

Reduced Basis Smagorinsky Turbulence Models

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Abstract

Large Eddy Simulation (LES) turbulence models provide accurate space-time predictions of turbulent flows. However, these models are little used in engineering applications due to very large computing times. Reduced Basis (RB) modeling aims at building very fast solvers for parametric PDEs, with “certified” error levels (that is, meeting pre-set error levels), typically with computing speed-up ratios ranging from tens to thousands.

We address in this talk the building of RB Smagorinsky turbulence models, a LES turbulence model for which the mathematical and numerical analysis is well established [3]. We shall use the so-called “Greedy” algorithms, based upon mathematical a-priori error estimates, what allows to obtain certified RB models [2]. We shall also use purely physics-based error estimation procedures in the Greedy algorithm, that have the advantage of being model-independent [1].

References

- [1] Bandera Moreno, A.; Caravaca García, C.; Chacón Rebollo, T.; Delgado Ávila, E.; Gómez Mármol, M.: *Reduced Basis modelling of turbulence with well-developed inertial range*. Computer Methods in Applied Mechanics and Engineering, Vol. 419. DOI 10.1016/j.cma.2023.116683 (2024).
- [2] Chacón Rebollo, T.; Delgado Ávila, E.; Gómez Mármol, M.: *On a certified VMS-Smagorinsky reduced basis model with LPS pressure stabilisation*. Appl. Numer. Math. 185 (2023), 365–385. DOI 10.1016/j.apnum.2022.12.003
- [3] Chacón Rebollo, T., Lewandowski, R.: *Mathematical and Numerical Foundations of Turbulence Models and Applications*. Birkhauser, 472 pages (2014). <http://www.springer.com/birkhauser/mathematics/book/978-1-4939-0454-9>