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# Volume slicing with multi-directional muon radiography

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Additional strategies to modify the rapid time measurement system of muon radiography may make it possible to survey a target without knowledge of its exterior shape. Examples of such targets would be an activated volcano with a growing lava dome or the geology of extraterrestrial exploration. Established techniques of muon radiography rely on precise exterior shape data because the method exclusively focuses on the integral density along the muon path. However, the exterior shape specific targets may be changeable (as a lava dome grows) or may be unknown. To resolve this point we need either (1) a time-sequential three dimensional exterior shape of the target (e.g., as obtained by synthetic aperture rader measurement); or (2) a method to resolve the internal density structure without the knowledge of an exterior shape. Unlike other phenomenon utilized in geophysical techniques, muons pass through targets without diverging. Therefore, a tomographic analysis method using radon transformation can be applied. A new, portable, battery-operated muon detector system with the capacity to create three-dimensional images of targets without the aid of external shape information is described in this paper. Mt. Omuro was chosen as an example in this survey because the structure is well known and, unlike other volcanoes, it is encircled with road and parking areas that are conveniently situated. A battery-operated muon detector was set up in a compact car and the target was measured by moving the car to different vantage points. The measurement time at each point was 20 minutes, a suitable time frame to assess a growing lava dome or to conduct an investigation at an extraterrestrial exploration point. Once the reconstructed slice of the target was obtained, it was found to be consistent with the known contours of the main structure and crater.

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