Regularization for Constraint Reduction Under Degeneracy

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Earlier within the scope of this grant, we proposed and studied "constraint-reduced" primal-dual interior-point algorithms for linear programming (LPs). Such algorithms take into account only a subset of the (dual) constraints in constructing search directions and achieve major speedup on important classes of LPs with large number of inequality constraints. Global and local quadratic convergence of several such methods has been proven under a minimal requirement that ensures the set of constraints active at the solution will eventually be contained in the working set.

This minimal requirement does not, in general, ensure that the "reduced" step is always well defined. When it is not, the working set of constraints is termed "degenerate". In the present work, we propose various ways to regularize this degenerate situation without imposing stronger assumptions on the working set of constraints, and while retaining previously obtained convergence results. Our results are of significant practical importance (in particular in many applications of interest to DOE), since most "real world" problems turn out to be degenerate. Planned extension to the context of convex programming, in particular convex quadratic programming, will be of direct application to entropy-based moment closure and to support-vector machines, which are two of the foci of our current and prospective DOE-supported work.

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†Department of Computer Science, University of Maryland, College Park, MD 20742. Research supported in part by DoE grant DEFG0204ER25655.