1067-65-252 **Dylan M Copeland*** (copeland@math.tamu.edu), Institute for Scientific Computation, Texas A&M University, College Station, TX 77843, and **Ulrich Langer**. *Domain Decomposition Solvers for Nonlinear Multiharmonic Finite Element Equations.*

In many practical applications, e.g. in computational electromagnetics, a time-harmonic excitation allows one to avoid expensive time-stepping schemes by switching to the frequency domain and solving a simple elliptic equation for the amplitude. This is possible for linear problems, but not for nonlinear problems. However, due to the periodicity of the solution, we can expand the solution in a Fourier series. Truncating this Fourier series and approximating the Fourier coefficients by finite elements, we arrive at a large-scale coupled nonlinear system for determining the finite element approximation to the Fourier coefficients. The construction of fast solvers for such systems is very crucial for the efficiency of the multiharmonic approach. In this talk, we construct and analyze nearly optimal solvers for the Jacobi systems arising from the Newton linearization of the large-scale coupled nonlinear system. Numerical experiments with parallel computations demonstrate the performance of the solver. (Received August 13, 2010)