Use of Microwave and Optical Remote Sensing Data in Near Eastern Archaeology

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Presentation Overview

I. A Brief History of Remote Sensing in Archaeology

II. Synthetic Aperture Radar's Characteristics and Capabilities

III. Research Problem: What Can SAR Offer to Archaeology?

IV. Project Design: Test Sites

V. Project Goals and Timeline
A Brief History of RS in Archaeology

The 20\textsuperscript{th} century:

- Landsat
- Cold War imagery, such as CORONA and U-2
- SRTM

The Past 20 Years:

- UAVs and Structure for Motion
- GIS systems
- Lidar
- Radar?
SAR's Characteristics and Capabilities

1. What IS SAR? What are its characteristics?

2. What kind of data is available?

3. How do you process and use the imagery?
What is Microwave Remote Sensing?

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Advantages of Microwaves

Penetration into the top surface layer

Vegetation

Glacier Ice

X-Band ~ 3 cm

C-Band ~ 6 cm

L-Band ~ 23 cm

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Principle of Synthetic Aperture Radar (SAR)

Combination of overlapping acquisitions

High resolution

Antenna footprint

Flight direction of sensor

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SAR's Characteristics and Capabilities

1. What IS SAR? What are its characteristics?
2. What kind of data is available?
3. How do you process and use the imagery?
Past, Current, and Future Datasets

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SAR's Characteristics and Capabilities

1. What IS SAR? What are its characteristics?

2. What kind of data is available?

3. How do you process and use the imagery?
SAR Workflows

There are various techniques for processing and analyzing SAR data:

- Basic image processing and geocoding
- Polarimetric SAR (PolSAR)
- Time series analysis
- Interferometry and phase unwrapping (d-InSAR)
- PS-InSAR and SBAS InSAR
- Fusion images
Unprocessed vs. Processed Data
Research Problem:
What Can SAR Offer to Archaeology?

1. Monitoring cultural heritage sites, particularly for the identification of looting.

2. Highlighting or identifying barely visible or near surface features.

3. Helping archaeologists make decisions about where to look for features.
ALOS 1 RGB: HH, HV, HH/HV
L-band, April 27, 2008

Google Earth 2020

Sentinel-1B RGB: VV, VH, VV/VH
C-band, July 14, 2017
Project Design: Test Sites

My goal is to take three sites in the Near East with varying topographic and archaeological features, and to apply a selection of radar processing and analysis techniques to assess them.

I will also attempt to identify specific aspects or elements that lead to one workflow being more successful depending on the site type.
Site 1: The Negev Highlands

This group of sites covers roughly an 80 x 80 km area, and dates to the late 10\textsuperscript{th} century BCE; there are about 60 sites known.

I will use radar to investigate a subset of the area, as well as to see whether medium-resolution imagery is capable of locating any of the sites.
Site 2: Tel 'Eton

Tel 'Eton, located in the Judean Hills in Israel, has been under excavation since 2006.

I will use radar to see whether I can trace the wall(s) further around the tell, as well as whether I can find indications of other structures or areas of significance that could merit further investigation.

Site 3: The Erbil Plain Archaeological Survey

The Erbil Plain Archaeological Survey, in the Kurdistan region of Iraq near the city of Erbil, is directed by Jason Ur and has been in progress since 2012.

The Erbil plain was an integral part of the ancient empire of Assyria. The EPAS project is attempting to map the hinterland, small villages, ancient roads, canals and irrigation systems.

Project Goals and Timeline

- Use the three identified test sites
- Apply radar analysis techniques as listed on the earlier slide about workflows
- Use ground truthing to the extent possible to verify results

Given the current situation, I am looking at a possible publication rather than a conference presentation. I hope to complete my MGIS before the end of 2021.
Thank you!

I will be happy to take questions...