Regularity Computations with Applications to Multigrid and Subdivision Schemes

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We outline our experiences with computing Sobolev and Hölder regularity of refinable vectors in two application areas: the design of prolongation operators for multigrid schemes with non-nested finite element spaces, and the investigation of surface $\sqrt{3}$-subdivision schemes which use face and edge values rather than vertex values. In the shift-invariant situation, the regularity questions occurring in these applications lead to large eigenvalue problems for the matrix transition operator associated with the underlying stationary vector subdivision scheme. We focus on iterative methods for solving these spectral problems. Finally, we demonstrate on natural examples taken from the above application areas that the existing theory and the developed Matlab routines can be useful in systematically investigating families of schemes. We also point out some of the remaining difficulties. Part of the work is joint with Q. Jiang and P. Schroeder.