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# APPLICATION OF ELLIPTIC BLENDING EVM & RSM RANS MODELS TO AUTOMOTIVE RELEVANT TEST CASES

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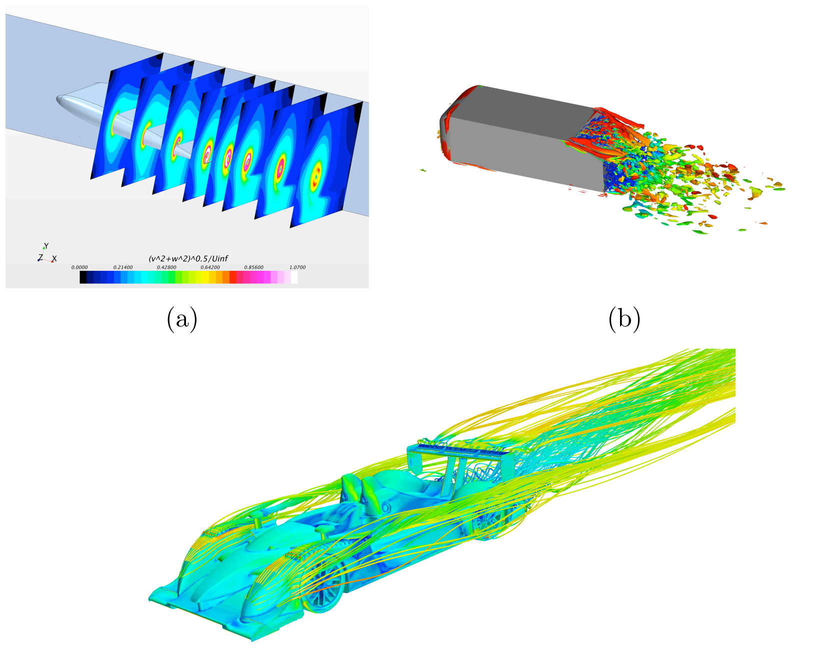
The use of Computational Fluid Dynamics (CFD) in the automotive industry has seen significant growth over the past 30 years, largely because of the availability of affordable high-performance computing (HPC) facilities and the development of robust CFD codes that can handle the often large and complex automotive geometries. Simultaneously in academia the past 30 years has seen much focus on the development of ever more accurate and sophisticated turbulence models. Unfortunately although there have been several papers [1, 2] to demonstrate the potential improvement of more advanced turbulence models over standard linear eddy viscosity models (e.g the standard $k-\varepsilon$ or $k-\omega$ SST model) for flows which are seen in automotive cases e.g wing tip vortices, 3D separation from a curved surface, the most commonly used models in the automotive sector are still variants of the $k-\varepsilon$ or $k-\omega$ models. This is largely due to two reasons; robustness and user knowledge of the performance of the turbulence model. It is also the case that very few properly objective tests have been conducted on realistic automotive bodies using these more advanced models. This disconnect between the demonstration of an improvement on a simple flow (e.g Ahmed car body) to a more realistic full car model, means there is still a lack of confidence in the automotive sector. While some manufacturers are starting to test more advanced hybrid RANS-LES models such as Delayed Detached Eddy Simulation (DDES), the day to day usage is still likely to be steady RANS models for the immediate future.

This paper demonstrates the performance of two novel turbulence models, based upon the principle of elliptic blending [2, 3] which have been improved specifically for industrial purposes by the University of Manchester and CD-Adapco using the commercial CFD



(a) (b)

(c)

Figure 1: Three automotive test cases: (a) NACA0012 wing tip case (b) Ahmed car body (c) LMP2 Le Mans race car

code: STAR-CCM+. These new models are tested on two classical cases: the NACA0012 wing-tip case [4] and the Ahmed car body [5], and finally on a realistic complex automobile case: a complete LMP2 Le Mans race car. The paper demonstrates and discusses the performance of these new models for such flows, and also investigates the influence of grid refinement for these cases. For each case, the computational expense and convergence for each approach are detailed.

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