

FMCW Radar for High Velocity Targets: Volcanic Eruptions

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Explosive volcanic eruptions and pyroclastic flows are characterized by a wide spectrum of particle velocities and locations in the vicinity of the volcano. To measure these velocities and locations we use Frequency Modulated Continuous Wave (FMCW) radar. This is a low power consuming, remotely operable and low cost measurement technique, not affected by cloud coverage or darkness. A 24 GHz electro-magnetic radar wave is reflected from the pyroclastic targets, resulting in a two-tone signal, which is directly related to particle distance and velocities. However, FMCW radar is traditionally only applied for near-field and low velocity targets such as car traffic.

In this work we expand the method to explosive volcanic targets in up to several km distance and velocities of more than 100 m/s. Contrary to established near-field FMCW radar, the far-field targets cause artificial dual targets to appear in the FMCW processing. To solve this challenge, we present a spectral analysis based processing variation, which does not need external information about the pyroclastic event. The method is tested on synthetic single channel data, showing its validity even for most basic data acquisitions. It is part of the development of a volcano-radar prototype for the University of Hamburg.

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