GEOMETRY OPTIMIZATION OF NITINOL STENT DESIGN BASED ON FEA TOPOLOGY OPTIMIZATION

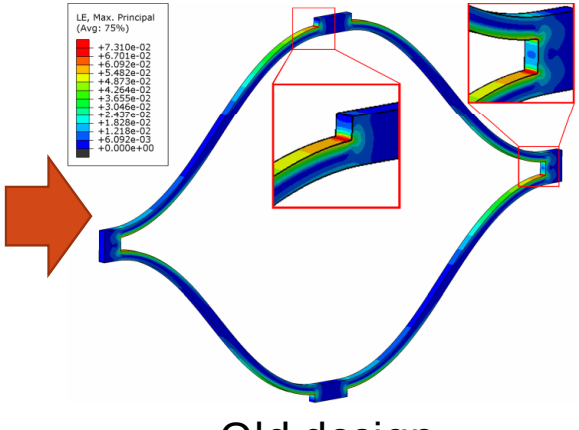
Dalibor Nikolic[1*], Dejan Krsmanovic[2], Nenad Filipovic[1,3]

[1] Bioengineering Research and Development Center, 34000 Kragujevac, Serbia

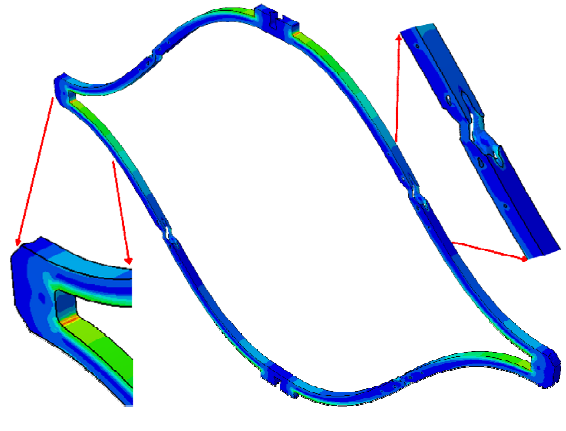
[2] CardioMed Technology Consultants, Miami, FL, 33014, USA

[3] Faculty of Engineering, University of Kragujevac, 34000 Kragujevac, Serbia

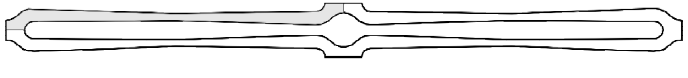
- **Introduction** – One of the problems in stent implantation is a process called in stent restenosis (ISR). In the pre-stent era, the occurrence of restenosis ranged between 32-55% of all angioplasties, and in bare-metal stent (BMS) era this range dropped to 17-41%. Many factors have influence on this phenomenon.
- **Aim** – Some studies show that in stent restenosis, strut shape and thickness have significant impact, especially if the stent is implanted in the small arteries. For better stent geometry modeling, we suggested novel approach – **topology optimization** on the existing stent design.
- **Materials and methods** – For evaluation of the topology optimization and mechanical performance of nitinol stents as well as comparison of differences between old design (non-optimized) and new optimized design the finite element method was used. Simulation was performed assuming that the stent devices used for this research were made by laser cutting, from tube form, by application of expanding and crushing force.
- **Results** – The behavior of two different stent models was analyzed: old Palmaz-Schatz design and optimized design obtained based on the results from topology optimization of the Palmaz-Schatz design. Performed simulation on stent models showed that the new modern design has better clinical behavior due to lower contacting surface, higher radial resistive strength and much better superplastic behavior. Optimization process was based on two optimization rules: minimization of the model volume and retention (or increase) of the maximal strain of the basic model.
- **Conclusion** – This new approach in stent optimization allows us to very easy create the best stent model based on old stent design.



Old design



Topology optimized design



New design