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3D composite finite elements for elliptic boundary value problems with discontinuous coefficients

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Review text:

The authors consider scalar and vector-valued elliptic boundary value problems with discontinuous coefficients across geometrically complicated interfaces. Using a composite finite element approach, a finite element method is developed to solve the problem under consideration. Some suitable Composite basis functions are constructed, mimicking the expected jump condition for the solution at the interface in an approximate sense. The construction is based on a suitable local interpolation on the space of admissible functions. The order of the approximation as well as the convergence properties of the method are studied. As applications, heat diffusion in an aluminum foam matrix filled with polymer and linear elasticity of microstructured materials, in particular, specimens of trabecular bone, are investigated. Furthermore, a numerical homogenization approach is developed for periodic structures and real material specimens which are not strictly periodic but are considered as statistical prototypes. Thereby, effective macroscopic material properties can be computed.

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