Convex formulations and relaxations of geometric packing problems

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Abstract

Packing problems in geometry can be formulated as finding the weighted independence number of an infinite graph. A classical result due to Motzkin and Strauss gives a characterization of the independence number of a finite graph in terms of copositive optimization. In this talk I will extend this result to infinite graphs. For this a duality theory between the primal cone of copositive kernels and the dual cone of completely positive measures is developed.

One way to relax this copositive formulation is to use semidefinite optimization and the weighted theta number of Grötschel, Lovász, Schrijver. I will demonstrate this in the case of multiple-size sphere packings. To approximate this infinite dimensional semidefinite program the use of tools from polynomial optimization are essential. Next to presenting numerical results (complementing recent results by Hopkins, Jiao, Stillinger, Torquato) I will emphasize the importance of the right choice of polynomial basis functions to guarantee numerical stability.

(based on joint works with David de Laat, Fernando Mario de Oliveira Filho, Cristian Dobre, Mirjam Dür)