An IGA-BEM solver for Lifting Flows around Wings

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ABSTRACT

This presentation will focus on investigating the performance of an in-house developed solver for lifting flows around wings. The solver, being under development by the first author in context of his PhD work [1], [2], is a collocation scheme for solving the Boundary Integral Equation (BIE) resulting from combining T-splines-based Iso-Geometric analysis (IGA) with Boundary Element Methods (BEM).

A challenge that has to be handled for flows of this type is to satisfy the so-called Kutta condition, namely, secure zero-pressure jump at the trailing edge (TE) of the wing. Assuming a known wake surface, this constraint leads, after collocating over TE, to a set of quadratic equations for the unknown coefficients of the projection Φ_p of the velocity potential Φ onto the T-spline space spanned by the basis used from the geometric representation of the wing surface. Combining this set of quadratic equations with the linear system obtained by collocating the BIE on the wing surface, we get a quadratic system $S(\Phi_p)$ that is solved with a Newton-Raphson technique using as starting point the solution of the collocated BIE resulting by adopting a linear approximation of the Kutta condition, referred to as the Kutta-Morino condition.

The performance of the solver will be tested and illustrated against the following aspects:
(i) Robustness and convergence of the iterative solution of the quadratic system $S(\Phi_p)$;
(ii) Comparison against experimental results and low-order panel methods, e.g., [3];
(iii) Influence of the geometry representation of the wing on the physical validity of the obtained results, e.g., behavior of the pressure-coefficient distribution along the span of the wing with emphasis in the area of the tip;
(iv) Convergence rate against global and local refinement;
(v) Measuring the error of the pressure jump on the wake.

REFERENCES

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