MATH+ Spotlight Talk
20 November 2024

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Rigidity and Reconstruction of Convex Polytopes via Wachspress Geometry

Abstract:

In how far is a convex polyhedron or polytope (= a polyhedron in higher dimensions) determined by partial combinatorial and geometric data, such as its edge graph, edge lengths and dihedral angles, up to combinatorial type, affine equivalence or isometry? Questions of this nature have a long history and are intimately linked to rigidity theory, algebraic combinatorics and real algebraic geometry.
After a short survey of the state of the art I will focus on the following reconstruction conjecture: is a polytope uniquely determined by its edge graph, edge lengths and the distances of its vertices from some interior point? If true, this would generalize and unify a number of results, such as Cauchy's rigidity theorem, the Kirszbraun theorem, as well as the reconstruction of matroids from their base exchange graph. I will elaborate on how this conjecture was resolved in three relevant special cases using tools from Wachspress Geometry and why a full resolution of the conjecture hinges on understanding the so-called Wachspress variety.