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GENERATION OF HIGH ORDER CURVILINEAR SPECTRAL ELEMENT MESHES FOR AERODYNAMIC APPLICATIONS

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High order methods are state of the art of the current scientific research and applications in the field of aerodynamic flow simulations for aeronautical industry. Practical engineering geometries are characterized by a high degree of geometrical complexity which an automatic grid generator must be able to handle. Hence, the application of high order solvers requires generation of high order computational grids [1].

In the present study the authors discuss the case of the curvilinear spectral element grid generation, where the order of the polynomials representing the solution within the elements is equal to the order of the functions describing the curvilinear boundaries of the subsequent elements. First, the authors discuss in details the algorithm of grid generation and focus their attention on proper distribution of quadrature points for high order methods at the element boundaries as well as within the inner area of the elements. Much effort has also been made in order to avoid generation of negative volumes which is an important issue especially in proximity of highly curved surfaces of the original geometry such as leading edge of the airplane wing etc.

Furthermore, the authors show the results of grid generation using this algorithm for practical applications. The benchmarks come from the aeronautical industry and the result of application of the algorithm to the L1T2 airfoil is shown in Fig. 1.

The study is concluded by an analysis emerging from the significant question how the order of the geometry representation for a curvilinear grid shall be adjusted to improve the accuracy of the aerodynamic flow predictions with respect to the analogical straight-sided spectral elements. For that reason the authors have carried out a number of flow simulations on both curvilinear and straight-sided grids. The aerodynamic lift coefficient calculated for different

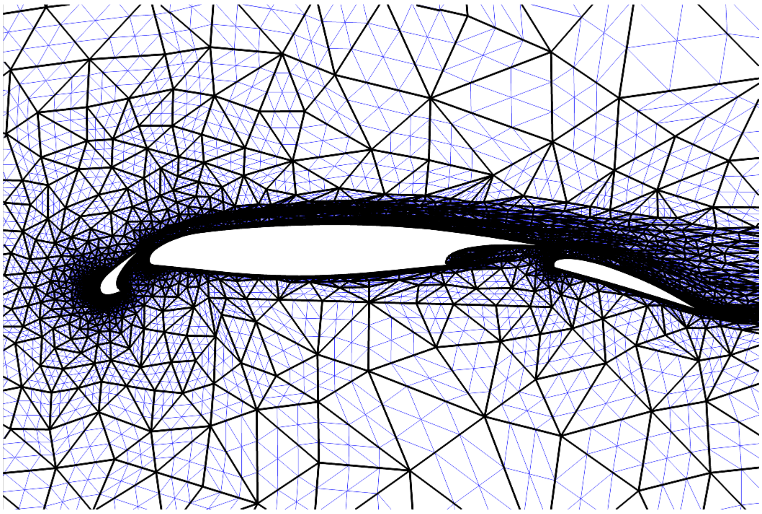

Figure 1 - High order grid around a L1T2 airfoil.

orders of the grid with curved-sided and straight-sided elements has been compared with the reference solution. Thus, the final comparison gives information on the convergence of the lift coefficient to the correct value with respect to the number of global degrees of freedom in the mesh.

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