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Grenoble, 28 September 2015

Report on the PhD manuscript of Denis V. Anikiev on « Joint Detection, Location and Source Mechanism Determination of microseismic events

Denis V. Anikiev submits a quite interesting manuscript regarding his PhD investigation on microearthquakes.

Challenges related to an automatic treatment of seismic signals are numerous. Denis V. Anikiev has pointed these difficulties in his report and he has provided solutions essentially based on a semblance function design which takes into account the event radiation pattern which should be determined as well as the location. This radiation pattern imprint is an original contribution of this work and may increase the threshold for detection.

The semblance function based on diffraction stacking is performed at each point of the medium, leading to a complexity connected to the number of total points we should consider.

The semblance function could be integrated into a statistical workflow for a probability density function for the location, improving uncertainty assessments.

In order to build up the semblance, the velocity structure has to be well-determined. Assessment of the impact of the velocity structure (see for example Gesret et al, 2015, GJInt, 200, 52-66) on the detection and the location uncertainties may question the performance of any tool for locating events. One may wonder what will be the requested precision in the velocity model for making this automatic tool for detection, location and moment inversion for weak events. In the real application, a velocity calibration has been performed during this investigation and true test events have been considered: a very good and pertinent analysis.

Validation on a real dataset coming from the Woodford gas shale reservoir in Oklahoma, USA with an impressive acquisition configuration is pertinent and fully exploited. Three full days of field data have been analyzed and 313 events have been detected and located. The temporal distribution of events during these three days should be underlined as they have a spatial coherence which suggests specific mechanical behaviour.

The real-time challenge is underlined in the manuscript but it will quite nice to know which part is requiring intensive computational tasks. Is it the traveltime computations? If so, why not doing it as a pre-computational task in order to keep the efficiency under control.

Work which has been achieved by the candidat Denis V. Anikiev with real application to an interesting dataset makes a valuable contribution to the challenging subject of monitoring microseismic events.

After reading the PhD manuscript as well as related publications, I have an excellent opinion of the research investigation of Denis V. Anikiev and, based on the written document, I may recommend Denis V. Anikiev for the degree of doctor at Saint Petersburg State University.

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