Equilibrium analysis of an immersed rigid leaflet with virtual elements

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Talk Abstract

In this talk we present a study [1], both theoretical and numerical, on the equilibrium of a hinged rigid leaflet with an attached rotational spring, immersed in a stationary incompressible fluid within a rigid channel.

Through a careful investigation of the properties of the domain functional describing the angular momentum exerted by the fluid on the leaflet (which depends on both the leaflet angular position and its thickness), we identify sufficient conditions on the spring stiffness function for the existence (and uniqueness) of equilibrium positions.

We propose a numerical technique that exploits the mesh flexibility of the Virtual Element Method [2] (VEM). A (polygonal) computational mesh is generated by cutting a fixed background grid with the leaflet geometry, and the problem is then solved with stable divergence-free VEM Stokes elements [3] of degrees 1 and 2 combined with a bisection algorithm. We prove quasi-optimal error estimates and present an array of numerical experiments to document the accuracy and robustness with respect to degenerate geometry of the proposed methodology.

Keywords: Virtual Elements, fluid-structure interaction, divergence-free elements.

References

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