Linear Programs with Alternative Block-Angular Structures: Implications for Parallelization and Model Management

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Abstract: Parallel decomposition is an efficient approach for solving various block-structured linear programs. In this paper, we examine a linear programming model that has alternative block-angular representations, and investigate how choice of representation might affect serial and parallel solution times. Specifically, we study the multicommodity extension of the well-known transportation problem with bounds on the node requirements. Depending on how the rows and columns of the coefficient matrix are ordered, this model yields alternative block-angular representations that differ in the number of coupling rows, and in the number and size of the diagonal blocks. Computational results, obtained using an MPI-implementation of the Dantzig-Wolfe decomposition algorithm on an SGI Origin 3800, indicate quite dramatic differences in solution times between the representations. We are also able to observe certain patterns in solution time when blocking is employed (i.e., when assigning more than one natural subproblem to a processor). Although preliminary in nature, our results have important implications for the model selection and solver distribution phases of emerging model management systems. Further study is needed to develop empirical timing models (e.g. regression) in order to establish robust guidelines for determining the best representation and optimal number of processors to be used in the solution process.

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