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Self-Similarity Analysis of Turbulent Wake Behind the DARPA Suboff

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ABSTRACT

The turbulent wake behind an axisymmetric body is a challenging flow and of interest in scientific research and engineering application (Kumar and Mahesh, 2018; Posa and Balaras, 2016). This study conducted a wall-modeled large eddy simulation (WMLES) (Mukha et al., 2019) to investigate the turbulent wake behind an axisymmetric body of revolution. The geometry is DARPA SUBOFF body at 0 yaw angle. The Reynolds number is $Re_L = 1.2 \times 10^7$ based on the length of the body and the free-stream velocity. Present method is validated by comparing time-averaged and turbulent fluctuation quantities with previous published experimental (Huang et al., 1992) and numerical data (Kumar and Mahesh, 2018). Mesh convergence test is also conducted to verified to the correctness of the present computational setting. Then, the modified normalized Liutex-Omega method is used to identify coherent structures in the wake flow. We discussed the self-similarity of the time-averaged streamwise velocity and the non-self-similarity of the turbulent fluctuations. All profiles of the time-averaged streamwise velocity in the wake are very close extending up to twelve diameters from the tail, with a great agreement with experimental data and similarity law.

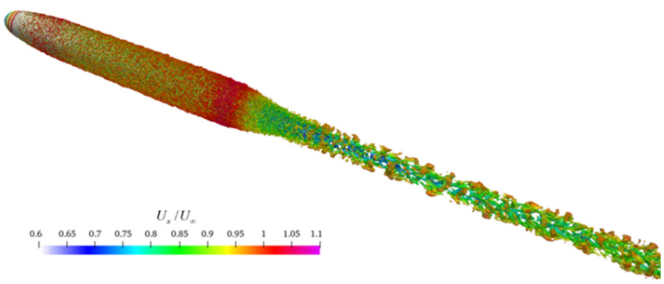

Figure 1: Turbulent wake identified by the modified normalized Liutex-Omega method.

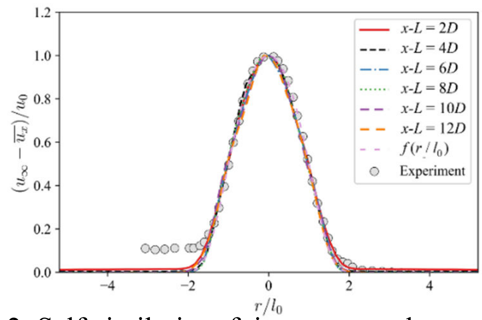

Figure 2: Self-similarity of time-averaged streamwise velocity in the wake

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