Elastic multipole method for describing deformations of 2D solid structures SIDDHARTHA SARKAR, ANDREJ KOSMRLJ, Princeton Univ — In recent years we have seen an explosion of mechanical metamaterials, where the geometry of highly deformable structures is responsible for their unusual properties, such as negative Poissons ratio, mechanical cloaking and tunable phononic band gaps. Understanding how such structures deform in response to applied external stresses is crucial for designing novel mechanical metamaterials. Here we present a method for predicting deformations of 2D solid structures with holes by employing analogies with electrostatics. Just like external electric field induces polarization (dipoles, quadrupoles, etc.) of conductive objects, external stress induces elastic multipoles inside holes. In structures with many holes the interactions between induced elastic multiploles are responsible for complex deformation patterns observed in experiments and finite element simulations. We demonstrate that our method can successfully predict deformation patterns in periodic as well as aperiodic structures with holes of varying sizes.

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