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Local Fourier analysis for staggered systems of PDEs

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For many systems of partial differential equations, multigrid methods are known to be amongst the most efficient numerical techniques for solving the resulting matrix systems. This efficiency results from achieving appropriate complementarity in the smoothing and coarse-grid correction processes; in practice, achieving this complementarity is often the most difficult (and always the most important) question in designing the multigrid process. In this talk, we discuss recent work in developing a general framework for the local Fourier analysis (LFA) of multigrid methods for arbitrary systems of PDEs. A particular motivation for revisiting this subject was to unify the treatment of staggered discretizations within LFA. Furthermore, a general technique for the LFA of overlapping multiplicative smoothers is presented. The resulting tools are demonstrated for a variety of systems of PDEs, including the Stokes, curl-curl, and grad-div systems.