**Remote sensing**

**Imaging radar and WMD (July 2003)**

A short article in New Scientist (Morris, H. 2003. *Satellites hunt for buried treasure*. New Scientist 12 July 2003, p. 12-13) reminded me of the puzzling failure of British and US forces in Iraq to discover any buried caches of weapons of mass destruction, either before the invasion of Iraq or in the aftermath of Saddam Hussein’s disappearance. Researchers at the Ben Gurion University of the Negev in Israel have tested the ground-penetrating capabilities of imaging radar that uses microwave pulses with various wavelengths. One of the principles of radar remote sensing is that microwaves can penetrate beneath the Earth’s surface, provided the materials contain little liquid water. The longer the wavelength the greater the depth from which information can be sensed. Ground-penetrating radar is a common tool in archaeological investigations and in glaciology (ice is “dry”), but is usually deployed along ground traverses. The Israeli experiments, which duplicated work done by remote sensing researchers at NASA’s Jet Propulsion Laboratory, used airborne imaging radar to detect buried metal target, which are highly reflective to microwaves. They used microwaves with moderately long wavelength, and showed that objects half a metre deep were easily detected.

Radar with a wavelength of around 70 cm is called P-band radar, and has the greatest potential for sub-surface mapping, with penetration up to 9 metres. In 1987, NASA’s Jet Propulsion Laboratory first flew an airborne radar imaging system (*AIRSAR*) that uses P-band, partly to exploit its ability to “see through” dense vegetation but also to produce ground-penetrating images in dry regions. *AIRSAR* has the potential to produce images with a resolution of 3.3 metres, and data produced by it have been available freely to civilian users. It would be no surprise, therefore, if there were imaging radar systems with P-band radar being used for intelligence gathering. The US National Imagery and Mapping Agency (NIMA), in conjunction with JPL and EarthData International, Inc., developed in 2000 the 2-metre resolution Geographic Synthetic Aperture Radar (*GeoSAR*) mapping system, that also includes a P-band imager. *GeoSAR* is funded by the US Defense Advanced Research Projects Agency (DARPA). NIMA, formerly the US Defense Mapping Agency, is a Department of Defense Combat Support and National Intelligence Community agency that provides imagery, image intelligence and geospatial information in support of US national security objectives. The French and Italian space agencies are also discussing the development such systems, perhaps to be deployed from orbit by the European Space Agency. The P-band technology is also a possible tool for an ESA Mars mission (Paillou, P. *et al*. 2006. *A study of P-band synthetic aperture radar applicability and performance for Mars exploration: Imaging subsurface geology and detecting shallow moisture*. *Journal of Geophysics Research*, v. 111, online publication; DOI: [10.1029/2005JE002528](https://doi.org/10.1029/2005JE002528)

It was NASA/JPL’s Shuttle Imaging Radar missions in the 1980s and 90s that revealed dramatic evidence for former tributaries of the Nile River System that are buried beneath the sands of the arid eastern Sahara desert in Egypt and Libya. Although not so dry, the Tigris-Euphrates plain is a desert, and it would be very surprising if P-band radar imaging has not been used in the search for buried WMD. Since radar energy is barely affected by the atmosphere, and the microwaves used in radar imaging are effectively highly focussed laser
beams, systems carried on satellites have the same spatial resolution as those carried on aircraft. Had a P-wave system been deployed on a military surveillance aircraft or satellite, then sizeable buried caches would have been difficult to miss. Even if the ground was damp, one of radar’s other features is that it responds to variations in the texture of the ground surface. Reworked soil over excavations would be easily spotted by any radar imaging system, either orbiting or on an aircraft. So it was somewhat odd when the US Secretary of State, Colin Powell, did not use any imaging radar evidence in his submission to the UN Security Council on 5 February 2003.