Title: Decomposition of arrow type positive semidefinite matrices with application to topology optimization

Speaker: Michal Kocvara

Abstract: Decomposition of large matrix inequalities for matrices with chordal sparsity graph has been recently used by Kojima et al. to reduce problem size of large scale semidefinite optimization (SDO) problems and thus increase efficiency of standard SDO software. A by-product of such a decomposition is the introduction of new dense small-size matrix variables. We will show that for arrow type matrices satisfying suitable assumptions, the additional matrix variables have rank one and can thus be replaced by vector variables of the same dimensions. This leads to significant improvement in efficiency of standard SDO software. We will apply this idea to the problem of topology optimization formulated as a large scale linear semidefinite optimization problem. Numerical examples will demonstrate tremendous speed-up in the solution of the decomposed problems, as compared to the original large scale problem. In our numerical example the decomposed problems exhibit linear growth in complexity, compared to the more than cubic growth in the original problem formulation. We will also give a connection of our approach to the standard theory of domain decomposition and show that the additional vector variables are outcomes of the corresponding discrete Steklov-Poincaré operators.