Computer Graphics 2016: Enhancing the dimensional accuracy of a low-cost 3D printer

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3D printing is widely utilized in the show business by filmmakers, effect studios and game designers to simply and fast fabricate characters or objects that are first virtually modelled through special effects. There are several commercial proposals within the field of low-cost 3D printers, with prices ranging from a couple of hundred euros for kits that the users should assemble by themselves. However, their performances in terms of part accuracy are quite limited and are basically the consequence of a scarcity of optimization both in mechanical terms as in software. Starting from these considerations, an optimization project was assigned to the scholars of the Specializing Master in Industrial Automation of the Politecnico di Torino. The Master is developed together with COMAU S.p.a., a corporation worldwide leader in automation expecially for the automotive sector. The task of enhancing the performances of the 3D printer Prusa i3, that's supplied within the assembly box, was assigned to sixteen engineers attending the Master who were divided into 4 groups. The activities have led to the birth of 4 new 3D printers: Fluo, Ghost, Metallica and Print-Doh.

In order to assess and validate the improvements, a benchmarking activity was administered to guage the dimensional accuracy of the four printers. The benchmarking was supported the manufacturing of an innovative reference artifact whose geometrical features are designed to suit within different ISO basic sizes. Each group printed a reproduction of the reference spare their own new printer then the replicas were measured by means of a coordinate measuring machine (CMM). Measures were wont to compare the performances of the four printers and therefore the results of the benchmarking considers the dimensional accuracy of the replicas in terms of ISO IT grades, but also the shape errors of the geometrical features through GD&T tolerances.

Owing to the shortage of optimization, the dimensional accuracy of low-cost 3D printers is sort of limited. so as to reinforce the performances of a Prusa i3 3D printer, an optimization challenge was assigned to the scholars of the Specializing Master in Industrial Automation of the Politecnico di Torino. The enhancements were applied to four printers by manufacturing new self-replicated parts by means of an equivalent 3D printers. Finally, a benchmarking activity was wont to check and validate the results of the optimization activities. The benchmarking involved the fabrication of replicas of an innovative reference artifact by means of the modified printers. A coordinate measuring machine (CMM) was then wont to inspect the size of the replicas. Measures were wont to compare the performances of the four optimized printers in terms of dimensional accuracy using ISO IT grades. The shape errors of the geometrical features of the replicas were also evaluated consistent with the GD&T system. The benchmarking results show that the foremost effective modifications to the first printer were those associated with the development of the structure stiffness and chatter reduction. Low cost 3D printing' may be a terminology that mentioned the fused filament fabrication (FFF) technique, which constructs physical prototypes, by depositing material layer by layer employing a thermal nozzle head. Nowadays, 3D printing is widely utilized in medical applications like tissue engineering also as supporting tool in diagnosis and treatment in Neurosurgery, Orthopedic and Dental-Cranio-Maxillo-Facial surgery. 3D

CAD medical models are usually obtained by MRI or CT scans then are sent to a 3D printer for physical model creation. This paper is concentrated on a quick overview of advantages and limitations of 3D printing applications within the field of drugs also as on a dimensional accuracy study of low-cost 3D printing technique.