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Extending Partially-Averaged Navier-Stokes equations to Variable-Density Turbulent Flow FILIPE PEREIRA, FERNANDO GRINSTEIN, DANIEL ISRAEL, RICK RAUENZAHN, Los Alamos National Laboratory, SHARATH GIRIMAJI, Texas A&M University — The mixing of distinct fluids is of importance to various areas of engineering. This class of problems is featured by its variable-density (VD) that leads to buoyancy effects, hydro-dynamical instabilities, transition and turbulent flow. All these phenomena turn the modeling of VD flows difficult. Whereas DNS and LES models are excessively demanding for practical problems, RANS tends to poorly predict such flows. Bridging methods, on the other hand, have the potential to surpass many of the limitations of the former models. By resolving only the phenomena that are not amenable to be modeled, these models can achieve a good compromise between accuracy and cost. Yet, their development for VD flows is rife with challenges. The aim of this work is to develop the Partially-Averaged Navier-Stokes (PANS) equations model for VD flow. To this end, the PANS framework proposed by Girimaji (2005) is extended to VD flow in order to derive a PANS-BHR2 closure. Particular attention is paid to the selection of the physical resolution (range of resolved scales) of the model. Thus, apriori testing is conducted to propose guidelines toward the efficient selection of the parameters determining the physical resolution of PANS-BHR2. The proposed model is then evaluated on two archetypal flow problem.

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