AN OVERLAPPING ADDITIVE SCHWARZ-RICHARDSON METHOD FOR MONOTONE NONLINEAR PARABOLIC PROBLEMS[*]

M. MUNTEANU[†] AND L. F. PAVARINO[†]

Abstract. We construct and study a scalable overlapping Additive Schwarz-Richardson (ASR) algorithm for monotone nonlinear parabolic problems discretized implicitly in time. At each time step, the Additive Schwarz preconditioner is built using the linear part of the nonlinear operator, partitioning the domain of the problem into overlapping subdomains, solving local problems on these subdomains and solving an additional coarse problem associated with the subdomain mesh. This preconditioner is then applied to the nonlinear operator using a Richardson iteration. We prove first an abstract convergence result and then convergence rate estimates showing the scalability of the ASR algorithm. The results of numerical experiments in the plane confirm the theoretical estimates and illustrate the performance of the one and two-level ASR algorithm and in the presence of discontinuous coefficients in the parabolic operator.

Key words. monotone nonlinear parabolic problems, domain decomposition preconditioners, overlapping additive Schwarz, finite elements, implicit time discretizations

AMS subject classifications. 65M55, 65H05

[†]Department of Mathematics, Università di Milano, Via Saldini 50, 20133 Milan, Italy (`{Marilena.Munteanu, Luca.Pavarino}@mat.unimi.it`).