Editorial

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As it is well known, the term 'rapid prototyping (RP)' refers to a manufacturing technology that can be used to create various complex physical models and prototype parts from three-dimensional computer-aided design (3D CAD) model by means of layer-by-layer construction. One of the most interesting and challenging application of RP technology is in the field of medicine. Using principles of RP, 3D digital image of anatomical parts can be translated into data and can be used to manufacture a physical, 3D model. Medical RP models are physical hard copies of a patient's specific anatomy, visualised by 3D scanning techniques. These medical models provide visual and tactile information for diagnosis and operational planning. RP is impacting the medical sector in several ways. It has a critical application in any sector where it is indispensible to decrease product development time, while providing users with functional performance feedback. Since human lives extremely depend on the quality of various medical devices and products, there is more motivation to use additive technologies, like RP, in their development. RP models have numerous applications for treatment planning for complex surgery procedures, design and manufacturing of implants and prosthesis, direct manufacture of biology active implants, training, surgical simulation, diagnosis, design and manufacturing of several medical tools, etc. Applying RP in medicine is a multidisciplinary approach which demands strong knowledge of both engineering and medicine. It also requires many human resources and good collaboration between engineers, radiologists and doctors. There are still some more expectations and potential improvements in RP technologies in medicine. Developments in the cost, speed, materials and accuracy can help RP technology to provide maximum benefit in the field of medicine.

The aim of this Special Issue is to provide a comprehensive collection of the latest research and technical work in the area of rapid manufacturing related to the medical application. The title of this issue 'Rapid Manufacturing in Medical Applications' is to support, promote and publish high quality research results, advances and developments in the areas related to rapid manufacturing within the medical sectors.

The first paper, authored by Sood, Mahapatra and Ohdar, addresses fused deposition modelling (FDM) technology due to its ability to build functional parts having complex geometrical shape in reasonable time period. In this paper, effect of five important process parameters, such as layer thickness, orientation, raster angle, raster width and air gap on surface roughness along three surfaces of test specimen, has been studied. The validity of the models is tested using analysis of variance (ANOVA) and residuals. Bacterial foraging optimisation algorithm, a latest evolutionary approach, has been adopted to find out best process parameter setting which maximises multiresponse performance index.

Dietrich, Hayes and Liou present, in the second paper, a distinct requirement for a consistent mechanical property evaluation technique to be used as a baseline for direct part fabrication. This research portrays proven techniques developed by industry to evaluate additive manufacturing (AM) for a variety of applications. Data are generated using the techniques provided and are applied to the generation of statistical analysis assessments. Selective laser sintering has established process control specifications that are proprietary to the individual company that developed the process. However, FDM is gaining ground for AM applications. The research provided offers a path for technical specification development using case examples.

In the third paper, Surendiran and Vadivel present a hybrid classifier system which combines statistical classifier ANOVA discriminant analysis and neural network/radial basis function network. Various geometrical shape and margin features were introduced based on max radius and min radius to characterise the morphology of masses. In this paper, each mass is described by shape feature vector which consists of 17 shape and margin features. The experiment is conducted with Digital Database for Screening Mammography. The dataset is divided into training and testing dataset. The highest classification rate achieved is 91.56%. The results indicate that the hybrid classifier approach contributes greatly for the classification of mammogram mass into benign and malignant.

The fourth paper by Abbaszadeh, Rahmati, Kheirollahi and Farahmand introduces a new methodology for design of custom-made femoral stem, providing high accuracy of femoral canal reconstruction via 3D modelling of femoral stem with optimal fill and fit. The result of this methodology is optimised load transfer, minimum stem micromotion, increase in initial stability and extended durability. In addition to the above, the possibility of combining the stem with different modular necks to satisfy any type of femoral head shapes and facilitating the communication between designer and surgeon are other advantages. Applying RP technology has facilitated manufacturing of complex 3D femoral stems and has lead to time and economical benefits.

Wilson and Asiabanpour present, in the fifth paper, a new approach for the quality of the CAD files that are produced by the laser scanning for face reproduction process for forensic anthropologists in determining the unknown skull's true owner through a low cost method of facial reconstruction without losing the skull as the original evidence. The procedure includes: laser scanning and producing stereolithography (STL) files; splitting large files into smaller and manageable files; repairing, stitching and filling holes of all STL slices; hollowing the model and model prototyping. Results prove this to be a very promising method which could serve as a replacement for more expensive approaches that require magnetic resonance imaging and computed tomography scans.

In the sixth paper, Kheirollahi and Abbaszadeh introduce the application of RP techniques in dentistry and fabrication of dental prostheses. With the help of various RP techniques, the fabrication of dental prostheses can be done easily and rapidly that otherwise is difficult to generate them by other techniques.

The editors would like to thank the reviewers of this Special Issue. Without their assistance, this project would not have been possible. Finally, we would like to thank our contributors by allowing us to share the results of their research with the rest of the engineering community.