GC2024-SG044

Designing a side-by-side experiment to compare low-power impulsive artificial seismic sources

Konstantin V. Kislov[1], Alexey Y. Marchenkov[2]

[1] Institute of Earthquake Prediction Theory and Mathematical Geophysics, Russian Academy of Sciences
[2] Lomonosov Moscow State University

kvkislov@yandex.ru

Artificial seismic sources are required for seismic exploration as well as for many other areas of science, for example, for archaeological research [1]. There is an extensive cluster of tasks for which the use of low-power impulsive sources (LIS) is sufficient. These is surface and near-surface work carried out in hard-to-reach areas, with difficult terrain, in urban areas, and low-budget work. Here are the requirements for the LIS.

- repeatability;
- mobility due to light weight and size;
- easy to use and autonomous;
- there is no repeated impact after recoil;
- cost effective;
- environmentally friendly.

The simplest source is hammer blows on plate. Plates can be of various types [2, 3]. To achieve the repeatability of the impacts, a proctor hammer [4] or a tamper [5] are used. Lifting the weight by using a tripod allows you to increase the force of impact. The tripod can be made from locally available materials, and the weight can be almost anything. The main disadvantage is the presence of the repeated impact after the recoil. In addition, the tripod is not easy to carry. A more compact tool is the accelerated weight drop [6]. The lifting height of the weight is less, but the weight is accelerated by a spring or elastic band. Other more expensive tools include application of electromechanical, electromagnetic, pneumatic or other principle and they use anadditional power source [7]. Generation of waves using seismic guns requires the presence of wells up to 1 m deep [8]. Sparkers operate by discharging high capacity energy storage devices [9]. Such sources require the preparation of a well filled with salt water. There are a lot of works devoted to comparison of artificial sources of seismic waves [10].

There cannot be a universal source. We are developing a set of tests for the outlined group of LIS. The following tasks are expected to be solved.

1. Comparison of site preparation, weight and configuration of plate.

2. Comparison of different seismic gun loadings.

3. Comparison of impacts from different sources.

4. Comparing the repeatability of different sources.

5. Comparison of sources for generating shear waves.

We plan to deploy two geophone arrays that include vertical and horizontal sensors. One should surround the impact site, another one should be placed along a strait line going away from the impact site. Available or locally manufactured devices will be used as sources.

References.

[1] J. Ge, M.BMagnani and B. Waldron, Near Surface Geophysics. 8 (2010) 331.

[2] J.-H. Jeong and J.-H. Kim, Jour. Korean Earth Science Society. 33(5) (2012) 395.

[3] M. Häusler, C. Schmelzbach and D. Sollberger, Geophysics 83(6) (2018) P19.

[4] M.C.L. Quinn, Geotechnical effects on fiber optic distributed acoustic sensing performance, Open Access Dissertations. (2021). Paper 1238. https://digitalcommons.uri.edu/oa_diss/1238.

[5] Source of seismic waves - tamper. Retrieved March 8, 2024, from https://geodevice.ru/main/seismic/sources/sledgehammers/tamper/?ysclid=ltetwcotiu695619817

[6] A. Bahar, F. Fatkhan, R. Sule, IOP Conference Series: Earth and Environmental Science (2019) 012063IOP.

[7] A.A. Repin, A.K. Tkachuk, V.N. Karpov, V.N. Beloborodov, A.G. Yaroslavtsev and A.A. Zhikin, J Min Sci. 52 (2016) 146.

[8] R.D. Miller, S.E. Pullan, D.W. Steeples and J.A. Hunter. Geophysics. 57 (5) (1992) 693.

[9] A.V. Chugaev, Mountain echo. 3(64). (2016) 18. (in Russian)

[10] J. Atanackov, A. Gosar, Acta Geodynamica et Geomaterialia. 10(1) (2013) 19.