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Predictive Mode Analysis of Parabolic Problems

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We consider a new theoretical tool for predicting the convergence rates of multi-grid methods applied to parabolic (space-time) problems. While local Fourier analysis (LFA) is typically used to predict the convergence behavior of multi-grid methods, numerical results show that, when applied to multigrid methods for certain parabolic problems, LFA does not offer its usual predictivity unless unrealistically long time intervals are considered. In this talk, we present a semi-algebraic approach to mode analysis that combines analytical mode analysis with numerical computation. We present results of applying this analysis to the one-dimensional diffusion equation and compare to LFA predictions. Numerical experiments show that our new analysis can be used as a predictive tool for these problems.