

Development of the doppler rader for volcano monitoring - Antenna,transmitter and receiver -

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The ejection of volcanic materials from a crater is the most spectacular event of the volcanic phenomena. The ejection velocity from a crater controls growth of a volcanic plume or generation of a pyroclastic flow, and it is one of the important parameters for understanding physical process of the eruption in the volcanic conduit. The velocity recently begins to be measured by the remote sensing using a doppler radar and so on instead of conventional ballistic analysis. The remote sensing of the ejection velocity is also useful for the detection of the invisible eruption. We therefore planned the development of a portable doppler radar, which is suitable for the mobile observation, to measure the ejection speed from a crater (or the traveling speed of a pyroclastic flow) from the safe place. In this year, we have designed the doppler radar and made the antenna, the transmitter and the receiver.

We selected 24GHz from 10GHz, 24GHz and 33GHz for radar as the operating frequency in consideration of the antenna size, and the attenuation due to precipitation and due to oxygen and water vapor absorption. We also adopted FMCW system that can use simple solid-state transmitters with much lower output power in comparison with a pulsed system. For low power consumption and portable system, we have developed the high-gain (37dBi) slot planer antenna. The radar uses a bi-static antenna system to reduce leakage between transmitter and receiver. In addition, the transmitter and the receiver are directly connected with the antenna to eliminate loss between antennas and transmitter/receiver. The radar outputs two doppler signals corresponding to the moving direction of target, and it provides monitor outputs such as a transmitting signal for the convenience of the maintenance and the development of the data processing system.

The transmit power of the radar is 2W and it is capable of detecting an object of 1m² radar cross-section at about 11km range. The beam width is 1.3 deg (vertical) and 3 deg (horizontal). The search area is 300m X 700m in a distance 11km. The size of the antenna with the transmitter and the receiver is 70cm(L) X 70cm(H) X 30cm(W), the weight is about 30kg and the power consumption is about 72W. The radar can be operated with a car battery though it is a little heavy to carry it alone.

In next step, we perform the experimental observation by using an artificial moving body to dig up defects of the radar and to improve them. At the same time, we develop the data processing system.