Hyperbolic Relaxation Method for Elliptic Equations in Numerical Relativity

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The constraint equations of general relativity can be formulated as a system of non-linear elliptic equations, which for example have to be solved to obtain initial data for evolutions in numerical relativity. As an alternative to well-known elliptic solvers, we show how the basic idea of parabolic Jacobi relaxation can be modified to obtain a new class of hyperbolic relaxation schemes that are suitable for the solution of elliptic equations. We describe the implementation of hyperbolic relaxation as a first order system in a pseudospectral evolution code, which bypasses the need for a conventional elliptic solver. First applications include initial data for binary neutron star systems.