Detection of landmines, UXO, and IEDs using advanced synthetic aperture radar technology:

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The detection of landmines, UXO (UneXploded Ordnance), and IEDs (Improvised Explosive Devices) is still a challenging task. The requirement of efficient and reliable detection of these objects in a reasonable time demands for fast sensors investigating large areas with sufficient resolution and sensitivity. Ground penetrating radar (GPR) is a suitable tool, typically operating in a very close distance to the ground and a rather time consuming punctual method of operation. In contrast to this methodology, standoff synthetic aperture radar (SAR) is able to scan large areas in a rather short time resulting in an increased throughput compared to classical GPRs.

TIRAMI-SAR is a multi-static polarimetric imaging radar at lower microwave frequencies (typ. 500 MHz to 3 GHz) for fast close-in detection of buried and unburied objects on a large area from a save standoff distance. The SAR principle is applied using multiple transmitters and receivers and a side-looking geometry, allowing high spatial resolution in three dimensions. In order to achieve this high resolution also for buried objects, advanced SAR processing is used for proper focusing even within the ground. In the past, the main problem using SAR for buried object detection was to discriminate the object from the background clutter. Now, the setup of the TIRAMI-SAR system demonstrates how to solve this problem by using a multi-static fully-polarimetric approach, consisting of two transmit and four receive antennas operated simultaneously during one scan, and the application of different polarization setups for the identical scene in time multiplex. The superposition of all multi-static images

ensures significantly enhanced clutter suppression resulting in fairly improved target detection. Furthermore, typical targets have different shapes and are located under various viewing angles with respect to the radar sensor. Therefore the use of different polarization combinations is indicated to improve the detection of all targets.

In order to illustrate previously mentioned effects, results with various unburied and buried objects are shown. As a special case, an experiment for the detection of thin wires is discussed. Thin wires are often components of IEDs connecting pressure plate structures with the activator of the explosive device. The wires have typically a diameter less than 1 mm, making detection by radar difficult.