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A Neural Network Approach to Understanding Turbulent Jet Formations

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Abstract : Advancements in neural networks have offered valuable insights into Fluid Dynamics, notably in addressing turbulence-related challenges. In this research, we introduce multiple applications of models of neural networks, namely Feed-Forward and Recurrent Neural Networks, to explore the relationship between jet formations and stratified turbulence within stochastically excited Boussinesq systems. Using machine learning tools like TensorFlow and PyTorch, the study has created models that effectively mimic and show the underlying features of the complex patterns of jet formation and stratified turbulence. These models do more than just help us understand these patterns; they also offer a faster way to solve problems in stochastic systems, improving upon traditional numerical techniques to solve stochastic differential equations such as the Euler-Maruyama method. In addition, the research includes a thorough comparison with the Statistical State Dynamics (SSD) approach, which is a well-established method for studying chaotic systems. This comparison helps evaluate how well neural networks can help us understand the complex relationship between jet formations and stratified turbulence. The results of this study underscore the potential of neural networks in computational physics and fluid dynamics, opening up new possibilities for more efficient and accurate simulations in these fields.

Keywords : neural networks, machine learning, computational fluid dynamics, stochastic systems, simulation, stratified turbulence
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