Sensitivity analysis of geometric errors in additive manufacturing medical models

Cita: Pinto, J., Arrieta, C., Andia, M., Uribe, S., Ramos, J., Vargas, A., … Tejos, C. (2015). Sensitivity analysis of geometric errors in additive manufacturing medical models. *Medical Engineering and Physics, 37*(3), pp. 328-334. https://doi.org/10.1016/j.medengphy.2015.01.009

Abstract

Additive manufacturing (AM) models are used in medical applications for surgical planning, prosthesis design and teaching. For these applications, the accuracy of the AM models is essential. Unfortunately, this accuracy is compromised due to errors introduced by each of the building steps: image acquisition, segmentation, triangulation, printing and infiltration. However, the contribution of each step to the final error remains unclear.

We performed a sensitivity analysis comparing errors obtained from a reference with those obtained modifying parameters of each building step. Our analysis considered global indexes to evaluate the overall error, and local indexes to show how this error is distributed along the surface of the AM models.

Our results show that the standard building process tends to overestimate the AM models, i.e. models are larger than the original structures. They also show that the triangulation resolution and the segmentation threshold are critical factors, and that the errors are concentrated at regions with high curvatures.

Errors could be reduced choosing better triangulation and printing resolutions, but there is an important need for modifying some of the standard building processes, particularly the segmentation algorithms.