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Implementation of fundamental-solution based hybrid finite element model for elastic inclusions of various shapes

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In the paper, a doubly periodic array of inclusions in infinite plane matrix is studied to determine its effective elastic properties. A representative rectangular cell containing single inclusion is solved using the present hybrid finite element model to obtain the numerical results of boundary tractions under the applied displacement boundary conditions. In the present numerical model, a general polygonal finite element with arbitrary number of sides is constructed by coupling the independent element interior and frame displacement fields. The element interior fields are approximated by the combination of fundamental solutions to prior satisfy the governing equation of the problem, so that the domain integral appeared in the weak-form functional is transferred to boundary integrals. Independently the element frame fields are approximated by the conventional shape functions to guarantee the continuity of adjacent elements. Following this, the polygonal inclusion elements are designed to reduce mesh effort in the inclusion domain. Several numerical examples are investigated for the effect of shape, volume fraction, elastic properties of inclusions and it is found that the present method gives good accuracy as compared with the conventional FEM.

Keywords: Doubly periodic inclusions; Representative volume element; Effective elastic properties; Polygonal inclusion element