



## **A complementary approach based on ultrawideband and narrow band radar for anti-personnel landmine detection**

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Detection of explosive ordnance by radar in the microwave range is proving to be increasingly effective in determining the location and characteristics of such objects buried at shallow depths in the ground. As is known, the variability of the shape and the different materials used for the manufacturing of anti-personnel mines require considerable effort in finding approaches that can constrain the number of false alarms while maintaining a high probability of correct detection. Microwave propagation in the ground in the 1-3 GHz band is an optimal compromise between spatial resolution and penetration depth (e.g., 10 cm) for the selected terrain [1]. With this band it is possible to exploit good depth resolution to determine with high sensitivity the dielectric discontinuities of buried objects having a characteristic size of about half of the wavelength of the signal. Single antenna ultrawideband (UWB) radars fall into this category and are also widely used in combination with metal detectors in so-called portable dual sensors [2]. To obtain information on the shape and size of buried objects, narrow-band radars (holographic or interferometric) can be used [3]. These sensors spatially scan the investigated area, providing high lateral resolution images in the scanning plane (1/4 wavelength). With this premise, the work will show the advantages of a combined approach of the two types of radars mounted on small robotic platforms [ <https://www.natospsdeminingrobots.com/> ] that can operate continuously via remote control, therefore mitigating the risk for the operator [4]. In particular, the position and shape information obtained with the UWB and narrow-band radars will be discussed in terms of antenna technologies, interface electronics, and processing algorithms for the elimination of false positives in field experiments carried out with low-metal content anti-personnel mine simulants.

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2. M. Sato and M., K. Takahashi, "Development of Dual Sensors and Deployment in Mine Affected Countries". In: Furuta, K., Ishikawa, J. (eds) Anti-personnel Landmine Detection for Humanitarian Demining. Springer, London, 2009, [https://doi.org/10.1007/978-1-84882-346-4\\_3](https://doi.org/10.1007/978-1-84882-346-4_3).

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