Tuesday, August 30, 14:00, Room H111

New Decomposition Method for Linear Programming Problems

Evgeny Golshtein, Russia Acad. of Science, Moscow, Russia

no abstract received

Tuesday, August 30, 14:30, Room H111

A New Method in Linear Programming

Valentin E. Brimkov, Bulgarian Academy of Sciences

We present an algorithm for solving the optimization Linear Programming Problem. The "classical Simplex Method is gradient in a sense that it ensures increasing (in the usual variants - the maximal possible) the value of the objective function on each itteration of the algorithm. Our method is gradient in some geometrical sense: Begining from a known vertex s, a sequence of consistent possible solutions (vertices) is generated, which are near around a straight line through s, determined by the cost vector. It is shown that the process leads to an optimal solution in a finite number of steps.

The algorithm would be effective for LP - polyhedrons with very large number of vertices.

Tuesday, August 30, 15:00, Room H111

On The Degree of Decentralization in Large-Scale Linear Programming

Karl Frauendorfer, Hochschule St. Gallen
Bernd Koch, Hochschule St. Gallen
Paul Stähly, Hochschule St. Gallen

Decomposition principles in large-scale linear programming are considered which are suitable for decentralized planning. Based on the (divisional) objective function and the (divisional) subproblems, bounds are derived for the optimal allocations of those resources that are shared by all divisions (common constraints). We examine the benefits associated with utilizing these bounds with respect to decentralization issues within decomposition principles. First numerical results are presented.

Semi-Plenary Lecture
Tuesday, August 30, 17:30, Room H104

Long-Step Strategies in Interior-Point Potential Reduction Methods

Yurii Nesterov, CORE, Louvain-la-Neuve

We analyze from a unique point of view the behaviour of path-following and primal-dual potential reduction methods on nonlinear conic problems.

We demonstrate that the most of the interior-point methods with $O(\sqrt{n}\ln\frac{1}{\epsilon})$ efficiency estimate can be considered as different strategies of minimization of a *convex* primal-dual potential in an extended primal-dual space. Their efficiency estimate is a direct consequence of large local norm of the gradient of the potential along a central path. It is shown that the neighborhood of this path is a region of the fastest decrease of the convex potential. Therefore the long-step path-following methods are, in a sense, the best potential-reduction strategies. We present three examples of such long-step strategies.

We prove also the efficiency estimate for a pure primal-dual potential reduction method, which can be considered as an implementation of a *penalty* strategy based on a "functional" proximity measure.

We demonstrate also that the same ideas can be used for developing infeasible start primal-dual interior point methods for conic convex nonlinear problems.

Wednesday, August 31, 14:00, Room H111

Some Recent Developments in the Probabilistic Analysis of the Simplex Algorithm

Karl-Heinz Küfer, Universität Kaiserslautern

Since Klee and Minty and others discovered exponential worst case behaviour for the well–known variants of the simplex algorithm, it has been a challenge for many mathematicians to explain the gap between the execellent practical perfomance and intractability in worst case situations. Using stochastic problem simulations Borgwardt and others analyzed the expected number of pivots required by the simplex algorithm. The expectation value can be estimated by a low degreed polynomial in terms of the problem dimensions. But expecation values alone do not quantify the probability of "bad examples, which require exponentially many pivots. Thus, the question for higher moments or at least for the variance has been posed. In our paper we answer the question partially. Using the rotation symmetry model for problem simulation and the shadow vertex algorithm we give sharp asymptotic bounds for the variance of the number of pivots required for certain classes of spherically symmetrical distributions.

Wednesday, August 31, 14:30, Room H111

Linear and Semi Assignment Problems: A Core Oriented Approach

Anton Volgenant, University of Amsterdam

A Linear Assignment Problem (LAP) with a dense cost matrix can be solved by first making this matrix sparse, i.e., the problem is solved on the core of the matrix. For a known LAP algorithm we give the related modifications. Computational results show that the algorithm then is suited to solve large problems. Problems up to size 2000 can be solved on a standard personal computer within about 75 seconds. Furthermore versions of the algorithm are described for non- sqare problems as well as for semi-assignment problems; computational results for problems up to size 2500 show again the success of the core oriented approach for assignment problems.

Wednesday, August 31, 15:00, Room H111

Randomized Simplex Algorithms on Klee-Minty Cubes

Bernd Gärtner, Freie Universität Berlin
Günter M. Ziegler, ZIB Berlin

We investigate the behavior of two most natural randomized simplex algorithms on special linear programs.

For this, we develop combinatorial models for the Klee-Minty cubes and similar linear programs with exponential decreasing paths. The analysis of two most natural randomized pivot rules on the Klee-Minty cubes leads to (nearly) quadratic lower bounds for the complexity of linear programming with random pivots. Thus we disprove two bounds conjectured in the literature.

At the same time, we establish quadratic upper bounds for random pivots on the linear programs under investigation. This motivates the question whether some randomized pivot rules possibly have quadratic worst-case behavior on general linear programs.

Wednesday, August 31, 15:30, Room H111

Existence and Duality Theory for Separated Continuous Linear Programs

Malcolm Pullan, University of Cambridge

We discuss recent developments in the theoretical study of separated continuous linear programs. These problems are infinite-dimensional linear programs as well as linear optimal control problems. Among other things, separated continuous linear programs serve as a useful model for various dynamic network problems where storage is permitted at the nodes.

The theoretical developments we present are twofold. Firstly, we give conditions on the problem data for the existence of optimal solutions that are piecewise constant, piecewise polynomial or more generally, piecewise analytic. These results are reminiscent of bang-bang results in linear optimal control. A counter-example is given to show that the piecewise nature does not hold under more general assumptions. Secondly, we present a detailed duality theory that closely resembles the duality theory of finite-dimensional linear programming. For instance, we present a notion of complementary slackness. This is followed by conditions for strong duality, that is, conditions under which there exist complementary slack primal and dual optimal solutions. The result given is sufficiently general to include any reasonable practical problem. We conclude with a counter-example to show that strong duality does not hold if the assumptions are weakened.

Wednesday, August 31, 16:30, Room H111

An Affine Scaling Algorithm for Linear Programming with Inequality Constraints

Michael Dowling, Technische Universität Braunschweig

A primal, interior point method is developed for linear programming problems for which the linear objective function is to be maximised over polyhedra that are not necessarily in standard form. This algorithm concurs with the affine scaling method of Dikin when the polyhedron is in standard form, and satisfies the usual conditions imposed for using that method. If the search direction is regarded as a function of the current iterate, then it is shown that this function has a unique, continuous extension to the boundary. In fact, on any given face, this extension is just the value the search direction would have for the problem of maximising the objective function over that face. This extension is exploited to prove our convergence results. The algorithm presented here can be easily extended to convex, quadratic programming problems and, with more effort, to much more general, non-linear programming problems.

Wednesday, August 31, 17:00, Room H111

Some Interior-Point-like Methods for the Linear Complementarity Problem

Christian Kanzow, Universität Hamburg

Interior-point methods for the linear complementarity problem try to solve the perturbed complementarity problem $x > 0, y > 0, y = Mx + q, x_i y_i = \mu$ for all i approximately and update the parameter $\mu > 0$ in such a way that μ approaches zero in order to obtain a solution of the linear complementarity problem itself. In so-called infeasible interior-point methods the linear equations $y = Mx + q$ do not necessarily have to be satisfied exactly, which is important in practical implementations; in particular, this makes it easier to find appropriate starting vectors. However, both interior-point and infeasible interior-point methods require positive vectors (x, y) during the whole iteration, which can lead to small stepsizes. Here, we present some reformulations of the perturbed complementarity problem as a system of nonlinear equations. In our algorithms, which are based on these reformulations, we still try to follow the central path, but we do not require the iterates to be in the positive orthant. The recently proposed method of Chen and Harker (SIAM J. Matrix Anal. Appl. 14, 1993, 1168–1190) can be shown to be equivalent to one of our reformulations. Some numerical results will be presented.

Wednesday, August 31, 17:30, Room H111

Generalized Continous Variable Dynamic Linear Programming

Janez Usenik, University of Ljubljana, Slovenia

The article presents an algorithm for modification of continuous dynamic linear programming. The innovation is that the matrix $A(t)$, in which all the elements are functions of t, $t \in [0, T]$, $T < +\infty$, is divided into two parts: $A(t) = [A_0(t) \vdots \tilde{A}(t)]$. In the first submatrix $A_0(t)$ all the elements are finite functions known in advance, in the second one the elements are, however, unknown but linked convexly in columns:

$\tilde{A}(t) = [\hat{P}_{\mu+1}(t)\ \hat{P}_{\mu+2}(t)\ \ .\ .\ \ \hat{P}_n(t)]$, $\hat{P}_j(t) = [\tilde{a}_{1j}(t)]\ \ .\ .\ .\ \ \tilde{a}_{nj}(t)]^T$,

$\hat{P}_j(t) \in C_j(t)$, $j = \mu + 1, \mu + 2, \ldots.., n$. The task is to find optimum of criterion function $[c(t), x(t)]$ and at the same time to determine optimum structure of unknown variable columns. This means that according to the meaning of the elements of matrix $A(t)$ in actual practice the described method represents in a wider sence important aid in (re)modelling the economy.

Wednesday, August 31, 18:00, Room H111

Contemporaries

Steven Vajda, University of Sussex in Brighton, England

About 50 years ago G. B. Dantzig developed his Simplex method for the solution of Linear Programming problems; this method concerns questions of the production and distribution of goods. At about the same time L. V. Kantorovich published his method to find optimal procedures in the planned economy of the (then) Soviet Union.

We compare the two methods by considering the manufacture by given tools of production.

The 'shadow-prices' of the Simplex method are analogous to the 'multiplicators' of Kantorovich. But the two concepts are not identical. However, we find a conspicuous parallelism in the performance of the two methods.