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**Hub Snub: removing vertices with high degree from  
coarse-grid correction**

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Network scientists often employ numerical solutions to linear systems as sub-routines of data mining algorithms. Due to the ill-conditioned nature of the systems, obtaining solutions with standard iterative methods is often prohibitively costly; current research aims to automatically construct preconditioners that are optimally efficient and scalable for a very broad class of graph associated matrices and network topologies. Frequently, networks encountered have skewed degree distribution and small-world topology and we present new strategies to aggressively coarsen the underlying systems into significantly smaller, better-conditioned systems, from which smooth error is approximated with high accuracy. Aggressive coarsening strategies are often applicable as a preprocessing step for almost any other preconditioner. We demonstrate their efficacy in conjunction with adaptive algebraic multigrid.

In this talk, we focus on analyzing coarse grid selection strategies that eliminate high-degree vertices. We observe that there is often relatively little energy in smooth modes at central, high-degree vertices and propose completely ignoring these hubs in coarse-grid representation. Clever smoother design further improves this property. We develop an adaptive approach to identify which hubs are best candidates for removal from coarse spaces in the setup of the multilevel hierarchy. We discuss the trade-off between convergence factors and complexity involved in this process.