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A monolithic Finite Element formulation for the hydroelastic analysis of Very Large Floating Structures

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Floating offshore structures are of great interest for many applications. A particular type of floating structures are the so called Very Large Floating Structures (VLFS). One can find several examples of VLFS, such as floating airports, floating solar energy installations, floating breakwaters, or even futuristic floating modular cities. The study of the behavior of VLFS is, therefore, relevant for a wide variety of industries and scientific disciplines. In this work we present a novel monolithic Finite Element Method (FEM) for the hydroelastic analysis of VLFS with arbitrary shapes that is stable, energy conserving and overcomes the need of an iterative algorithm. The new formulation extends the monolithic FEM approach proposed by Akkerman *et al.* in [1] to floating thin structures, leading to a set of coupled mixed-dimensional PDEs. The formulation presented in this work is general in the sense that solutions can be found in the frequency and time domains, and overcomes the need of using elements with C^1 continuity by employing a continuous/discontinuous Galerkin (C/DG) approach as formulated in [2]. We show that the proposed approach can accurately describe the hydroelastic phenomena of VLFS with a variety of tests, including structures with elastic joints, variable bathymetry and arbitrary strucutral shapes. The formulation is implemented on the novel Julia-based FEM package Gridap.jl [3], which provides an efficient and user-friendly interface for the solution of complex mixed-dimensional PDEs.

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