Euclidean Distance Matrices, Semidefinite Programming and some related Problems in Graph Theory

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Abstract:

Let $G = (V, E, \omega)$ be an edge-weighted graph with node set V, edge set E, and non-negative weights ω_{ij} on the edges. A realization of G in $\Re^r$ is a mapping of the vertices of G into points in $\Re^r$ such that every two adjacent vertices v_i, v_j of G are mapped into points p^i, $p^j \in \Re^r$ whose Euclidean distance is equal to the weight ω_{ij}. G is said to be realizable if there exists a realization of G in $\Re^r$ for some positive integer r.

The Graph realization problem is the problem of determining whether a given graph G is realizable or not. Such problem arises in many different fields, namely chemistry (molecular conformation), statistics (the multidimensional scaling) as well as archaeology, genetics, geography etc.

In this talk we discuss the graph realization problem. Using Euclidean distance matrices, we formulate this problem as a semidefinite program. A primal-dual interior point method is then used to solve the resulting problem. We also present necessary and sufficient conditions for the solution to be unique.

Bio:

Dr. Alfakih obtained his PhD in operations research from the University of Michigan in 1996. He held postdoctoral fellowships at the department of combinatorics and optimization of the University of Waterloo, Canada; and at the Technical University of Munich, Germany. He also held visiting positions at the Fields Institute for research in mathematical sciences in Toronto and the University of Toronto. Prior to his current position as an ERCIM fellow at the Norwegian University of Science and Technology, Dr. Alfakih was a member of technical staff at Bell Laboratories in New Jersey, USA.

Dr. Alfakih research interests are in the area of linear, nonlinear, combinatorial, and semidefinite optimization and their applications.