APCOM & ISCM
11-14th December, 2013, Singapore

A stochastic homogenization approach to estimate bone elastic properties

***V. Sansalone[1], S. Naili[1], C. Soize[2], and C. Desceliers[2]**

Université Paris-Est, Laboratoire Modélisation et Simulation Multi Echelle, MSME UMR 8208 CNRS.
[1] 61, Avenue du Général de Gaulle, 94010 Créteil Cedex, France.
[2] 5, Boulevard Descartes 77454, Marne-la-Vallée Cedex 2, France.

*Corresponding author: vittorio.sansalone@univ-paris-est.fr

Mechanical properties of bone tissue depend on its hierarchical structure spanning many length scales, from the organ down to the nanoscale. Multiscale models allow estimating bone mechanical properties at the macroscale based on information on bone organization and composition at the lower scales. However, reliability of these estimates can be questioned in view of the many uncertainties affecting the information they are based on. In this paper, a new methodology is proposed coupling probabilistic modeling and micromechanical homogenization to estimate the elastic properties of bone while taking into account the uncertainties on the bone micro- and nanostructure. Elastic coefficients of bone solid matrix are computed using a micromechanical homogenization method. A stochastic treatment of the modeling variables allows propagating the uncertainties affecting their actual values into the estimated elastic coefficients of bone. Numerical simulations are used to show the relevance of this approach.

Keywords: Continuum micromechanics, Stochastic modeling, Maximum Entropy Principle, Elastic Properties