and systematic means for quantifying the evolution of dissipative systems.

[1] Schmuck, Pradas, Kalliadasis, Pavliotis. PRL 110, 244101(2013).

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