THESIS REVIEWER'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Numerical Simulation of the Eye Structure Under Endoscopic Treatment**
Author's name:	**Jarno Mastomäki**
Type of thesis :	master
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of Instrumentation and Control Engineering
Thesis reviewer:	Josef Sepitka, Ph.D.
Reviewer's department:	Department of Mechanics, Biomechanics and Mechatronics

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	**challenging**

How demanding was the assigned project?

Assignment of the thesis was to perform numerical simulation of eye endoscopic needle due to surgery based on review of eye structure and suitable numerical method for simulation of an experiment. To access validity of the numerical results and to propose a possible modification of the model and numerical solution.

Fulfilment of assignment	**fulfilled with major objections**

How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.

The assignment was fulfilled with major objections. It is very difficult to follow the goals because they are not written in the thesis. Review is very poor and unprofessional. 1. There is no review of present endoscopes used in surgery in the thesis. The prototype used in the thesis is not compared to current equipment. 2. There is no any information about a physiology and anatomy of eye in the thesis. 3. Hyperelastic model study has just 2 references from scientific paper (22 and 23) and 2 references from Ansys software manual (24 and 25) and one reference (26) from internet blog! Reference 22 talks about hyperelastic models but knee ligaments are studied there. There is no any information about eye modelling in the reference 22. Reference 23 talks about porohyperelastic modelling of eye but porosity of the eye is not included in the thesis. 4. One of Moonle-Rivlin Model reference (30) is from private webpage. 5. Zonular fibres are modelled in the FE model but there is no any information about that before chapter 3.2.2. 6. There is not any review of mechanical properties of eye component in the thesis. Author wrote in Chapter 3.3.1: "There were no given elastic properties for such case in the literature." This is not true. I tried combination of topics "elastic properties:" and "sclera" in Web of Science from 2016 to 2020 and I obtained 32 results. 7. Whole theory and moduli description in Chapter 3.3.1 are wrong. Nanomechanical testing of human cornea was studied using nanoscale dynamic mechanical analysis. Author of thesis wrote theory of quasistatic nanoindentation but he moduli presented like elastic moduli are in the fact dynamic storage moduli. 8. Poisson ratio (0.49) of Sclera tissue combined in the Table 12 does not match with Poisson ratio used in equation 41 (0.50).

Methodology	**correct**

Comment on the correctness of the approach and/or the solution methods.

FE modeling of the of simulation of eye endoscopic needle and the eye due to surgery is ok.

Technical level	**C - good.**

Is the thesis technically sound? How well did the student employ expertise in the field of his/her field of study? Does the student explain clearly what he/she has done?

Technical level of thesis corresponds to the quality of review.

Formal and language level, scope of thesis	**C - good.**

Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?

Thesis starts at the page 18. Many typing errors in the thesis. Numbers of pictures (just empty brackets) and references are often missing in the texts.

Selection of sources, citation correctness	**E - sufficient.**
Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?	
Review is very pure and references are quite old. To cite blog is not reliable (ref 26). To compare results with source from Wikipedia (ref 60) is impermissible.	

Additional commentary and evaluation (optional)
Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.
Please insert your comments here.

III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

Question 1:
Could you describe differences between elastic modulus and storage modulus? Could you show the methods how to obtain elastic and storage moduli of biomaterials?

Question 2:
Porohyperelastic, viscoelastic and poroelastic material models of the eye are not applied in your FE model. Why did you choose hyperelastic model? Could you show me an advantage/non-advantage these models compare to hyperelastic model you used in the thesis?

Question 3:
Cornea and sclera were modeled like materials with the same elastic modulus. Do they have same elastic modulus? Could you show me range of elastic moduli of eye components published in present literature (cornea, sclera, retina etc.)?

Question 4:
Do you mean that mechanical properties of sclera or cornea are depth dependent? Figure 68. shows inner structure of sclera. Could you try explain the influence of collagen orientation (inner microstructure) to the mechanical properties?

The grade that I award for the thesis is **C - good.**

Date: **31.8.2020**   Signature: