Matrices for analysing rigidity and global rigidity of periodic frameworks

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Abstract

Rigidity theory is concerned with the (local and global) rigidity and flexibility analysis of bar-joint frameworks and related constraint systems of geometric objects. This area has a rich history which can be traced back to classical work of Euler, Cauchy and Maxwell on the rigidity of polyhedra and skeletal frames. One of the major recent research directions in this field, which was in part pioneered by S.C. Power, is to extend the rigidity analysis of finite frameworks to infinite periodic or crystallographic frameworks.

A classical tool for analysing the *local* rigidity of finite frameworks is the rigidity matrix. Similarly, an important tool for analysing the *global* rigidity of finite frameworks is the stress matrix, which was first established by R. Connelly in 1982 based on the idea of an energy function for a framework. In this talk we will introduce these matrices and some of their key properties, and we will discuss extensions of these matrices for periodic frameworks. A periodic analogue of the rigidity matrix was established by C. Borcea and I. Streinu in 2010, and this matrix has played a fundamental role in obtaining results on the local rigidity of periodic frameworks. In recent (and ongoing) work with Shin-ichi Tanigawa and Louis Theran we have also established a periodic analogue of the stress matrix.