SM1S_11334

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Two Scale Finite Element Method

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A two scale computational method based on the finite element method is presented. A method is suited for problems with two length scales, macro and micro, where a direct numerical resolution of the micro scale by the standard finite element method is too expensive. At the micro scale a standard finite element method is used, while at the macro scale the Petrov-Galerkin method is used. The coordinate functions of the Petrov-Galerkin method are chosen to be the coordinate solutions of the associated micro scale problems while the weight function are the standard finite element basis functions of the macro scale finite element discretization. The method is illustrated by the computation of the torsion of the prismatic bar that at the micro mechanical level consists of the square cells with the elliptical fibres which are randomly oriented. Problems with several thousand cells and tens of the fibre orientations are readily computed.

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