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Optimization-based additive decomposition of weakly coercive problems with applications to iterative solver design

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We present an abstract mathematical framework for an optimization-based additive decomposition of a large class of variational problems into a collection of concurrent subproblems. The framework replaces a given monolithic problem by an *equivalent* constrained optimization formulation in which the subproblems define the optimization constraints and the objective is to minimize the mismatch between their solutions. The significance of this reformulation stems from the fact that one can solve the resulting optimality system by an iterative process involving only solutions of the subproblems. Consequently, assuming that stable numerical methods and efficient solvers are available for every subproblem, our reformulation leads to robust and efficient numerical algorithms for a given monolithic problem by breaking it into subproblems that can be handled more easily. An application of the framework to the Oseen equations illustrates its potential.