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Opinion on the PhD Thesis
by
Ing. Jan Veselý

Constitutive modeling of human saphenous veins under 3D stress state

1. Contents of this opinion

This opinion consists of the following sections:
- Scientific relevance of the submitted thesis
- Scientific contents of the work
- Extent of new knowledge contained in the work
- Quality of treatment of the topic including the organization of the work
- Conclusions

2. Scientific relevance of the submitted thesis

The thesis deals with the mechanical behavior of saphenous vein. As the saphenous vein is often used as an arterial bypass the knowledge of the mechanical behavior and material parameters is crucial for further development of artifical grafts and the coronary artery bypass graft surgery.

3. Scientific contents of the work

The inflation tests with free axial extension of a number of human great saphenous veins were conducted and described in the thesis. The aim being to obtain data suitable for multi-axial constitutive modeling at overloading conditions. A hyperelastic, nonlinear and anisotropic constitutive model based on the theory of closed thick-walled tubes was fitted to the data.

4. Extent of new knowledge contained in the work

The author of this opinion believes that this is the first study which presents a complete set of material parameters of the human saphenous vein modeled as a thick-walled tube. This model is suitable for describing the threedimensional stress state within the framework of the nonlinear theory of elasticity.

5. Quality of treatment of the topic including the organization of the work

The quality of the treatment of the topic is excellent. The main basis for this statement is the brilliant balance between fundamental theoretical and analytical work, and their comparison with extensive experimental data. The organization of the thesis is logical. The description of the state-of-the-art seems to be exhaustive. The original contribution of the author is presented in a lucid manner.
The candidate definitely meets the general demands of the industry by comprehensibility of the models and minimal demands on the input.
As a whole the thesis leaves a very good impression. Finally, it deserves mention that the linguistic style of the work is excellent.
In spite of the high quality of the thesis there are some ambiguities and arising questions:

- The relation (2) holds only if the coordinate systems x and X are Cartesian and overlapping.

- The part of the thesis devoted to description of elements of continuum mechanics is hardly comprehensible. That must be due to the effort to be brief.

- In (26b) should be Θ instead of θ.

- Regarding the deformation gradients F_A and F_B at (28) there is not an exact definition of the used coordinate systems. The question follows: *What exactly are the coordinates and how was the derivative $x_{i,K}$ perfomed?*

- At the page 50 it is expressed that it was impossible to reliably measure the opening angle α and that the angle was set zero. *Is or is not the knowledge of the residual stress essential to determine the material properties?*

- *What is the relation between the angle α in Fig. 18 and the one in Fig. 11?*

6. Conclusions

Based on the submitted opinion, consisting of an assessment of

- the scientific relevance of the thesis
- the scientific contents of the work
- the extent of new knowledge contained in the work
- the quality of treatment of the topic,

it is concluded that this work meets the highest quality standards.

The thesis by Mr. Veselý provides the evidence that the author did not only acquire in-depth knowledge in his scientific field but also developed the ability to extend the limits of knowledge in this field substantially.
All the goals of the thesis, though very high, have been completely fulfilled and it is the sincere belief of the reviewer that Mr. Jan Veselý should be, after the successful defence, awarded the **Ph.D.** degree.

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