Parallel Computation of the Fiedler Vector and Solution of Large Sparse Linear Systems via Banded Preconditioners

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The eigenvector corresponding to the second smallest eigenvalue of the laplacian of a graph, known as the Fiedler vector, has a number of applications in areas that include matrix reordering, graph partitioning, protein analysis, data mining, machine learning, and web search. The computation of the Fiedler vector has been regarded as an expensive process as it involves solving a large eigenvalue problem. We present a novel and efficient parallel algorithm for computing the Fiedler vector of large graphs based on the Trace Minimization algorithm (Sameh and Wisniewski, 1982). We compare the parallel performance of our method with a multilevel scheme, designed specifically for computing the Fiedler vector, which is implemented in routine MC73_Fiedler of the Harwell Subroutine Library (HSL).

In the second part of this talk, we will demonstrate the application of the Fiedler vector by reordering the large elements closer to the main diagonal and extracting a banded preconditioner. We will show the scalability of our banded preconditioning method using the Spike algorithm for solving systems involving the preconditioner compared to other direct and iterative solvers such as MUMPS, SuperLU, Boomer-AMG, Trilinos-ML, and others.