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Extensive Scaling of Computational Homology and Karhunen-Loève Decomposition in Rayleigh-Bénard Convection Experiments[1]

HÜSEYIN KURTULDU, MICHAEL SCHATZ, Georgia Institute of Technology —

We apply two different pattern characterization techniques to large data sets of spatiotemporally chaotic flows in Rayleigh-Bénard convection (RBC) experiments. Both Computational homology (CH) and a modified Karhunen-Loève decomposition (KLD) are used to analyze the data. The KLD dimension D_{KLD}, the number of eigenmodes required to capture a given fraction of the eigenvalue spectrum, is computed for different subsystem sizes. A similar quantity D_{CH} for the same experimental data is acquired by the probability distribution of topological states constructed from the outputs of CH. We show that both D_{CH} and D_{KLD} scale over a large range of subsystem sizes for the state of SDC; moreover, we find the presence of boundaries leads to deviations from extensive scaling that are similar for both methodologies.

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Huseyin Kurtuldu
Georgia Institute of Technology

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