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Reducing Nonlinear Complexity of Two-level Nonlinear Additive Schwarz Preconditioned Inexact Newton Method

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We propose and test a new two-level nonlinear additive Schwarz preconditioned inexact Newton algorithm(ASPIN). The two-level nonlinear preconditioner combines a local nonlinear additive Schwarz preconditioner and a global *linear* coarse preconditioner. This approach is more attractive than the two-level method introduced in Cai et al. (2002), which is nonlinear on both levels. Since the coarse mesh function evaluation only requires the solution of a linear coarse system rather than a nonlinear coarse system derived from the discretization of original partial differential equations, the overall computational cost can be reduced considerably. Our parallel numerical results based on a driven cavity incompressible flow problem show that the new two-level ASPIN is nearly scalable with respect to the number of processors, the fine mesh size, and Reynolds number, provided that the coarse mesh size is fine enough.