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Investigation of the capability of the moiré technique in detecting the first displacement of seismic waves

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Extended Abstract

Summary

Today, accurate detection of seismic waves is a favorite task for many researchers in this field. Accurate determination of the beginning of seismic phases is also very important in seismological studies. In other words, it is very important to receive seismic pulses and convert them into seismic signals in a way that is highly consistent with reality in terms of reception time and waveform. In this study, a conventional mass-spring oscillation system has been used to detect seismic waves, and a stability system based on the moiré technique has been used to convert the oscillating mass displacement into an electrical signal. In this seismograph, the sensitivity of the seismograph is changed simply by changing the angle between the grid lines or changing their step. Due to the magnification of the moiré technique, this seismograph is capable of detecting very small displacements of the order of a few micrometers. In this study, the response obtained from the moiré seismometer and a sample of conventional seismometers to typical seismics under the same conditions has been investigated. The results show a very good match of the data of both sensor samples. On the other hand, the beginning of the seismic waves reaching the moiré sensor is determined to be much more accurate than that of the conventional sample. The results are a good indication of the efficiency and high accuracy of the moiré seismometer.

Introduction

Seismology is one of the most accurate and widely used geophysical methods for land modeling and exploration of underground economic resources using receiver sensors. , Elastic seismic waves propagated on the ground from artificial or natural sources are received and converted into recordable electrical signals. By processing the recorded signals, useful information is obtained for the benefit of scientists and engineers; Therefore, accurate detection of received seismic waves and the quality of the generated signals are very important in the accuracy of the results of data processing. In this study, the capability of the moiré technique in determining the exact time of the beginning of the received waves has been investigated quantitatively and experimentally. For this purpose, a stability system based on the Mara snake technique along with the conventional oscillator system used in seismometry has been designed and built that is presented in this paper.

Methodology and Approaches

In this study, to detect seismic waves from the conventional mass and spring oscillation system used in seismometry, and to convert the displacement of the oscillating mass into an electrical signal, a stability system based on the moiré technique has been used. Due to the application of a typical vibration on the oscillating system, one of the gratings is moved relative to the other. Therefore, moiré fringes pass in front of the laser light and the light intensity that reaches the light detector is changed. The intensity of light received by the optical detector always varies between the maximum and minimum, which is the result of the passage of dark and light fringes, and is converted into an electrical signal at the output. There is a good fit in the data obtained from both the moiré and electromagnetic seismometer samples. On the other hand, in the signal obtained from the moiré seismometer, as mentioned earlier, the beginning of the seismic wave can be determined with high accuracy, while in different pulses obtained from the electromagnetic sensor, determination of the exact start of seismic phases is not possible. In fact, this feature of the moiré stability system presented in this study is considered as a significant advantage along with its high capability in seismic data collection.

Results and Conclusions

In this study, the capability of the moiré technique in accurately determination of the beginning of seismic waves received by a seismometer was investigated. Accordingly, the moiré technique was used in the design and construction of a stability system along with a conventional oscillator system in seismometry. Based on this, we can conclude that the proposed optical stability system based on moiré technique is very reliable and has high efficiency.