Holographic Interferometry of Thin-walled Structure Distortion during the Stereolithography Process

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Stereolithography is a widely used technology in the field of rapid prototyping that is now under intensive development. This technology is based on a photopolymerization process that uses ultraviolet radiation to selectively draw or print cross sections of a model on a photocurable resin surface. The photochemical process may be realized in two primary configurations: laser based vector by vector scanning and projection based layer by layer exposing. The advantages of such technology are well known. However, the implementation of new technologies is associated with a number of challenges. In particular, these include the problem for minimizing of the distortion of geometrical shape. This problem is most significant with additive manufacturing of thin-walled structures. The distortion may be caused by a number of reasons. The most important among them are: shrinkage accompanying the photochemical process, heating of curable surface during the projection exposition. Present communication deals with the issues of mathematical modelling for the distortion of thin-walled solids caused by mentioned above reasons and elaboration of experimental methodology for their identification.

From the mathematical point of view stereolithographically created solids may be formalized as growing deformable inhomogeneous bodies whose inhomogeneity is caused by junction of incompatible deformed parts. Pivotal role in the theoretical modelling is given to the implant field that determines the

inhomogeneity and depends on the processes on growing surface. Details of this theory are shown in [1-4]. In order to get the complete statements of the problem one have to obtain some experimental data concerning an evolution of growing process. This data may be represented by the time depend distortion of a part of the body surface that is not applied to the deposition. In order to implement this experimental procedure the setup based on holographic interferometry of distortion of thin-walled structure during the stereolithography process is developed. It allows identifying the distribution of distortion field with respect to various regimes of vector scanning and projection.

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References

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