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A multiscale flux basis for mortar mixed discretizations of reduced fracture models

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We are concerned with the application of nonoverlapping domain decomposition methods on reduced fracture models. We provide for this problem a new DD algorithm in which the global problem is reduced to a mortar problem posed on the fractures that is solved by an iterative solver. Classical iterative methods are based on the CG or optimized Schwarz waveform methods which require solving one local Dirichlet or Robin problem on each subdomain per interface iteration. Increasing the number of fractures and refining the grids both lead to an increase in the number of iterations and the number of subdomain solves. One way to eliminate this dependency between the total number of subdomain solves and the fractures solves is to use multiscale basis functions. Precisely, the proposed algorithm involves precomputing the flux or velocity actions from the subdomains, called multiscale flux basis, associated with each mortar degree of freedom on every subdomain. This requires a fixed number of subdomain solves. Then, the subdomain solves required at each interface iteration are replaced by linear combinations of the precomputed multiscale flux basis functions. We test our algorithm on various test cases for two types of fractures, fractures which have a permeability higher than that in the surrounding medium and those in which the permeability is lower than that in the surrounding medium.

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