

Polytope Rigidity – Generic, Concrete and Universal

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If we consider a polytope as a point-hyperplane framework we can study its deformations that preserve both edge lengths and face co-planarities. In collaboration with Bernd Schulze, Matthias Adrian-Himmelman and Albert Zhang we worked out the rigidity theory of these systems of which I will give an overview in this talk. A main findings was that generically chosen polytopes are rigid, but that already quite small non-generic polytopes can show intricate rigidity behavior. First, we identified natural examples that require techniques of third or higher order where practical rigidity certificates are not yet available. Second, we show that already 3-dimensional polytopes exhibit local universality: for every real algebraic set S we can construct a 3-polytope whose deformation space is locally equivalent to S . This is achieved by generalizing the classical grid bracing problem to higher dimensions and establishing a duality between polytope rigidity and rigidity of spherical frameworks.