An Unmanned Aerial Vehicle Platform for the detection of Landmines and IEDs using GPR

Asilah Al Mesmari[(1)], John J. Pantoja[(1)], Jesus Alvarez[(1)], Adamo Banelli[(1)], Felix Vega[(1)], Chaouki Kasmi[(1)]

(1) Directed Energy Research Centre, Technology Innovation Institute,

Abu Dhabi, United Arab Emirates

Asilah.almesmari@tii.ae

Abstract—In this paper, we present the status of an ultra-wide band ground penetrating radar system mounted on an UAV. The device has been designed for humanitarian demining operations. We describe the platform, the GPR, the method of detection and the integration of artificial intelligence-based algorithms for classification of the landmines. A set of preliminary results is also presented.

Keywords-component; Ground Penetrating Radar, Unmanned Aerial Vehicle (UAV), humanitarian demining, artificial intelligence

I. INTRODUCTION

One of the most promising tools for humanitarian demining is the Ground Penetrating Radar (GPR) [1]. Among the advantages of GPR are discrimination between landmines and metal fragments, reduction in detection time and reduction of false alarms.

However, one of the main challenges in humanitarian operations is the mobility of the operator and the demining tool over the landmine field.

In order to overcome this challenge, we propose to install the GPR on an aerial vehicle (UAV) platform, that will be remotely piloted, scanning the terrain at low altitude.

II. DESCRIPTION OF THE SYSTEM

The system consists of a UWB GPR, using a MIMO antenna system as operating between 900 MHz to 5 GHz. A set of six Vivaldi antennas are connected to a NanoVNA through a RF switch and a distribution network. See Figure 1 for reference.

The S matrix produced by the NanoVNA is processed by a set of digital filters for denoising. The resulting signal will be transmitted via a wireless link to a computational platform where a Machine Learning algorithm will process the signal, discriminating between landmines and clutter [2].

The system will be mounted on a DJI Matrice 600 UAV. The platform will scan a 1 x 1 square meter area in 10 minutes, which is 85% reduction time over the conventional process. The range of operation is 200 m, from the pilot.

Initial tests were done with the instrument to characterize the electromagnetic signature of real improvised explosive devices (IEDs) and landmines in a controlled environment. These results are presented in Figure 2.

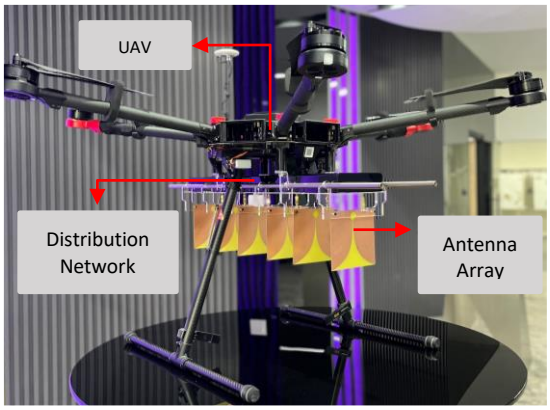

Figure 1. GPR setup mounted on an UAV with 6 antennas

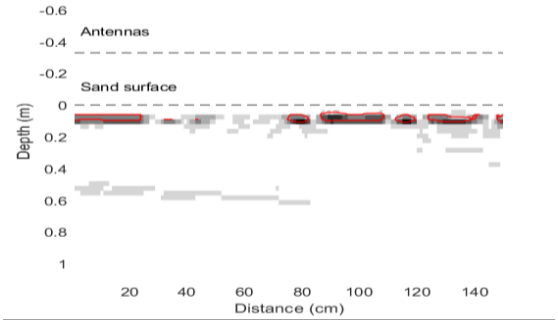

Figure 2 . Results data of soil detection measured in UAE desert

Above figure, is a radargram processed with background removal to create an environment where the sand is homogenous. The dark grey areas highlighted in red represents the variation of the objects buried, whereas the light grey areas are the interface of the next layer of sand.

REFERENCES

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