11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

ISOGEOMETRIC ANALYSIS FOR THE EVALUATION OF CAROTID ARTERY STENT PERFORMANCE

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Key words: *Isogeometric Analysis, Biomechanics, Carotid Artery Stenting*

Cardiovascular diseases are the main cause of death in western countries and they are responsible for hundreds of thousands of early deaths all over the world [1]. The current trend in clinical procedures requires high-tech and minimally invasive devices, in particular for cardiovascular applications (e.g., stents, valves, endoprosthesis, etc). Design, development, and performance assessment of these devices are a natural field of application for computational biomechanics, typically founded on engineering tools based on the Finite Element Method (FEM).

Isogeometric Analysis (IGA) has recently emerged as a cost-effective alternative to classical isoparametric FEM [2]. The main feature of the method consists of using typical CAD basis functions for both geometric description and variable approximation, in an isoparametric fashion. This implies the ability to describe exactly the computational domain geometry throughout the analysis process, thus simplifying the mesh refinement process, and to include, at the same time, the capability to control the basis function regularity. These features lead to a wide variety of approaches able to treat efficiently many FEM critical aspects and to attain better results on a per-degree-of-freedom basis (see, e.g., [3] and references therein).

The aim of this work is to develop a novel computational framework based on IGA to evaluate the performance of commercially available carotid artery stents. Analyses involving large deformations and different material models (elastic, elasto-plastic, shape memory alloys) are performed within the numerical solver FEAP and its additional package for IGA [4], and results obtained with IGA and standard FEM are compared and discussed in detail (see fig.1 for the results of an isogeometric simulation of a typical stent bending test).

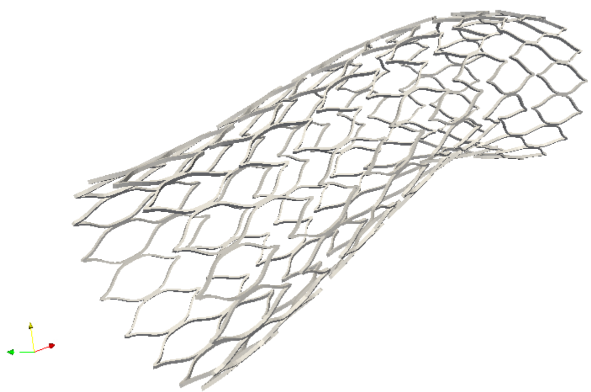

Figure 1: Bending test deformed configuration obtained via IGA.

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