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On the POD based reduced order modeling of high Reynolds flows FARIDUDDIN BEHZAD, BRIAN HELENBROOK, GOODARZ AHMADI, Department of Mechanical and Aeronautical Engineering, Clarkson University, Potsdam, NY, USA — Reduced-order modeling (ROM) of a high Reynolds fluid flow using the proper orthogonal decomposition (POD) was studied. Particular attention was given to incompressible, unsteady flow over a two-dimensional NACA0015 airfoil. The Reynolds number is 10^5 and the angle of attacked of the airfoil is 12°. For DNS solution, hp-finite element method is employed to drive flow samples from which the POD modes are extracted. Particular attention is paid on two issues. First, the stability of POD-ROM resimulation of the turbulent flow is studied. High Reynolds flow contains a lot of fluctuating modes. So, to reach a certain amount of error, more POD modes are needed and the effect of truncation of POD modes is more important. Second, the role of convergence rate on the results of POD. Due to complexity of the flow, convergence of the governing equations is more difficult and the influences of weak convergence appear in the results of POD-ROM. For each issue, the capability of the POD-ROM is assessed in terms of predictions quality of times upon which the POD model was derived. The results are compared with DNS solution and the accuracy and efficiency of different cases are evaluated.

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