

Development of the sound source exploration technique using plural small Rover in the Mars exploration

*Yuki Otsuka¹, Hiroaki Saito¹, Masa-yuki Yamamoto¹

1. Kochi University of Technology

Introduction

In Mars explorations so far, two or more rovers have never been explored at the same time and spot. In addition, the sound on Mars, for example, the sound of sandstorm, volcanic eruption, mostly have not been observed by previous Mars explorations.

Therefore, in this study, the systems is developed for Mars explorations by using several small rovers. And The purpose of this system is the observation of the sound on Mars. If this system can be implemented, we can measure many kinds of physical quantities indirectly.

Searching sound source

Several slave rovers have microphones and search sound source. The master rover gathers and processes information from slave rovers, grasps location information of slave rovers and communicates with the ground station or relay satellite. The details of the method for probing Mars are as follows. After landing on Mars, three slave rovers form an equilateral triangle centered around the master rover. By forming an equilateral triangle, the directivity of this system can be eliminated. During searching sound source, this system uses infrasound. Therefore, the distance between each slave rovers is from 30m to 50m. In this case, this system can cover about 4.6Hz to 7.7Hz. Infrasound results from aerial vibration caused by the release of gas or thunder. As described above, this system can observe the release of gas or sandstorm on Mars by using infrasound.

When searching the sound source, this system estimates a position of sound source by cross-correlation function on the sound waveform that each microphone measured. Regarding signal-f received by microphone1 and signal-g received by microphone2, when shifting signal-g by n samples.

Sound source position estimate experiment

It is conducted two experiments using three IC recorders and three original recording devices. In each experiment, it is formed IC recorders or original recording devices in an equilateral triangle. After that, we made sound from arbitrary point. Conducting cross-correlation function on each recorded wave data, time difference of arrival and distance difference from the sound source was found. We created hyperbolas by using distance difference between the sound source and drew the locus of the candidate for sound source position.

Results and consideration

The result of experiments by using IC recorder are shown in figure 1. The results of experiment by using original recording devices are shown in figure 2.

In the experiment by using IC recorders, the sound source position was estimated precisely. However in the experiment by using original recording devices, sound source position was not found. Because of noise caused by wind, an error occurs in the result of cross-correlation processing. It is required for solving this problem to deal with error covering microphones with the sponge.

Conclusion

Our program for estimating sound source position operated normally. However this original recording devices are weaker than noise caused by wind. After solving this problem, further study is needed for autonomous operation of rovers, master rovers and so on.

Keywords: Sound source exploration, Mars, Several small rovers, Infrasound

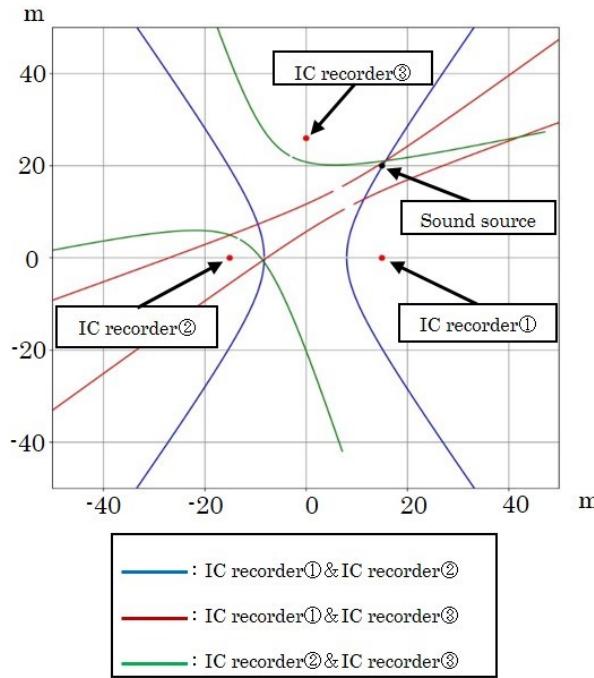


Fig.1 Result of experiment using IC recorder

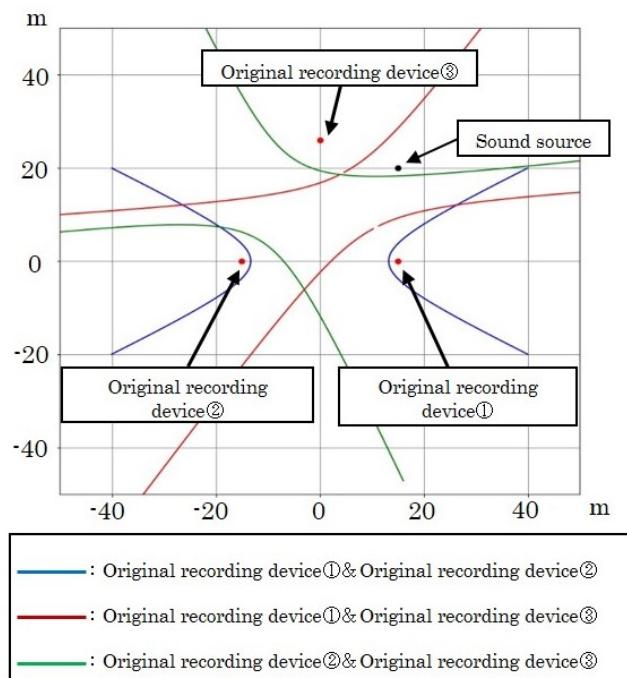


Fig.2 Result of experiment using original equipment