The 13th International Conference "Mechatronic Systems and Materials (MSM - 2017)"

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The aim of the conference is to provide an opportunity to share information and facilitate co-operation in mechatronics, new materials and dissemination of current research results in this multi-disciplinary field. The task of the Conference is not only to acquaint participants with the works of scientists from different countries, but to expand their collaboration in the future.

The abstracts are printed without editing, but as presented by their authors.

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FINITE ELEMENT ANALYSIS OF 3D PRINTED SCAFFOLDS

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ABSTRACT

The use of finite element analysis (FEA) as an alternative tool to evaluate the mechanical properties of 3D printed scaffolds is one of the first steps to find optimum 3D porous scaffolds with interconnected porosity and with good mechanical properties. First of all, the simulations and measurements are performed in a non-destructive way. This is important because mechanical properties are extracted without compromising the structure to real mechanical loads. The level of porosity, pore size distribution, pore morphology and the degree of pore interconnectivity in bone grafts significantly influence the extent of bone ingrowth [1]. To calculate porosity would be a important way to assist designing 3D scaffold with optimum characteristics as required for a particular patient in need. Such analysis can be used to vary several geometrical or material parameters at the same time and to choose the most suitable ones for the replacement of natural tissues [2].

Porosity and pore sizes of scaffolds play a critical role in bone formation. Pores are necessary for bone tissue formation because they allow migration and proliferation of osteoblasts and mesenchymal cells, as well as vascularization [3]. Porous scaffolds were designed varying parameters by SOLIDWORKS software. The chosen architectures are defined as woodpiles: geometry, where layer consists of parallel logs which are rotated certain angle every next layer. So, to change the porisity need to change main scaffold parameters: h – log high, b – log width, w – pore size, T - period ($b + w$) (Fig.1).

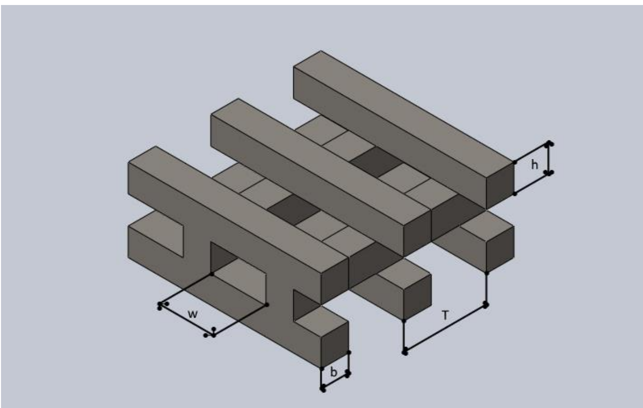

Fig. 1. Schematic diagram for scaffold parameters

In this work porous scaffolds were designed with various architectures by varying design. Various scaffold architectures can be imprinted by applying various lay-down patterns (0/90, 0/30/60/90/120/150, 0/60/120, and 0/20/40/60/80/100/120/140/160) as shown in Fig. 2

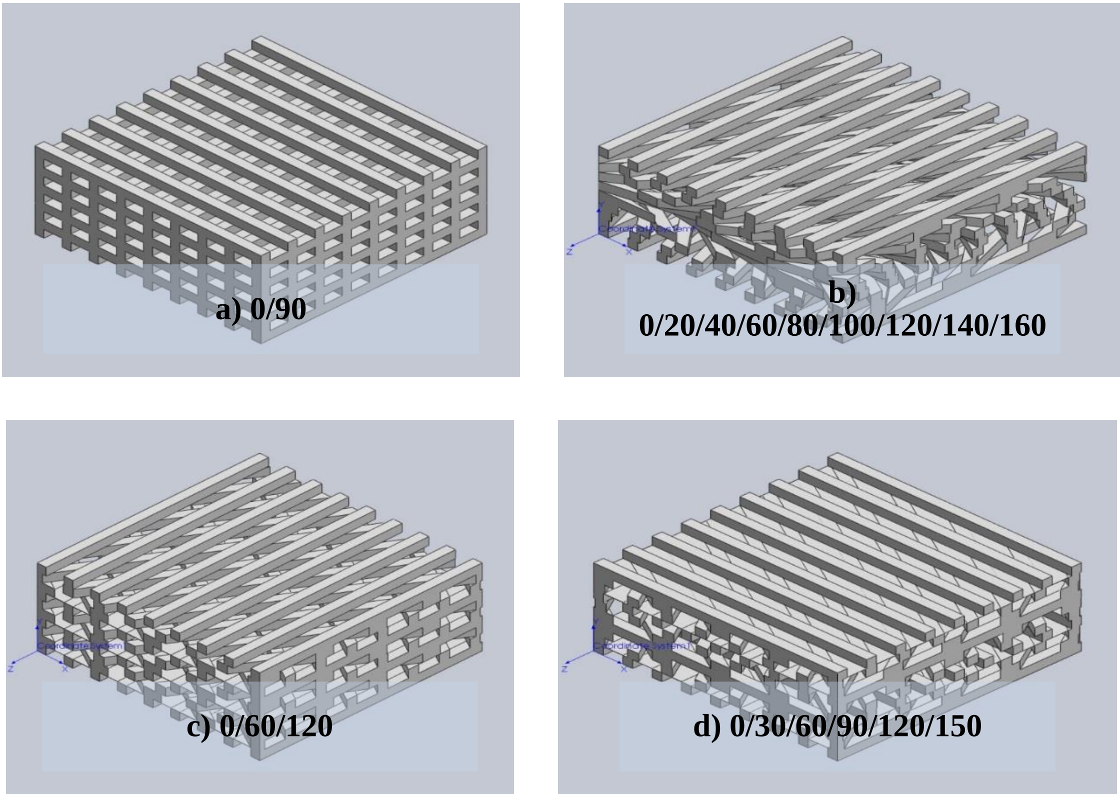

Fig. 2. 3D scaffolds with different architectures: a – logs are rotated 90 deg every next layer, b - each layer is rotated 20 deg in respect to the previous one, c - each layer is rotated 60 deg in respect to the previous one, d - logs are rotated 30 deg every next layer

Finite element modeling usage as an alternative tool to evaluate the mechanical properties of 3D printed scaffold is a good idea, because before the real test can find out which models are superior. Another important advantage is possibility to change the pore size and the final porosity before test.

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