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Review
of habilitation thesis and scientific, didactic and organizational output of Izabela Major, Ph.D.

1. Subject of the review

The scope of the review includes:
1) Habilitation thesis "Analysis of selected wave phenomena in continuous compressible and incompressible hyperelastic structures", Izabela Major,
2) Summary of professional accomplishments,
3) List of publications which represents the appendix for initiation of habilitation procedure.
The basis for the review is the document No. KOR/4168/2014 as of May 26, 2014 prepared by the Dean of the Faculty of Civil Engineering in the University of Žilina Prof. Josef Vičan.

2. Evaluation of the monograph in the habilitation application

The habilitation thesis reviewed concerns mathematical and numerical modelling of wave phenomena that result from propagation of disturbance with transport of deformation energy in compressible and incompressible hyperelastic materials.

The habilitation thesis is comprised of nine chapters that form 140 pages of the typescript including two pages with the list of symbols, six pages with 121 literature items, four pages with the list of figures (71 figures) and two appendices concerning basic information about Murnaghan and Zahorski materials (2 pages).

The first chapter provides general information about wave phenomena. This is a short chapter and, in my opinion could be successfully connected with the second chapter.

The second chapter contains a literature review concerning the subject of the study. It justifies selection of the methods of mathematical description of wave phenomena in hyperelastic materials aimed to be used in practical applications.

The third chapter presents aims and scope of the habilitation thesis. It also contains the main thesis of the study: "analytical computation and numerical modelling of wave phenomena using flat acceleration waves in single- and two-material rods with two or three segments with varied cross sections made of

materials described by Murnaghan elastic potential" and "extension of solutions for equations of motion of travelling wave, obtained as a result of the procedure of averaging, using the method of phase surface, on hyperelastic materials where elastic material is a nonlinear function of invariants and numerical modelling of wave phenomena with travelling waves in rods and elastic layer". *It is difficult to agree that these statements could represent a thesis of the study; they are rather general aims.* Further part of this chapter discusses the assumptions adopted and lists specific aims of the study. In the conclusion of the chapter, the author lists material considered in particular in her research " Murnaghan material", "Mooney-Rivlin incompressible material" and "Zahorski incompressible material".

The fourth chapter presents constitutive equations for hyperelastic compressible and incompressible materials, supplementing the information with literature data. The chapter also contains information about opportunities for application of hyperelastic materials in civil engineering. This information was supported with literature data.

The fifth chapter is a theoretical introduction to non-linear elastodynamics, including basic information about discontinuity waves and travelling waves. Although this information represents a textbook content, it is very useful for the reader to track further chapters.

The sixth chapter analyzes acceleration wave propagating in the rod made of Murnaghan material, with variable cross-section. Based on the related literature and author's own studies, the propagation of the acceleration wave was discussed in a thin segment rod with slowly changing cross-section. This chapter also contains the examples of numerical solutions for propagation of the acceleration wave in Murnaghan material. The computations used ADINA software based on the finite element method.

The seventh and eight chapters contain solutions concerning propagation of non-linear travelling waves in the rod and elastic layer, respectively. In the numerical examples presented in both chapters, the authors used hyperelastic model of the material described with Zahorski's elastic potential. Similar to the sixth chapter, the models of propagation of disturbance in the rod and the layer were modelled in the ADINA software.

The ninth chapter represents the section of summary and final conclusions. The study is supplemented with the list of references containing publications connected with the research problems analyzed by the author and problems concerning the wave phenomena in hyperelastic materials. The appendices contain information about Murnaghan and Zahorski materials, with elastic constants for these materials and derivatives of the function of elastic potential with respect to invariants of deformation tensor.

2.1 Evaluation of the study and comments

In scientific terms, I evaluate the study at a high level. It represents a substantial contribution to mathematical and numerical modelling of wave phenomena generated with propagation of disturbance in hyperelastic material continuum. The scientific level of the mathematical models presented in the study does not raise any doubts. The chapters are selected properly and described in detail. The terminology used is widely used in the literature connected with the problems discussed. The scope of investigations contained in certain chapters of the study is, however, too extensive with respect to the title of the monograph. Representation of the examples and results of numerical computations presented

in the figures also seems to be a shortage of the study. The figures are little comprehensible and those with degrees of freedom removed are entirely illegible. The author could have made single-dimensional figures based on the results obtained numerically. This was possible for selected lines of two-dimensional and three-dimensional models.

Scientific and practical importance of the models of wave phenomena generated in the material continuum is very high. The results of the analysis of wave phenomena substantially enrich the scientific literature. I would like to emphasize that the analytical and numerical solutions for wave phenomena largely concern the studies published by the monograph's author. Furthermore, the habilitation applicant, by presentation of her own numerical models using FEM and ADINA software, pointed to the opportunities for using commercial pieces of software which are used by many scientific institutions, institutes and in the industry.

3. Evaluation of scientific and research output

3.1 Scientific and research activity

Izabela Major, Ph. D., was born on September 16, 1974 in Nowy Sącz, Poland. She obtained a degree of M.Sc. in building and engineering structures in 1999 in the Faculty of Civil Engineering in the Częstochowa University of Technology. In 2005, she defended her doctoral thesis in the Faculty of Mechanical Engineering and Computer Science. Since that time, Izabela Major has been working as an assistant professor in the Faculty of Civil Engineering in the Częstochowa University of Technology. Her scientific and research activity concerns continuum mechanics and mechanics of building and engineering structures. This activity is oriented mainly to problems connected with propagation of disturbance in hyperelastic material continuum. The content of the reviewed habilitation solution is therefore closely related to her scientific and research activity.

3.2 Evaluation of the scientific output

The publications of the habilitation applicant include several tens of individual and co-authored scientific items concerning national and international publications. Specifically, these include: one chapter in the international monograph, 11 papers in reviewed national journals and 2 papers in international journals, 20 non-reviewed papers in book publications, 7 papers in international books. Contribution in the most of co-authored studies is 50% and I found 7 reviewed and 12 non-reviewed studies (19 in total). The summary of scientific accomplishments provides information that the publications of the author have been cited 11 times nationally and 6 times internationally, which makes 17 citations in total. The habilitation applicant also carried out 9 research projects, being 3 times a project manager and the project team member in other cases. She also carried out 8 engineering studies and projects. These include 4 studies carried out independently and 4 co-authored studies.

It can be observed that the candidate demonstrates good activity in terms of publications and major part of the reviewed studies concerns problems connected with wave phenomena in hyperelastic material continuum. *With regard to the current regulations on Scientific Degrees and Titles, all the requirements concerning publications are met.*

4. Evaluation of didactic and organizational activity

The didactic activity of the candidate is typical for the work of academic teachers at a position of the assistant professor. However, it should be observed that this activity is exceptionally wide. The candidate has been involved in lectures, seminars, laboratory classes, blackboard classes and design courses on typical subjects for the students of the Faculty of Civil Engineering. These include: mechanics, theoretical mechanics, materials, mechanical engineering of buildings, building and engineering structures etc. The author was a promoter of 36 engineers (including 6 in part-time university courses) and 38 M.Sc. degrees (including 9 in part-time university courses). She developed 3 new curricula. Izabela Major is an author and co-author of 6 textbooks and didactic materials. She participated in creation of the computer laboratory. She is the member of Polish Association of Engineers and Technicians of Civil Engineering and was a member of 6 university commissions. She received 4 rewards of the Rector of Częstochowa University of Technology for her didactic and organizational activity.

I evaluate the didactic and organizational activity of the candidate as very good.

5. Final conclusion

Based on the habilitation thesis and scientific, research, didactic and organizational output collected by Izabela Major, Ph.D. and presented for the review, my opinion is that, according to current regulations concerning scientific degrees and scientific titles that are used in the Faculty of Civil Engineering of the University of Žilina, Izabela Major, Ph.D., meets the requirements for scientific degree of habilitated doctor and can be accepted for post-doctoral examination.

Adam Bokota