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## **Globally Convergent Methods for Large Sparse Systems of Nonlinear Equations**

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1995

Dostupný z <http://www.nusl.cz/ntk/nusl-33607>

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Datum stažení: 21.07.2024

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Systems of Nonlinear Equations

L. Lukšan      M. Rozložník

Technical report No. 649

September 1995

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# Globally Convergent Methods for Large Sparse Systems of Nonlinear Equations <sup>1</sup>

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## **Abstract**

The paper is devoted to globally convergent methods for solving large sparse systems of nonlinear equations with an inexact approximation of the Jacobian matrix. These methods include difference versions of the Newton method and quasi-Newton methods like the Broyden and the Schubert ones. We propose two classes of Armijo-type descent methods and one class of trust region methods together with proofs of their global convergence. The considerable attention is concentrated on the application of conjugate gradient-type iterative methods to the solution of linear subproblems. We prove that both the GMRES and the smoothed CGS method can be used for the construction of the trust region methods for solving large sparse systems of nonlinear equations.

## **Keywords**

Nonlinear equations, Armijo-type descent methods, trust region methods, global convergence, inexact Jacobians, nonsymmetric linear systems, conjugate gradient-type methods, residual smoothing

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<sup>1</sup>This work was supported by the Grant Agency of the Czech Republic under grant 201/93/0429. First draft August 1995.

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