Abstract

Keywords:

Personalised implants, finite element method, genetic algorithms, additive technologies

In medical fields, many new solutions have appeared in the last few decades to improve the diagnosis, therapy and recovery of patients. Orthopaedics and implantology are also experiencing dynamic development resulting from the need to help patients injured as a result of accidents, diseases and other conditions. Among orthopaedic implants, there are more and more studies dealing with the subject of the so-called personalised implants, which are designed to fit perfectly into a given patient. Such adjustment is possible thanks to the use of engineering tools that are designed to carry out the entire design process from obtaining imaging data to the implant model.

In the presented work, an attempt was made to automate and optimize the process of designing personalised implants. The developed algorithm is designed to prepare a model of an implant fitted on the basis of the patient's characteristic anthropometric parameters. Then, using meta-heuristic methods in the form of a genetic algorithm, various implant variants are generated, which are evaluated according to the adopted criteria in order to select the best design from among them. Implant models are evaluated using the finite element method. The paper presents the entire process of designing a fitted implant on the example of a femur implant, from the collection of patient imaging data, through the preparation of geometric, parametric implant proposals, to obtaining the best solution in an automated way. The results show that it has been possible to prepare an optimization method that allows to significantly speed up and simplify the process of designing personalized implants. Prepared models are adapted to be manufactured using additive technologies.