6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 – 15 June 2018, Glasgow, UK

# Microstructural Mechanical Properties of Human Cancellous Bone Based on Compression Test and Digital Image Correlation

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**Key Words:** *compression test of the cancellous bone, Digital Image Correlation, human cancellous bone mechanical properties, validation and verification of the FEM results*

The aim of the paper and presentation is to present the experimental testing technique of cancellous bone which is free from problems connected with the use of classical methods in many aspects. This technique is the coupling of the classical testing methods of mechanical properties of bone tissues with contemporary optical methods of displacement measurement. The optical methods provide non-contact measurements, what is the big advantage in the case of the testing the cancellous bone microstructure. The use of the Digital Image Correlation system with high-resolution cameras (5Mpx), using two or three cameras simultaneously observing two perpendicular surfaces of the cubic shape specimen will be presented. As the example the compression test of the cancellous bone microstructure, using the high-resolution Digital Image Correlation system for strain measurements, have been done for cubic shape specimens of the human cancellous bone, cuted out of the femoral heads. It allows evaluating orthotropic mechanical properties and detailed observation the bone microstructural behavior during loading. The results in the form of the stress-strain curves, mechanical parameters (Young modulus, yield point) and full field strain color maps will be also presented. Achieved results are comparable with results from the other much more complicated tests presented in the literature. The proposed technique is an easy and efficient way for testing the porous bone microstructures, where the geometry layout influences the mechanical behavior and samples are difficult to test. Additionally, as the DIC results are in the form of the color maps they can be directly used to finite element method numerical model validation and results verification. The numerical simulation of the bone compression test and method of results verification will also be presented. Acknowledgment: The study results presentation has been co-financed from the statutory subsidy of the Faculty of Mechanical Engineering of the Silesian University of Technology in 2018 and by a project 10/040/BK_17/0045, (BK-220/RMT-4/2017).

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