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Big Data Visualization Challenge: Application to Aerodynamics

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The current rise of the computational power allows using advanced modeling approaches (such as LES or RANS/LES) on increasingly complex applied aerodynamics configurations. Billion cell calculations, although uncommon, are now reachable. However, handling Terabytes of data generated by simulations performed on grids "only" containing 10 to 100 million points (*cf.* figure 1) already constitutes a bottleneck for numerical unsteady aerodynamics. Thus, the analysis of big data in CFD is strongly related to the balance between the physics solved and the unsteady flow data stored.

In this context, this presentation illustrates the current available capabilities at ONERA to visualize large data sets issuing from advanced computations of unsteady turbulent flows (see, *e.g.*, [1], [3], [5]). Issues regarding the level of validation [2] and the post-processing of short duration data are exposed illustrated on the basis of high Reynolds axisymmetric separating/reattaching flows (see, *e.g*, [4],[5]).

These issues lead to further remarks on the need for CFD research scientists to gather an improved knowledge of their available hardware. Indeed, when a deep insight into big data sets is considered, the physical meaning of the chosen analysis has to be assessed along with the feasibility in term of IT equipment. The CPU cost of a post-processing technique on a large amount of data can have an order of magnitude equivalent to the computational resources required to simulate a configuration and generate the related unsteady data. Thus, the relationship between the performance of the hardware (*i.e.* CPU, memory access and storage) and the manipulation of large scale matrices is also discussed.

References

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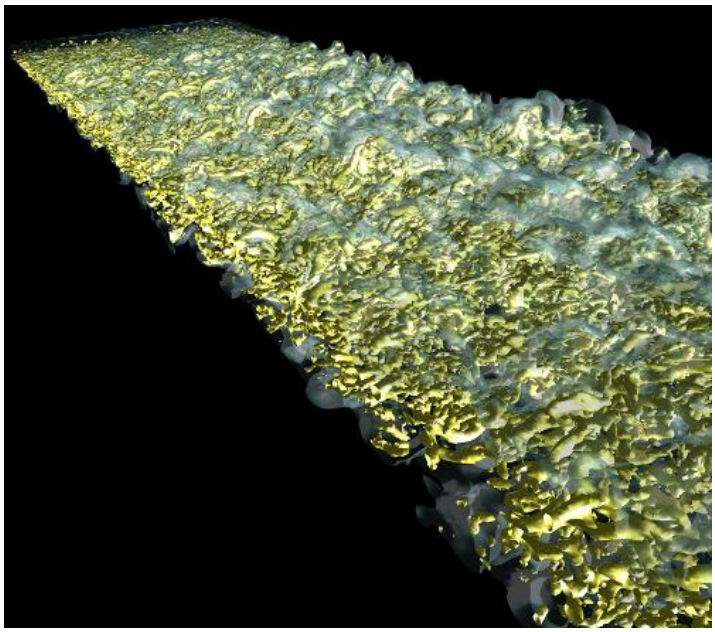

Figure 1 : Visualization of the coherent structures in a turbulent mixing layer plotted from the ZDES flow data by Deck [6]