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DEVELOPMENT OF A HOMOGENIZATION TECHNIQUE FOR TRABECULAR BONE USING THE FABRIC TENSOR CONCEPT

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Summary: In the literature, it is possible to find several homogenization techniques capable to assist an efficient multiscale analysis. These homogenization techniques allow to predict the anisotropic macro-scale mechanical properties of heterogeneous materials (at their micro-scale level). Bone can be classified as hierarchical structure, where the different structural levels can be identified from the microscale to macroscale. In this work is presented a new homogenization technique for trabecular bone tissue. This technique uses as input a gray level medical image in which is used the Fabric Tensor concept. Using an orientation distribution function (ODF), that is provided by the fabric tensor concept, is possible to define the material preferential direction, that supplemented with a Phenomenological material law concept allows to define the mechanical properties for each principal direction of the material. Finally, with the material orientation and the mechanical properties for each principal direction, the material anisotropic constitutive matrix is defined. This proposed methodology efficiently homogenize the trabecular bone highly heterogeneous medium what allows to define its homogenized microscale mechanical properties and still to reduce the analysis computational cost (when compared with classical homogenization techniques). In order to verify the efficiency of homogenization technique several examples were solved using meshless methods, using a confined square patch of trabecular bone under compression.