

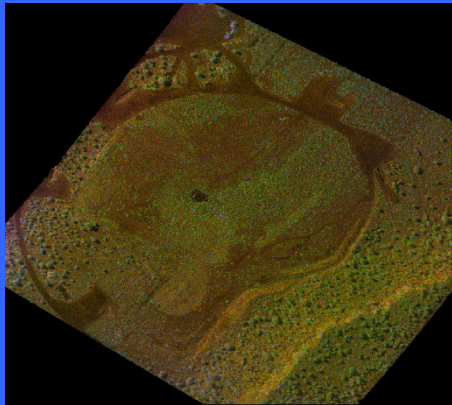
# Characterizing and Monitoring Suspected Underground Nuclear Sites with VideoSAR

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## Background/State of the Art

- To fully characterize objects found in satellite SAR images of the UNESE site-making DEMs, full-pol VideoSAR techniques have been developed.
- VideoSAR is unique. As far as we know, it is not being done.
- We are not aware of other agencies that are working with VideoSAR

## Innovation



- We are exploring the utility of synthetic aperture RADAR (SAR) to characterize surface signatures of an underground nuclear explosion by exploiting existing methods and developing new SAR exploitation algorithms and collection strategies.
- We have compelling results that shows our methods are working.

*Defense Nuclear Nonproliferation R&D*

## Approach, Metrics and Outcomes

### MAIN ACHIEVEMENT

- Identifying man-made objects associated with underground nuclear tests by using innovative SAR and polSAR image products

### HOW IT WORKS

- VideoSAR is a measurement technique that utilizes a continuous spotlight collection along a path that circumscribes the site of interest. From this collection, digital elevation models and advanced polarimetric SAR image products are created that highlight polarimetric signatures of man-made objects.
- We are using SNL-developed software to exploit the data. Some of the software was already developed, but most of the DEM and polSAR software had to be written for this platform and project.
- Our results are confirmed by aligning with the ground truth of an old underground nuclear test site.

### ASSUMPTIONS AND LIMITATIONS

- Assumptions: VideoSAR will provide interrogation of the target from all aspect angles. Metal objects may glint. Polarimetric SAR may show unique scattering mechanisms so that automatic man-made object detection is possible.
- Risk: We may not be able to geolocate well enough for meaningful DEM generation. Polarimetric SAR may not provide unique scattering decomposition.
- Risk: For this exploration is new and new algorithms and exploitation may be found.
- Gaps: Detailed surface structure could be created with a generalized stereo code.

## Impact

- Those interested in the success of this research are:
  - Treaty monitoring entities
  - State Department
  - US intelligence community

### TRLs (start and finish)

- TRL 2 (start)
- TRL 3/4 (end)

## Goals/Action Plan

### Current FY

- Continue to develop the capability of polarimetric decompositions to model and detect polarimetric signatures of man-made objects that are associated with underground tests.

### Future FY

- Data combination with other sensing modalities.
- Characterize the tunnel site.

## Team

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