A new Algorithm Based on Factorization for Heterogeneous Domain Decomposition

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Abstract: Often computational models are too expensive to be solved in the entire domain of simulation, and a cheaper model would suffice away from the main zone of interest. We present for an evolution problem of advection reaction diffusion type in one dimension a heterogeneous domain decomposition algorithm, and prove that we can recover a solution that is very close to the solution of the fully viscous problem, by only solving an inviscid problem in parts of the domain. Our new algorithm is based on the factorization of the underlying differential operator, and we therefore call it factorization algorithm. We present numerical experiments which show that our theoretical error estimates are sharp, and that the new factorization algorithm gives approximate solutions which are one order of magnitude more accurate in the viscous region than the best heterogeneous domain decomposition methods known from the literature. We also present a new multiscale expansion which gives more precise informations on the algorithm.

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