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Effect of structured and unstructured mesh in Large Eddy Simulations of a turbulent flame in OpenFOAM

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This paper briefly describes various challenges and issues faced while performing Large Eddy Simulations (LES) of a canonical turbulent flame. Due to the capability of LES to resolve details of the large-scale turbulent eddies, better insights in the combustion and fuel-air mixing physics can be obtained. However, this increased sensitivity to the physics becomes more demanding on the numerical methods and mesh resolution requirements. In the present work, various steps for simulating a turbulent flame from literature, namely Sandia Flame D in OpenFOAM CFD solver is tested in both RANS and LES context. Although the RANS results were agreeing with the experimental data set, LES was not able to capture the flame at first attempt. Then the effect of mesh type, numerical schemes, boundary conditions, and domain dimensions is tested and highlighted. Finally, conclusion is made on the importance of using structured mesh over unstructured mesh specifically with LES.