ME Seminar

Data-driven modelling of 2-dimensional natural convection

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ABSTRACT

With the rise of machine learning, a new phase of dimensionality reduction in fluid dynamics has been started. Conventionally used proper orthogonal decomposition (POD) is being slowly replaced by the non-linear autoencoders. Convolution autoencoder (CAE) with multiple layers and non-linear activation functions can surpass the performance of a linear POD. In this seminar, we demonstrate a CAE for a 2-dimensional Rayleigh–Bénard convection (RBC). Furthermore, we develop a second-level non-intrusive reduced order model to estimate the temporal evolution of the latent vectors of CAE based upon a computationally cheap echo state network (ESN). The predicted modes from the ESN can be plugged into the decoder of a CAE to produce the temperature field of the flow. Thereby, the present work exploits the 2 different machine learning algorithms to build a completely data-driven model which can autoregressively predict temperature. The results indicate a good accuracy in first and second-order statistics along with the temporal dynamics.

ABOUT THE SPEAKER

Sandeep Pandey is currently working as a Software Engineer for autonomous driving at Veoneer in Germany where he is leading an interdisciplinary team for big data analysis to support the rollout of autonomous vehicles. He has done his post doctorate at Technical University of Ilmenau where he examined the application of machine learning in turbulence flow. He obtained his Ph.D. from the University of Stuttgart where his thesis was focused upon the DNS of supercritical CO_2 for fundamental investigation of heat transfer deterioration and its modelling. Sandeep has completed his M.Tech. from IIT Delhi in Energy Studies and he holds B.Tech. in Mechanical Engineering. His current research is targeted towards high-fidelity simulation, applied machine learning and data analytics from the perspective of thermo-fluid dynamics.

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