POLITECHNIKA ŚLĄSKA
WYDZIAŁ MECHANICZY TECHNOLOGICZNY

Instytut Mechaniki i Inżynierii Obliczeniowej

Praca doktorska

Homogenizacja materiałów niejednorodnych z uwzględnieniem anizotropii oraz nieliniowych związków konstytutywnych

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Summary

The work presents the research on the development of computational methods that allow to improve a computational efficiency of homogenization of heterogenous materials with assumption of both the prescribed inclusion orientation distribution and nonlinear constitutive behaviour. The work is concerned with the homogenization including the novel method of optimal pseudo-grain discretization. The proposed approach leads to reduction of the pseudo-grains amount that is required to represent the prescribed orientation distribution which, in turn, results in homogenization that is more computationally efficient. The usage of proposed method allows to determine the parameters of the pseudo-grains that are essential to perform the two-step homogenization. The effectiveness of the optimal pseudo-grain discretization method has been presented by performing the homogenization of selected composite and porous materials.

Another original contribution of this work is the formulation of novel method of generation of three-dimensional geometry of the representative volume elements (RVE) with consideration of the prescribed orientation distribution of the inclusions. The task of a new method is a determination of spatial orientation of the inclusions in such a way that a set of the inclusions represents the prescribed orientation distribution. This goal has been reached by introducing a modification of previously formulated optimal pseudo-grain discretization method. The introduced novel method of RVE generation allows to represent the prescribed orientation distribution by applying the reduced number of inclusions in comparison with other methods presented in literature. An effectiveness of proposed method has been presented by generation of the RVEs representing selected composite and porous materials. The direct finite element method based homogenization has been performed on the basis of the generated RVEs.