The Vertex Separator Problem and Continuous Quadratic Programming

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Abstract

Given a network G, the Vertex Separator Problem is to find the smallest collection of vertices whose removal splits the network into two disconnected subsets of roughly equal size. The vertex separator problem has applications in computing sparse matrix re-orderings, in VLSI chip design, and in network security. A widely used heuristic for solving the vertex separator problem and other graph partitioning problems is the Kernighan-Lin algorithm, in which a given partition is improved by making a series of vertex exchanges between sets. In this talk, we consider a new approach to the problem in which the VSP is formulated as a continuous bilinear quadratic program. A specialized algorithm for solving the quadratic program (and thus, the VSP) is presented. For large-scale networks, the quadratic program is incorporated into a multilevel algorithm in which the original network is approximated by a series of coarser networks. We present numerical results comparing the sizes of separators obtained by our multilevel algorithm with those of the METIS graph partitioning package.