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Reinforcement learning versus linear control of Rayleigh-Bnard convection ALESSANDRO CORBETTA, GERBEN BEINTEMA, Eindhoven University Of Technology, LUCA BIFERALE, University of Rome, Tor Vergata, PINAKI KUMAR, FEDERICO TOSCHI, Eindhoven University Of Technology —

Thermally driven turbulent flows are common in nature and in industrial applications. The presence of a (turbulent) flow can greatly enhance the heat transfer with respect to its conductive value. It is therefore extremely important -in fundamental and applied perspective- to understand if and how it is possible to control the heat transfer in thermally driven flows.

In this work, we aim at maintaining a RayleighBnard convection (RBC) cell in its conductive state beyond the critical Rayleigh number for the onset of convection. We specifically consider controls based on local modifications of the boundary temperature (fluctuations). We take advantage of recent developments in Artificial Intelligence and Reinforcement Learning (RL) to find -automatically- efficient non-linear control strategies. We train RL agents via parallel, GPU-based, 2D lattice Boltzmann simulations. Trained RL agents are capable of increasing the critical Rayleigh number of a factor 3 in comparison with state-of-the-art linear control approaches. Moreover, we observe that control agents are able to significantly reduce the convective flow also when the conductive state is unobtainable. This is achieved by finding and inducing complex flow fields.

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