Supervisor's comments on doctoral project of Milosz Wcisło

Seismic waves in inhomogeneous, weakly dissipative, anisotropic media

Milosz Wcisło attended my course "Seismic Body Waves in Inhomogeneous Anisotropic Media". After finishing the course, he approached me with the wish to make PhD studies under my supervision. His main interest was attenuation of seismic waves. I agreed. Milosz started his PhD study on October 1, 2016.

His study concentrated on two subjects. One was theoretical, and it consisted in the application of weak-attenuation concept (perturbation approach based on the idea that attenuation represents a perturbation of the elastic state) to the problem of reflection/transmission. The other subject was processing data from various regions with the goal to estimate attenuation in the studied region. For this purpose, he used the so-called peak-frequency method, which he developed with his colleagues.

On the first subject, we closely collaborated together. Several interesting results were found. Expected result that effect of attenuation on the reflection/transmission is negligible in comparison with effect of attenuation on seismic wave propagation inside layers was definitely confirmed. It was also shown that the commonly used correspondence principle leads in some situations to non-physical results. Milosz found how to fix the problem. Milosz generalized the program package ANRAY for the ray computations of seismic wave fields in 3D laterally inhomogeneous isotropic or anisotropic media so that it can also include attenuation. Milosz also generalized program package SEIS for the ray computations in 2D laterally inhomogeneous isotropic media so that it can be used for testing effects of attenuation on reflection and transmission. By comparing ray results with results of other independent methods, which could be considered exact, he showed that weak-attenuation concept can be used for modelling of attenuation in most of realistic structures no matter if they are smooth or layered.

As mentioned above, Milosz also studied more practical aspects of attenuation phenomenon. Using his above-mentioned peak-frequency method, he managed to estimate effective values of attenuation from the western Bohemia swarm activity, and their spatial and temporal variations. Similarly he studied variations of attenuation caused by the wastewater injection on an Italian site. In an interesting study of combined effects of attenuation and source directivity from the data obtained during the hydraulic stimulation in a borehole in China, he was able to estimate not only attenuation in the vicinity of the borehole, but also uniquely determine the fault orientation and rupture direction on it.

Certain part of results presented in the thesis has already appeared in several impacted international journals. There is still a potential for at least one, more probably two, papers based on thesis' results. Milosz's contributions can be also found in non-impacted reports and expanded abstract series. He presented his results at several international conferences, always with very good response. The quality of his written texts improved significantly during his PhD studies.

I am convinced that Milosz deserves the PhD title. I am looking forward to the further collaboration with him after the successful defense.

Prague, October 11, 2023 RNDr Ivan Pšenčík, CSc