

Hyperspectral Imaging for Landmine Detection:

Ihab Makki, Rafic Younes, Clovis Francis,
Tiziano Bianchi, Massimo Zucchetti

Lebanese University

Since a long time, many countries around the world are suffering from a danger that menaces the citizens: mines and unexploded ordnances. Beyond the immediate dangers to life and limb, the mine problem is imposing a heavy economic burden to the affected communities. Unfortunately, the techniques that are used in the demining process such as metal detectors, specially trained dogs, and mechanical clearance using armored vehicles fitted with flails are generally slow, expensive and dangerous. Because of this and knowing that new technologies may provide effective alternatives, we are working on the use of hyperspectral imaging in landmines detection. Hyperspectral imaging is a trending technique in the field of remote sensing used in different applications like agriculture, mapping, target detection and food quality monitoring. This technique gives the ability to

identify remotely the components of the image by acquiring the spectral response at each pixel in a series of narrow bands in the visible and infrared ranges. By this, we obtain a reflectance spectrum that will be used as a fingerprint to identify the presence of landmines.

The process will be as follow: a preconfigured drone (hexarotor or octorotor) will carry the hyperspectral camera. This programmed drone is responsible of flying over the contaminated area in order to take images from a safe distance. Various image processing technique will be used to treat the image in order to isolate the landmine from the surrounding. Once the presence of a mine or explosives is suspected, an alarm signal is sent to the base station giving information about the type of the mine, its location and the clear path that could be taken by the mine removal team in order to disarm the mine.

This technology has advantages over the actually used techniques:

- It is safer because it limits the need of humans in the searching process and gives the opportunity to the demining team to detect the mines while they are in a safe region.
- It is faster. A larger area could be cleared in a single day by comparison with demining techniques
- This technique can be used to detect at the same time objects other than mines such oil or minerals.

In our presentation, we would like to give an overview of different projects that worked on the detection of landmines using hyperspectral imaging. We will show the main results achieved in this field and future work to be done in order to make this technology effective.

In addition, we worked on different target detection algorithms in order to achieve high probability of detection with low false alarm rate. We tested different statistical and linear unmixing based methods. In addition, we introduced the use of radial basis function neural network in order to detect landmines at subpixel level. A comparative study between different de-

tection methods will be shown during the presentation.

A field experiment has been done in order to study how the spectral signature of landmine will change depending on the environment in which the mine is planted. For this, we acquired the spectral signature of 6 types of landmines in different conditions: in Lab where specific source of light is used; in field where mines are covered by grass; and when mines are buried in soil. The results of this test will be shown also in the presentation.

Dr. Ihab Makki; Lebanese University & Politecnico di Torino; Beirut Lebanon; ihab.makki@polito.it

Prof. Rafic Younes; Lebanese University; Beirut Lebanon; ryounes@ul.edu.lb

Prof. Clovis Francis; Lebanese University; Beirut Lebanon; cfrancis@ul.edu.lb

Dr. Tiziano Bianchi; Politecnico di Torino; Turin Italy; Tiziano.bianchi@polito.it

Prof. Massimo Zucchetti; Politecnico di Torino; Turin Italy; massimo.zucchetti@polito.it