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Multistable Compliant Auxetic Metamaterials Inspired by Geometric Patterns in Islamic Arts AHMAD RAFSANJANI, DAMIANO PASINI, Mechanical Engineering Department, McGill University, PASINILAB TEAM — Beyond their aesthetic significance, geometric patterns in Islamic arts can offer a rich source of inspiration that can be used to create new mechanical metamaterials. In this work, we follow this route and present a new class of compliant mechanical metamaterials which simultaneously exhibit negative Poisson's ratio and structural bistability. Designed by finite element simulations, this multifunctional metamaterial is fabricated by perforating a symmetric cut pattern into a sheet of natural rubber. Its building blocks are rotating units with square or triangular shapes connected together with compliant flexure hinges. Under the action of uniaxial extension, the relative rotation between the adjacent members triggers snap-through instability and brings together auxeticity and structural bistability. As a result, this metamaterial can accomplish reversible reconfiguration between two stable arrangements.

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