Review of Thesis
submitted in partial fulfilment of requirements for promotion to associate professorship

Specialization: Theory of Civil Engineering Structures and Materials

Applicant: Jan Novák, Phd.

Reviewer: Prof. Felix Fritzen

Thesis title: Modelling of Microstructure-Informed Fluctuation Fields for Generalized Finite Element Methods

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Importance of topic of thesis

Comments: The topic is highly relevant: local fields are the next step after homogenizing the stress response in order to make reliable predictions, e.g., regarding microstructure optimization, failure initiation and morphology/topology related senstivity studies.

Superior	☒	Good	☐	Average	☐	Poor	☐	Not applicable	☐

Method of solution

Comments: The methods proposed comprise particular finite element solution techniques exploiting Eshelby's seminal findings (also implemented in mumech, an open source software). Further, the method of wang tilings is used which I think is an actual innovation in microstructure simulations of solids that is attributed to the author. The complexity reduction due to the reduced number of particles (e.g. Chapter 5) is pronounced.

Superior	☒	Good	☐	Average	☐	Poor	☐	Not applicable	☐

Quality and correctness of results achieved

Comments: Results state that (a) complexity reduction by merging FE with analytical solutions is possible (mainly Chapters 2, 3; also 5) and (b) the stochasticity of the material can be condensed in a systematic way by using the Wang tiling approach. The topic's relevance is also emphasized by the many follow-up works that also helped in developing further very sucessful junior researchers such as M. Doškár. This confirms the quality and correctsness, too.

Superior	☒	Good	☐	Average	☐	Poor	☐	Not applicable	☐

Originality of results achieved

Comments: The use of the Wang tiling is, in my opinion, a true addition to the mechanics community. It is interesting to see its relation to computer graphics. The linkage of the tiling with the design of random microstructures is interesting and innovative. To the best of my knowledge these developments truely go back to Jan Novák, underlining the originality of the author's scientific portfolio. The use of micromechanics enriched finite elements (with and without Wang tiles) is interesting, too.

Superior	☒	Good	☐	Average	☐	Poor	☐	Not applicable	☐

Publication rate of results achieved

Comments: Continuous progress has been made over a longer time span and with various co-authors. A range of quality journals from mechanics, engineering software, computer aided design etc. outline the broad scope. Although not excessive in number the publication count is still good (and I am rather for quality than for quantity).

Superior	☒	Good	☐	Average	☐	Poor	☐	Not applicable ☐

Response to results and citation rate

Comments: The results have been cited and reused at a good rate. The topic might be a bit niche, i.e. not as "en vogue" as other topics, and this must definitely be taken into account. (Again, citation counts are not a real quality indicator for me personally.)

Superior	☒	Good	☐	Average	☐	Poor	☐	Not applicable ☐

Applicability of results to development in the field and for further research

Comments: The methods have been used and extended and their usefulness has been demonstrated.

Superior	☒	Good	☐	Average	☐	Poor	☐	Not applicable ☐

Applicability of results to technical practice

Comments: The reduction of the computational effort can be applied in practice. The open soure software μmech is interesting in that regard. It is supporting the "FAIR" (findable accessible interoperable reproducible) spirit whose relevance has seen a steep increase in science.

Superior	☒	Good	☐	Average	☐	Poor	☐	Not applicable ☐

Compliance with requirements on thesis – quality of thesis

Comments: The thesis is well-made and achieves a good condensation of many topics without getting lengthy. The author has demonstrated his capability to make meaningful selections and he was able to avoid excessive unneeded surrounding text, which is appreciated.

Superior	☒	Good	☐	Average	☐	Poor	☐	Not applicable ☐

Comments

I recommend the acceptance of the habilitation manuscript and the continuation of the habilitation process without any reservations, explicitly including the promotion to associate professor.

Overall evaluation of thesis

I rate the thesis very good.

Additional comments on the thesis and the author:

List of minor typos has been communicated to the author.

| Promotion to associate professorship recommended | yes ☒ | no ☐ |

Date: Sep 07, 2022

Reviewer's signature: ▮▮▮▮▮▮▮▮▮▮