UPPSALA UNIVERSITY
Dept. of Earth Sciences
Geophysics

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Alireza Malehmir
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Scientific Board of the Institute of Geophysics of the Polish Academy of Sciences (PAN)

I hereby submit my review report for the thesis of Andrzej Gorszczyk entitled *Application of discrete curvelet transform in enhanced seismic imaging and accurate velocity model building.*

Reviewing this thesis was rather straightforward for me because I also reviewed some of the articles published during his PhD thesis preparation. The thesis tackles a long-standing issue in seismic imaging namely "de-noising". De-noising seismic data will help to enhance signal in the seismic data and will allow a number of approaches to be implemented. The thesis clearly illustrates this using a complex de-noising approach that one is able not only to improve imaging part of the data but also extract information from the data (velocity), which otherwise would be masked by the noise. While the concept has been used in the image processing field, this is quite attractive for seismic data processing and should open a new era for low S/N data typical of hardrock environment or even for engineering applications related to urban seismic data.

I read the thesis carefully with a good pace and found it quite easy to follow. Illustrations have high quality and text is reasonably well polished. References are up-to-date and include the key ones related to the thesis. A survey of the field is done in a concise and to-the-point manner. Readers are guided in the beginning of every chapter about what they will see in each chapter and how to coordinate themselves as they continue. It is logically organized with an introduction to the problems, approaches used by others (other de-noising methods), DCT approach used in the thesis, modifications implemented, examples of improving post-stack data on both synthetic and real case data but also on prestack seismic data for the purpose of velocity model building through FWI are shown. Moreover, it clearly states the contributions of the candidate and how much support he has received during his PhD work/time. It also clearly states goals, objectives, advantages and drawbacks of the method to be human-time-consuming and look into the future how this can be somewhat automatized through for example statistical approaches.

I am astonished by the improvements obtained for some of the images and if they are true some new geological interpretations should come out of this, particularly when I see that not much of coherence signal is lost (the difference plot), faults are better seen (Figure 2.13f) and indications of cross-cutting events are better realized (Figure 3.11e). I see at some occasions that may be some artifacts introduced (e.g., Figure 1.7d) but overall improvements and tuning

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the threshold would imply this is negligible and case-related. The wavenumber-frequency plots are quite useful and at some point may even indicate where there is still noise left and where possible the sharpness of the signal is obscured (widening the signal).

The PhD candidate has 3 peer-reviewed publications and a number of peer-reviewed conference publications (extended abstracts) in the thesis making it **quite outstanding** to my judgment. There are a few PhD students who can achieve to this level and collaborate with a number of institutions and various fields of exploration seismics. **I therefore strongly recommend the thesis to be accepted and awarded with an honour by the respective committee for its achievements.**

I'm happy to provide further information if required. Please do not hesitate to contact me if you need additional information concerning this thesis review report.

Sincerely,

Malehmir

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10.08.2017
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