Port-Reduced Reduced Basis Component for incompressible fluid flows

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We develop a Port-Reduced Reduced Basis Component approach (PR-RBC) to solve partial differential equations (PDEs) that govern incompressible coastal and riverine fluid flows. Our method is presented for Stokes and Navier-Stokes equations. In this work, the PR-RBC formulation introduced in the literature is extended to incompressible flows, as well as to non-linear PDEs. The PR-RBC strategy incorporates several main ingredients: construction of a model using archetype components, finite element discretization, model reduction for the inter-component degrees of freedom (ports) and for the intra-component degrees of freedom (bubbles), treatment of the incompressibility, and offline/online decomposition.

The component study makes it possible to reduce offline learning to a few inexpensive components which characterize the geometry of the system, before operating on a larger scale during the online stage. The major interest of the method lies in the capacity of a single offline reduction study to analyze any new hydraulic system synthesized from a library of generic components initially configured.