IMAGE RECONSTRUCTION BASED 3-D STRESS ANALYSIS IN BRAIDED COMPOSITES: INDEPENDENT MESH METHOD

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An independent mesh modeling approach is proposed for complex multiple connected configuration of matrix in composite materials with three-dimensional fiber architecture. The approach is based on yarn surface geometry definitions imported from an image reconstruction and/or a predictive tool describing the yarn placement in the composite. The phase boundary between the yarn and the matrix is described as an approximation of the Heaviside step function with higher order shape functions. Polynomial B-spline approximation functions are used in the present paper. An advantage of the proposed method, originally proposed for crack modeling [1], is that its implementation only involves integration of the products of original shape functions and their derivatives and does not require modification of the integration domains. Fiber yarns are modeled by using displacement based spline approximation and yarn shape geometry. The displacement continuity condition between the yarns and the matrix are imposed by using penalty function method. Model solution for plates with inclusions were obtained and examined to evaluate the accuracy of the method. The proposed technique appears to tolerate small errors in yarn geometry definition, such as interpenetrations. Tensile loading of a tri-axial braided composite was considered.

[1] Iarve, E.V., "Mesh independent modeling of cracks by using higher order shape functions", *Int. J. Numer. Meth. Engng*, 2003, v56, 869-882.

Key words: Composite, tri-axial braid, spline