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Numerical homogenization of trabecular bone microstructure using the standard mechanics approach^{*}

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Resumen

Numerical homogenization is a tool to determine effective macroscopic material properties for microstructured materials. In this work, the standard mechanics approach is used to compute the homogeneous anisotropic linear-elasticity tensor of trabecular bone. Trabecular bone is the material microstructure of bones, which is of enormous biomechanical interest and mainly located inside vertebral bodies and the epiphyses of long bones. It is often affected by osteoporosis in elderly humans. The homogenization procedure is based on a suitable set of microscopic finite element analysis on cubic specimens for macroscopic strain scenarios. The subsequent evaluation of the effective stresses and strains are used to determine homogeneous elasticity tensors. The analyses are performed for artificial periodic microstructures and for representative volume elements of actual trabecular microstructures obtained by means of micro CT scans. The presentation will address the theoretical aspects of the homogenization procedure and the details of its implementation, including the construction of the finite element models from the CT data. There will be discussed the effects of the boundary conditions on the solution.

Referencias

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