# Multiscale Method for Static and Dynamic Analyses of Heterogeneous Materials

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A uniform extended multiscale finite element method (EMsFEM) is developed for solving the static and dynamic problems of heterogeneous materials in elasticity. To describe the complex deformation, a multi-node coarse element is proposed. In addition, the mode base functions are introduced to consider the effect of the interior forces of the structure for dynamic problems. Furthermore, the orthogonality between the displacement and mode base functions is proved theoretically. Numerical experiments show that the mode base functions almost do not work for the static problems, while they can improve the computational accuracy of the dynamic problems significantly. On the other hand, it is also found that the number of the macro nodes of the multi-node coarse element has a great influence on the accuracy of the numerical results for both the static and dynamic analyses. The uniform EMsFEM can obtain sufficiently accurate results with less computational cost by comparison with FEM.

**Keywords:** Multiscale computational method, Heterogeneous material, Dynamic analysis, Multi-node coarse element, Multiscale base function

**Acknowledgements**
The supports of the National Natural Science Foundation (11232003, 11072051, 90715037, 10728205, 51021140004), the 111 Project (B08014) and the National Key Basic Research Special Foundation of China (2010CB832704) are gratefully acknowledged.