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STABILITY ANALYSIS OF NONLINEAR DISCRETE APPROXIMATIONS

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The stability of nonlinear (and linear) discrete approximations is connected to the analysis of the linearized discrete problem. It predicts the behaviuor of the solution and enables us to prove convergence results. It is noted in [1] that the selection of a proper iterative algorithm can help us not only to find a stationary solution of the mathematical model but also to get an important information on the stability of the obtained solution.

Our first example shows, that different iterative algorithms may have very different stability properties and the selection of the iterative algorithm should be based on the information about the stability of the differential problem. We investigate two iterative methods for solution of one problem of nonlinear optics. The main goal is not only to find a stationary solution but also to investigate its stability. It is shown that both methods have different stability properties and the less stable algorithm is close to the approximation of physically important non-stationary problem (see also [2].

We also compare the stability properties of the Euler and Newton methods. It is proved that the stability region of the Euler method approximates the stability region of the differential problem. The Newton method is not useful if we are interested not only to solve the problem, but also to investigate the stability of a solution.

New results on the stability of nonlinear time-dependent discrete problems with respect to initial conditions are obtained by Matus [3]. The second part of the talk deals with the application of the quadratic approximations of nonlinear schemes for the stability analysis of nonlinear difference schemes.

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