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Development and application of Spectral/*hp* element methods for high-Reynolds number complex geometry flows

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Although the use of flow simulations for industrial design is well established, as industry imposes greater demands on the design there is an increasing demand for more accurate unsteady flow simulations. Using existing commercial methods, it can be extremely costly in computational terms to achieve sufficient accuracy in unsteady flow simulations. This demand for increasingly accurate flow physics around complex geometries are therefore making high order methods such as spectral/*hp* type discretisations [1] more attractive to industry.

Nevertheless a number of challenges still exist in translating academic tools into engineering practice. As the start of the pipeline, meshing techniques for high order methods are required to handle highly complex geometries [2]. Next, many engineering problems require high Reynolds numbers leading to turbulent flow that typically can only be marginally resolved. Therefore, there is a need for greater robustness in marginally resolved conditions where aliasing errors [3] and high frequency damping are typically required [4]. Finally maintaining computational efficiency is also obviously important.

In this presentation we will outline the demands imposed on computational aerodynamics by our industrial collaborators (McLaren Racing, Rolls Royce) and discuss the numerical challenges which we have had to be overcome to make our academic open source tools [1] more suitable for industry. Particular attention in this presentation will be given to the role of robustness for high Reynolds number flows [4].

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