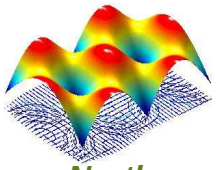
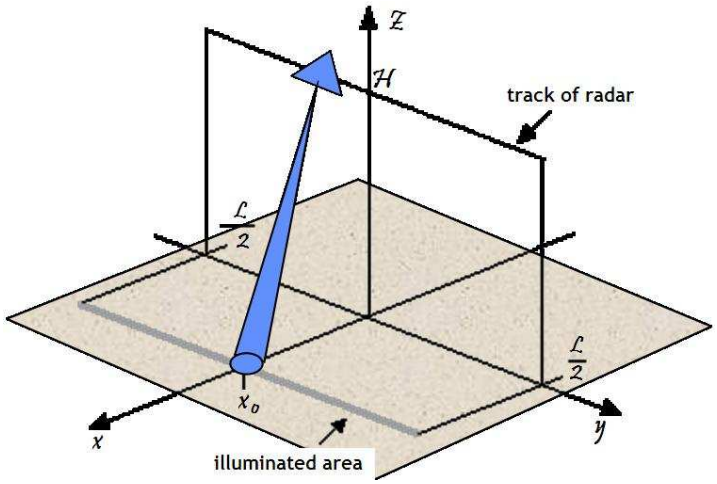


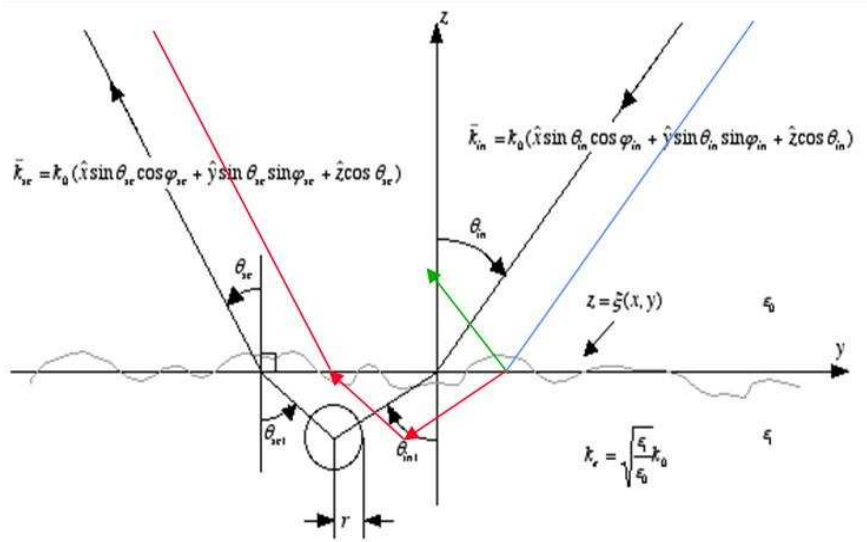
Signal Processing Methods for Detection of Sub-Surface Objects by Ultra-Wideband SAR

Collaboration with Professor Alla Timchenko, Ukraine

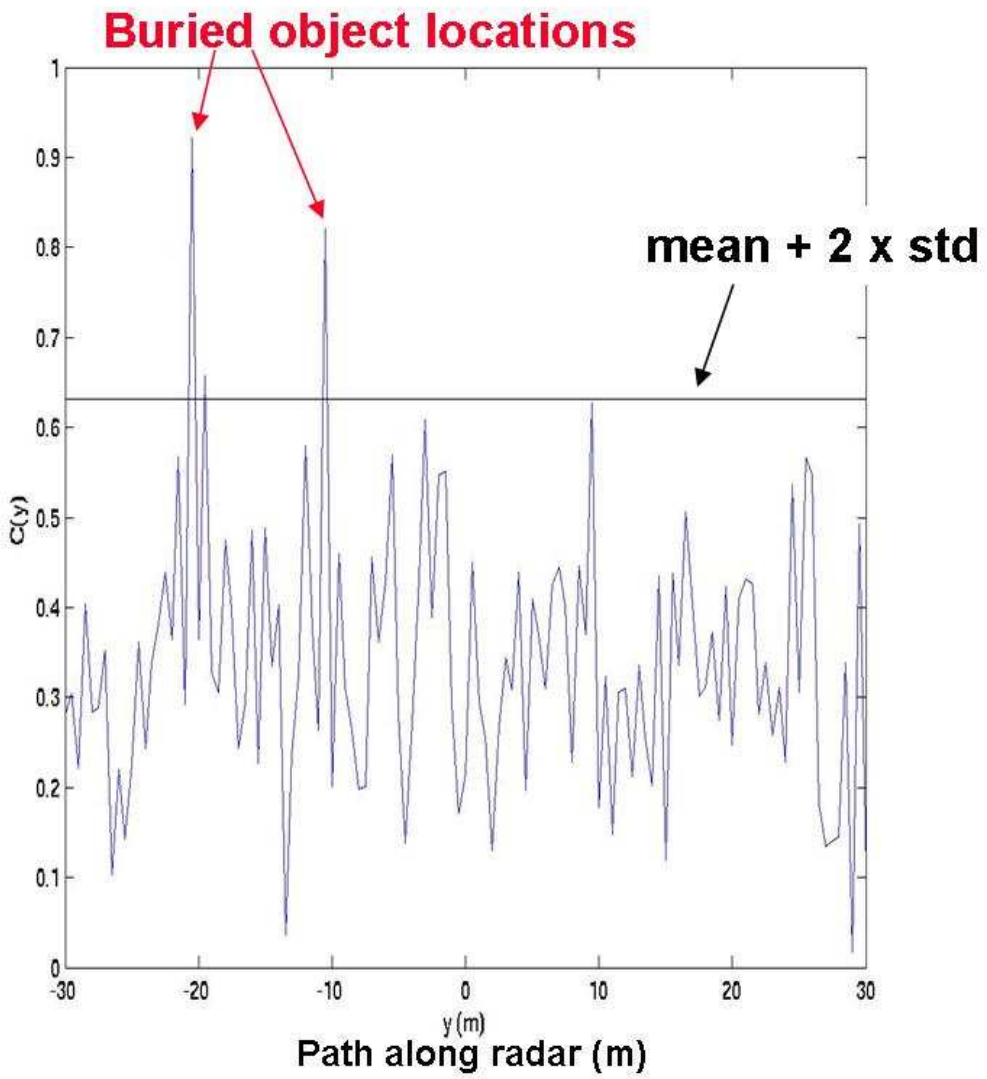
The detection of objects buried beneath the earth's surface is of interest for many applications, including the detection and localization of buried land mines. The use of Ground Penetrating Radar (GPR) is a promising technique that exploits the ability of an electromagnetic wave to penetrate into the soil and scatter from the buried object. A significant challenge for GPR is de-coupling the scattered return from the buried object from the scatter that arises from the rough soil surface and other material inhomogeneities. In this work, we develop expressions for the combined electromagnetic backscatter due to surface, object, and inhomogeneities, and use it to derive a physics-based weighting function. This function is utilized in an advanced signal processing framework for ultra-wideband SAR to maximize the signature from the buried object. We show that this signature can be successfully separated from the surface scatter, even in the presence of significant soil moisture. This

work is in collaboration with Dr. A. I. Timchenko at the Institute for Radiophysics and Electronics of National Academy of Sciences of Ukraine.





- Radar (SAR) acquires multiple observations along a track
- For patches with object, radar return contains sphere return — much smaller than surface return
- Correlation processing removes statistically random surface return to reveal presence of object



(result produced by Shari Matzner, PhD candidate, NEAR-LAB)

- Scattering model of Dr. Alla Timchenko (Ukraine)
  - Implemented for sub-surface radar geometries

- Initial results show potential detection of object from correlation processing