

Editorial

Welcome to a brand new year of 2010!

In this editorial, we bring you the latest update concerning rapid prototyping technologies, which of course many of you are aware, include many terminologies such as layer manufacturing and solid freeform fabrication, amongst others. The long-standing need to standardize the terminologies within the rapid prototyping and manufacturing industry has now been met with a new ASTM International standard, ASTM F2792, Terminology for Additive Manufacturing Technologies. The new document is the first approved standard under the jurisdiction of ASTM Committee F42 on Additive Manufacturing Technologies, which was formed in 2009.

Commenting on this, Mr Terry Wohlers, principal consultant and president, Wohlers Associates Inc., and chairman of Subcommittee F42.91 on Terminology, said that individuals and organizations have often used a wide mix of non-standard and poorly understood terms, which has led to confusing communication within the industry.

‘Terminology is used in everyday communication among individuals, in presentations, at industry events, in press releases and in magazine and journal articles’, said Mr Wohlers. ‘It is important that this communication is consistent and accurate, and it is our hope that ASTM terms are used rather than the haphazard approach of the past’. Primary users of the standard, according to Mr Wohlers, will include additive manufacturing users and producers, educational and research organizations, government agencies, investors, consultants, analysts and journalists.

He said that the recently published standard represents the first of at least two or three phases of work. ‘We chose some of the most important terms for the first group but have many more to identify and define’, he explained. All participation in future revisions to ASTM F2792 is welcome, particularly from current and potential users of additive manufacturing systems.

Besides the terminology, the standards under the jurisdiction of F42 cover many other aspects of Additive Manufacturing. Each main committee in ASTM International is composed of subcommittees that address specific segments within the general subject area covered by the technical committee. The subcommittee and the title of existing standards for each subcommittee are given as follows:

F42.01 Test Methods
F42.02 Processes
F42.03 Materials

F42.04 Design
F42.90 Executive
F42.91 Terminology

In this issue, we present five papers. In the first paper, Galantucci describes new challenges for reverse engineering in facial treatments. In particular, he provides insights into how the new 3D non-invasive surface measurements can support diagnosis and treatment, offering 3D measurements that would have been impossible to obtain only a few years ago, in terms of the rich information detail, precision, accuracy and reliability. In this paper the main aspects and methods for skull and facial scanning and measurement are analyzed, taking into account volumetric methods (CT, MRI) and surface approaches (laser scanning, structured light and photogrammetry).

In the second paper, Savalani *et al.* describe a miniature selective laser melting (SLM) system which was built specially to achieve better control of the atmospheric conditions in which magnesium would melt. Magnesium was chosen for the research because it has several intrinsic properties including its excellent biocompatibility, biodegradable, bioresorbability and proper mechanical properties which would make it suitable for orthopaedic applications. The results revealed that the SLM is a promising technique to fabricate magnesium substitute for various orthopaedic applications.

A case study is the focus of the third paper in the field of imaging-based thermal modelling and reverse engineering. Virtual prototyping of objects with thermal characteristic requirements depends on several aspects such as the geometry of the component, material properties, ambient environmental conditions and most importantly temperature curves/heat patterns of the component when functional. In this case study, Sukumar *et al.* present the data acquisition methodology towards thermal modelling of as-built automotive parts into their virtual prototypes. Results of immersing the reverse-engineered mesh in the thermal simulation environment are shown and the finite-element based simulation results are verified to agree with the thermal image sequences.

Next, Podshivalov *et al.*, propose a new approach of multi-scale finite element analysis of bone micro-structure which can provide physicians with a ‘digital magnifying glass’ supplying continuous bi-directional transition between macro- and micro-scales. In the macro-scale, the

material appears to be smoother and more homogeneous. The zooming-in process reveals additional details and the heterogeneity of the material. In this paper, the authors also consider the 2D geometric aspects, demonstrating the feasibility of the proposed method, using a multiscale domain-based geometric model.

Scaffold-based tissue engineering strategies often face the problem of tissues forming only within the periphery layers of the scaffold due to mass transfer issues. In the final paper of this issue, Tan *et al.* attempt to overcome this limitation by incorporating a 3D interconnected network of channels within the scaffold as part of the fabrication process so as to enhance nutrient delivery and cell migration. This article describes the developmental process of an indirect fabrication approach which involves the application of rapid

prototyping technology as well as the use of a foaming scaffold material to produce highly and uniformly porous scaffolds with complex channel architectures. Finally, cytotoxicity assessment confirmed that the multiple steps involved in the fabrication process did not induce toxicity within the scaffold.

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