High-order mesh generation and flow simulation about complex geometries

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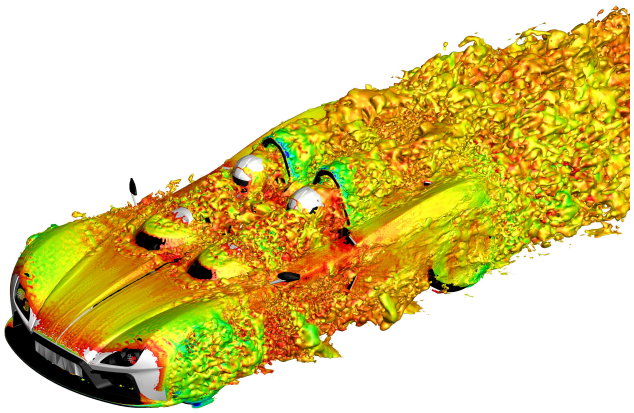
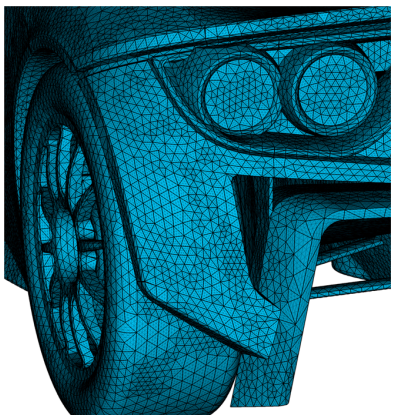
ABSTRACT

We will describe our latest efforts in simulating complex flows about realistic geometries using high-order unstructured spectral/hp elements. We will discuss the developments in mesh generation [1] and flow solution [2] that have led us to successfully simulate flows about geometries as complex the Elemental RP1 race car shown in the figures below. We believe this is the first high-order flow simulation for an automotive whole car geometry, and certainly one of the most complex geometries that has ever been attempted by this method.

The computational domain is discretized into approximately 2.5 million high-order elements (tetrahedra and prisms) with 5th order polynomials, approximately one billion degrees of freedom, required to represent the flow features to the desired accuracy. The flow Reynolds's number is 50,000 and the boundary layer is captured using a layer of prisms close to the surface to the car.





REFERENCES

[1] C. D. Cantwell, et al., "Nektar++: an open-source spectral/hp element framework," *Computer physics communications*, 192 (2015) 205–219.

[2] M. Turner, J. Peiro, D. Moxey, A variational framework for high-order mesh generation, Procedia Engineering 163 (2016) 340–352