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New Coarse Space Components for Additive Schwarz

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The Additive Schwarz method (AS) does not converge in general when used as a stationary iterative method, and it can only be used as a preconditioner for a Krylov method. In the two level variant of AS, a coarse grid correction is added to make the method scalable. We propose new coarse space components which allow the two level method to become convergent when used as a stationary iterative method, and show that a suitable choice makes the method even nil-potent, i.e. it converges in two iterations, independently of the overlap and the number of subdomains. One of the coarse spaces we obtain is optimal, which means it uses the fewest number of basis functions possible for the method to become nil-potent. We also compare our coarse spaces with GenEO recently proposed by Spillane, Dolean, Hauret, and et al. We finally illustrate our theoretical results with numerical experiments.