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Turbulent Convection: Numerical Modeling and Physics Enhanced Machine Learning.

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Complex phenomena, such as turbulence, require the use of laborious and resource-intensive algorithms. This incurs significant costs in terms of storage space and computation time. Machine and deep learning techniques are introduced to tackle such challenges, offering solutions such as reduced models, simulation acceleration, and data compression.
Physics-Informed Neural Networks (PINNs) harness the power of neural networks by incorporating PDE residuals into the learning loss terms. Consequently, they present significant tuning challenges, particularly in balancing the various loss terms, wether it be PDE residual losses or labeled data losses. In our work, we explore optimal loss balancing through automatic scaling of various relaxation loss coefficients to accelerate the learning process.
The model is then applied to infer hidden variables, such as the 3D temperature field from partial knowledge of the velocity field, which poses numerous challenges.

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