QUASI-NEWTON PRECONDITIONERS FOR
THE INEXACT NEWTON METHOD

L. BERGAMASCHI, R. BRU, A. MARTINEZ, AND M. PUTTI

Abstract. In this paper preconditioners for solving the linear systems of the Newton method in each nonlinear
iteration are studied. In particular, we define a sequence of preconditioners built by means of Broyden-type rank-one
updates. Optimality conditions are derived which guarantee that the preconditioned matrices are not far from the
identity in a matrix norm. Some notes on the implementation of the corresponding inexact Newton method are given
and some numerical results on two model problems illustrate the application of the proposed preconditioners.

Key words. Quasi-Newton method, Krylov iterations, updating preconditioners, inexact Newton method

AMS subject classifications. 65F10, 65H10, 15A12

*Received November 2, 2005. Accepted for publication January 24, 2006. Recommended by C. Brezinski.
†Department of Mathematical Methods and Models for Scientific Applications, University of Padova, Italy,
(berga,putti)@dmsa.unipd.it). Work partially supported by the Italian MIUR project “Numerical Models
for Multiphase Flow and Deformation in Porous Media”.
‡ Instituto de Matemática Multidisciplinar, Departamento de Matemática Aplicada, Universidad Politécnica de
Valencia, Spain, (rbru@mat.upv.es). Work supported by the Spanish DGI (FEDER) grant MTM2004-02998,
Generalitat Valenciana project GRUPOS03/062 and the research programme of the Univ. Politécnica of
Valencia. Part of the work of this author was carried out during his visit to the Department of Mathematical Methods
and Models for Scientific Applications of the Univ. of Padova.
§Department of Pure and Applied Mathematics, University of Padova, Italy, (acalomar@math.unipd.it).
Work supported by the research fellowship “Parallel implementations of exponential integrators forODEs/PDEs”.

76