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**Is the ideal approximation operator always ideal for a
particular C/F splitting?**

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Given a coarse grid, the ideal prolongation operator is defined by $\mathbf{P}_\star = [\mathbf{W} \quad \mathbf{I}]^T$, where the weight matrix, $\mathbf{W} = -\mathbf{A}_{FF}^{-1}\mathbf{A}_{FC}$, interpolates a set of fine grid variable (F -points) from a set of coarse grid variable (C -points), and the identity matrix, $\mathbf{I}$, represents the injection of C -points to and from the coarse grid (Falgout and Vassilevski, 2004). In this talk, we consider $\mathbf{P}_\star$, constructed from both traditional C/F splittings and C/F splittings corresponding to aggregates, for several challenging problems. We demonstrate the effects of the C/F splitting on the convergence of multigrid hierarchies constructed with $\mathbf{P}_\star$. Finally, we argue that $\mathbf{P}_\star$ may be misleading in demonstrating the “ideal” nature of interpolation of a given C/F splitting by providing numerical evidence that hierarchies built using $\mathbf{P}_\star$ converge more slowly than hierarchies built from alternative prolongation operators with the same C/F splitting. This is important as we wish to minimize the number of levels in a multigrid hierarchy by coarsening aggressively to yield a small set of C points for which $\mathbf{P}_\star$ may have relatively poor convergence.