Spectral Graph Analysis with Unite and Conquer Approach

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The social networks can be represented by graphs where the summits correspond to the actors of the network and the relations between the actors. The spectral graph analysis can help to obtain information on the network. For example, the dominant eigenvector of the underlying large sparse eigenproblem can represent ranking and centrality and, the smallest ones can be used for graph clustering. To solve this problem, we propose an adaptation of restarted Krylov methods for high performance parallel architectures. This approach, called "unite and conquer" can be seen as a technique to precondition the restarted Krylov methods such as implicitly restarted Arnoldi/Lanczos methods. Indeed, there are two ways to optimize the execution of a restarted Krylov method to solve large sparse eigenproblem on a large-scale distributed system. The first one is to optimize the number of floating point operations per restart cycle through maximizing the concurrency inside a restart cycle while minimizing latencies. The second way is to accelerate/improve the rate of convergence for a given computational scheme. The unite and conquer restarted approach focuses on decreasing the number of restart cycles by coupling either synchronously or asynchronously several restarted methods called also co-methods. In the end of a restart cycle, each co-method locally gathers available results of all collaborating co-methods and selects the best one in order to create its restarting information. Consequently this permits the global reduction of the number of cycles to convergence. We show that our solvers issued from this approach are very efficient. This is particularly the case on undirected graph in the context of clustering applications.

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