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NAVIER-STOKES RESOLUTION USING IN-PLANE/OUT-OF-PLANE SEPARATED REPRESENTATION.

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Fluid flows in degenerated geometries, in which the characteristic length in one direction is much smaller than in the others, are a challenging task for standard mesh-based simulation techniques, that often require a tremendous number of discretization points or elements to provide accurate resolutions. Classically, ad-hoc simplifications or approximations (e.g. lubrication theory) are rather called for in order to conduct tractable simulations. In this work, we consider, within the Proper Generalized Decomposition (PGD) framework, an in-plane / out-of-plane separated representation of the solutions of the Navier-Stokes equations in thin geometries. The use of such separated representation allows a high-resolution representation of the solution evolution along the thickness coordinate while keeping the computational complexity characteristic of 2D simulations, since meshes are decoupled in the plane (coarse) and thickness (fine) directions. This technique is particularly well suited to obtain efficiently fine and accurate solutions in boundary layers or in narrow geometries when approximations based on lubrication theory are not suitable.

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