Linearly implicit time integration of semilinear wave equations with dynamic boundary conditions

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In this talk we present a linearly implicit time integration scheme for semilinear wave equations with a non-stiff nonlinearity. Such methods treat the (stiff) linear part of the differential equation implicitly and the nonlinear part explicitly. Thus they require only the solution of one linear system of equations in each time step. We investigate the stability of the scheme and show a second order error bound.
As an application, we consider a finite element discretization of a semilinear acoustic wave equation with dynamic boundary conditions as in [2]. Based on the analysis in [1] we derive a full discretization error bound. Afterwards we present numerical experiments which show that the linearly implicit method is competitive to standard time integration methods like the Crank-Nicolson or the leapfrog scheme.

References

[1] D. Hipp, M. Hochbruck, and C. Stohrer, Unified error analysis for nonconforming space discretizations of wave-type equations, *to appear in IMA J. Numer. Anal.*, revised June 2018.

[2] E. Vitillaro, Strong solutions for the wave equation with a kinetic boundary condition, *Recent Trends in Nonlinear Partial Differential Equations. I. Evolution Problems, Contemporary in Mathematics*, pp. 295–307, 2013.