

Session:

Effect of upstream turbulence on single and dual-stream jets. Assessment of ZDES simulations

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This paper aims at investigating the effect of upstream turbulence coming from the engine's internal geometry on the jet flow development. Simulations are performed using ZDES [1] combined with synthetic turbulence generation methods. Two cases are studied: an incompressible, single-stream jet and a compressible dual-stream one.

Single-stream jet

The first case is an incompressible round jet [2] illustrated in Fig.1. The Synthetic Eddy Method (SEM) of Jarrin *et al.* is used at the inlet of the nozzle to simulate upstream turbulence. Four ZDES simulations are carried out to assess the effect of each parameter of the SEM. It is found that the use of SEM accelerates the RANS-to-LES transition in the mixing layer close to the nozzle exit. Besides, the increase of the turbulence rate in the jet core leads to a reduction of the potential core length (Fig. 2).

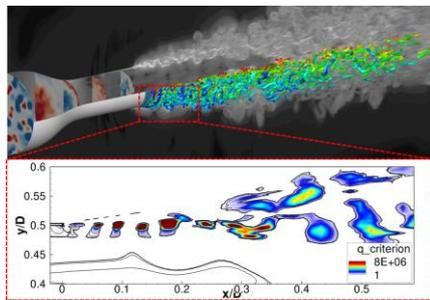


Fig. 1. Illustration of a simulation with upstream turbulence, focus on the mixing layer development

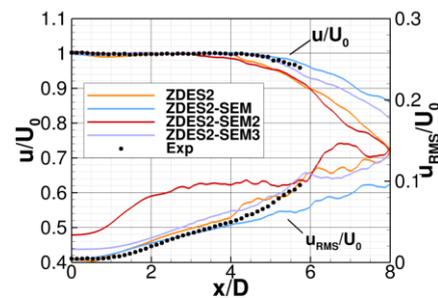


Fig. 2. Mean and RMS velocity along the jet centerline, effect of different SEM parameters

In the final paper, the analysis of the results will focus on the growth of the instabilities in the mixing layer and the influence of the SEM parameters on the frequency distribution of the turbulent fluctuations along the jet centerline.

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Dual-stream jet

The second part of the paper is devoted to the analysis of a dual-stream nozzle representative of a modern aircraft engine (MARTEL test case). The upstream turbulence is generated with the method of Smirnov *et al.* as in Ref. [3]. Visualizations of the simulations are shown in Fig.3. The final paper will provide in-depth analysis of the jet development with regards to the parameters used with the Smirnov method. In particular, the effect of upstream turbulence on the shock-cell positioning and mixing layers development will be scrutinized.

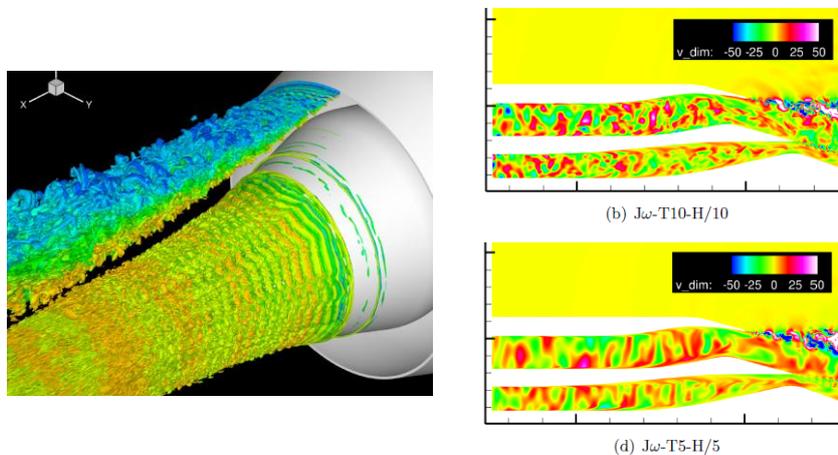


Fig. 3. Dual stream jet, simulations with different upstream turbulence parameters. Left: Q-criterion isosurface, right: contours of radial velocity.

References

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