Experimental-numerical methodology for the manufacturing of cranial prosthesis via laser forming

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ABSTRACT

This work presents an experimental-numerical methodology aimed at addressing the effect of laser beam power and scanning velocity on the thermomechanical material response during the laser bending of AISI 302 sheets. The main motivation is to obtain a database (with laser beam power and scanning velocity as the independent variables and the different deformation patterns as the dependent variables) to be used in the manufacture of 3D cranial prosthesis prototypes via laser forming. To this end, a series of single-pass laser bending tests are performed and, in order to achieve an adequate material characterization, the resulting bending angles are measured and compared with the corresponding numerical predictions computed by means of a coupled thermomechanical plasticity-based formulation, which is discretized and solved in the context of the finite element method, accounting for large strains, temperature-dependent material properties and convection-radiation phenomena. Finally, it should be mentioned that the procedure proposed in this work is an alternative design approach to the laser forming processes available in the literature [1-3].

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REFERENCES

[1] Jin Cheng, Y. Lawrence Yao, 2004. Process Design of Laser Forming for Three-Dimensional Thin Plates, *Journal of Manufacturing Science and Engineering 126*, 217-225.
[2] Chao Liu, Y. Lawrence Yao, 2004. Optimal Process Planning for Laser Forming of Doubly Curved Shapes, *Journal of Manufacturing Science and Engineering 126*, 1-9.
[3] Jitae Kim, S.J. Na, 2009. 3D laser-forming strategies for sheet metal by geometrical information, *Optics & Laser Technology 41*, 843-852.