An IGA-BEM Method for the Open-Water Marine Propeller Flow Problem

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ABSTRACT

In this work we deal with the problem of the flow around a marine propeller rotating with constant angular velocity in a stream of uniform velocity parallel with the axis of the propeller (open-water mode of operation). The flow is considered to be inviscid, incompressible and irrotational except for the *wake*, which is an a-priori unknown force-free vortex sheet surface emanating from the trailing edge of each blade. In this setting, the problem can be formulated as a Fredholm Boundary Integral Equation of the 2nd kind with respect to the strength of normal dipoles distributed over the propeller's boundary and the wake [2]. This BIE is accompanied by conditions on the wake, namely no flow and no pressure jump across it [1], as well as appropriate conditions for vanishing disturbance at infinity . Adopting the concept of Isogeometric Analysis (IGA), the solution of the continuous problem is approximated via a discrete space involving a bicubic T-spline basis used for representing the boundary surface of the propeller and its wake. The resulting linear system is solved iteratively so that the shape of the wake secures zero-pressure jump through it (wake alignment) [3]. Using an in-house developed code, the proposed IGA-BEM scheme is tested against simple (e.g., cycloid) blade shapes and its performance is compared with results available in pertinent literature.

REFERENCES

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