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POLYGONAL MULTIRESOLUTION TOPOLOGY OPTIMIZATION FOR STRUCTURAL DYNAMICS

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The present research combines versatile polygonal elements with a multiresolution scheme to achieve computationally efficient and high resolution designs for structural dynamics problems. For typical quadrilateral and triangular elements, multiresolution methods have previously been developed that can use a coarse mesh for the displacement nodes, and finer meshes for design and density variables. This technique allows for a higher resolution of the solution, for only a slight increase in computational time. To implement the multiresolution approach for polygonal elements, ongoing work is focused on introducing conforming and non-conforming sub-discretizations within each polygon in order to obtain finer design and density variable meshes. The conforming approach uses the existing nodes and element centroid to divide the area of the polygonal element, while the non-conforming approach uses a mesh embedding approach to sub-discretize each of the larger convex polygonal finite elements. Both approaches use the centroids of the density variables as integration points for the finite element shape functions, as this has shown to provide accurate results for typical elements. The research work will focus on exploring optimization of eigenfrequency problems and also maximization of dynamic compliance problems. These problems often require more computational time within the system analysis as compared to the design optimization, and thus the multiresolution scheme is expected to provide faster computational time and improved quality solutions. We employ irregular domains to present sample solutions for structural dynamics problems. These include eigenfrequency and/or band gap (space between eigenfrequencies) maximization. Furthermore, we also investigate forced vibration problems where the displacement response at a point of the structure is minimized for a specified sinusoidal input.