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An isogeometric BEM for exterior potential-flow problems around lifting bodies

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ABSTRACT

In this paper, the isogeometric concept introduced by Hughes et al (2005), in the context of Finite Element Method, is applied to Boundary Element Method (BEM), for solving the exterior Neumann problem associated with the steady lifting flow around a hydrofoil. This work extends our previous analysis (Politis et al 2009) concerning similar problems without circulation.

The formulation of the problem is based on a Boundary Integral Equation for the associated velocity potential (Morino, 1993) combined with the Kutta condition requiring zero-pressure jump at the trailing edge. The developed Isogeometric-BEM is based on a parametric NURBS representation of the hydrofoil and employs the very same basis for representing the velocity potential.

The Boundary Integral Equation is numerically solved using a collocation method where as collocation points are used the Greville abscissas of the knot vector. Numerical error analysis of the Isogeometric-BEM, using various refinement techniques (h-, p- and k-refinement), will be performed and compared with classical low- and higher-order panel methods. Moreover, a parametric geometric model will be used for optimum design of the hydrofoil by embedding the hydrodynamic solver to an optimization process.

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