Hidden Human Detecting behind a concrete wall by using microwave imaging

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***Abstract*—** In microwave imaging systems, high resolution and good penetration of the electromagnetic (EM) waves inside materials are required. The work presented in this article is based on the use of image processing methods in order to reduce the noise that occurs in reconstructed images from a microwave imaging systems. The goal is to apply processing operations such as dilation and erosion on the reconstructed image. The focus has been on the detection of a human being hidden behind a wall. Simulation results show an improvement in image quality compared to the original image and a significant reduction in noise

***Keywords*—** Microwave imaging, morphological filters, Antenna, Concrete wall.

I. INTRODUCTION

The image processing is the set of methods and techniques operating on them, in order to make this operation possible, simpler, more efficient and more pleasant, to improve the visual aspect of the image and extract information considered very relevant. Currently, microwave imaging is widely used in the military for locating and detecting buried objects [1-4].

The object to be illuminated in the case of microwave imaging may well be in free space, or within a supposedly known domain, in the case of imaging buried objects. The electromagnetic field that interacts with the unknown object comes from one or more transmitting antennas. The diffracted field resulting from this interaction is measured by one or more receiving antennas. The number and manner in which emitters and receivers are arranged are additional features of reconstruction methods. A multi-view configuration (multiview) uses multiple transmitters, or a single transmitter that moves. The multistatic term refers to the measurement of the field diffracted by several receivers, or by a single moving receiver [5].

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The work presented in this article is located in these two themes, it is the development of a processing system in order to remove the noise that appears at the level of reconstructed images from a microwave imaging system and especially the detection of a human being hidden behind a concrete wall. The rest of the paper is organized as fellows; in section II a problematic about noise reduction is presented. The results of image procession are discussed in section III. The paper is concluded in section IV.

II. PROBLEMATIC

There are several image processing methods available in the literature that provides sharper images while reducing noise [6]. As part of our study, we have been content to apply some of the most commonly encountered: the morphological filter.

A. Noise reduction by a morphological filter

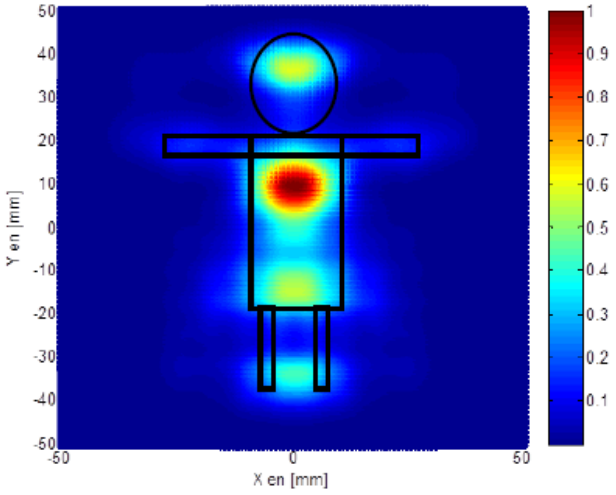
In mathematical morphology, filtering is preserving the image by removing certain geometric structures corresponding to noise (usually implicitly defined by one or more structuring elements). The morphological filter simplifies the image by preserving its structure, but generally loses information. The morphological filter is stable and has a known invariance class. The most fundamental morphological operations are dilation and erosion. Dilatation adds pixels to the boundaries of objects in an image, while erosion removes pixels from the edges of objects. The number of pixels added or removed from objects in an image depends on the size and shape of the structuring element used to process the image. In morphological dilation and erosion operations, the state of a given pixel of the output image is determined by the application of a ruler for the corresponding pixel and its neighbors to the input image. The rule used to process the pixels defines the operation as dilation or erosion

Such a transformation makes it possible to suppress the isolated pixels that correspond to the noise, then to dilate the shapes of the image so as to make them a proportion close to

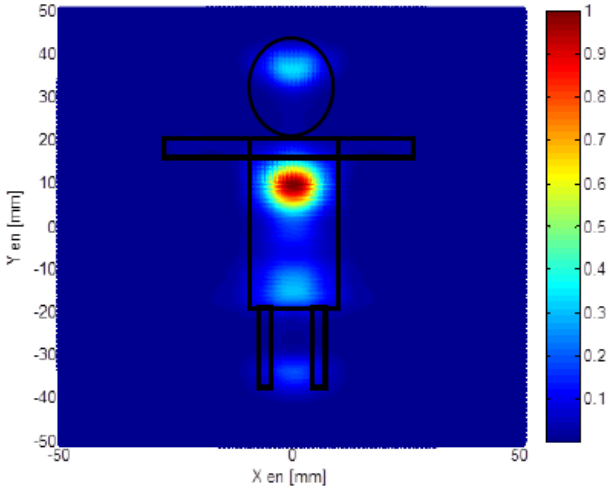
that which they had before the erosion. The noise is thus attenuated. When an image is noisy, its binarization brings out black spots or isolated and isolated white spots that must be removed by techniques: dilation and erosion.

III. Results

We tried to apply the treatment methods to an image obtained from a human being with the dimensions of a doll hidden behind a wall. Obstacle detection represents an important challenge that justifies the development of imaging radar. These are developed in the context of civil and military security. In terms of military threats, conflicts can occur in all environments and especially in urban areas. Currently, the danger presented by terrorism is certainly the main threat, it is within this framework that we try to apply the morphological filters to have a clear image of a human being. The simulation results are sketched in Fig 1.b and 2.b

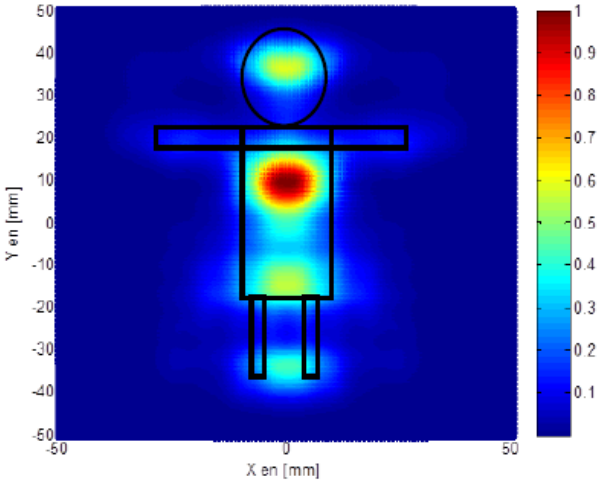


(a)

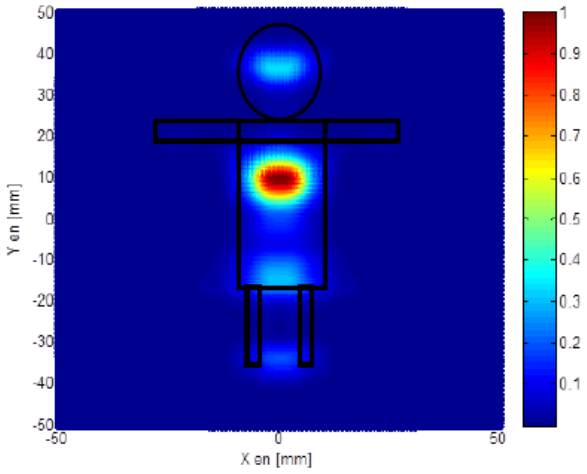


(b)

Fig.1. 2D images for the case of a human(doll dimensions)
(a) reconstructed image untreated by microwave imaging
(b) reconstructed image processed by the erosion method



(a)



(b)

Fig.2. 2D images for the case of a human (doll dimensions)
(a) reconstructed image untreated by microwave imaging
(b) reconstructed image processed by the dilatation method

By applying the two methods namely: erosion, dilation systematically the noise is reduced. However, it has been noticed that applying this type of treatment, the shape of the object to be detected is degraded. For all these reasons, other methods of treatment must be used in the case where the object to be detected has a more complex form such as that of the human being with real dimensions.

IV. Conclusion

Image processing allows us to modify the content of images in order to derive useful information for a particular application. Matlab offers many processing options with a wide range of ready-to-use tools such as erosion, dilation and many other filters. The major disadvantage of Matlab is in its relative slowness to perform certain calculation operations (for example the Fourier transform).

However Matlab can quickly deploy tests to verify the validity of an image processing method. Image manipulation is matrix manipulation, which is very easy by using Matlab.

In addition, we noticed that the dilation and erosion methods give good results in terms of filtering.

As a future work, we aim to detect a human by using real dimensions by microwave imaging application and use other performed image processing.

References

[1] D. Sheen, D. McMakin, and T. Hall, "Three-dimensional millimeter-wave imaging for concealed weapon detection," IEEE Transactions on Microwave Theory and Techniques, vol. 49, no. 9, pp 1581 –1592, sep 2001.

[2] D. M. Sheen, D. L. McMakin, H. D. Collins, T. E. Hall, and R. H. Severtsen, "Concealed explosive detection on personnel using a wideband holographic millimeter-wave imaging system," I. Kadar and V. Libby, Eds., vol. 2755, no. 1. SPIE, pp 503–513, 1996.

[3] I. G. Cumming and F. H. Wong, "Digital processing of synthetic aperture radar data", Artech house, 2005.

[4] S. M., Chouiti, L. Merad, S. M. Meriah, F. Derraz, and X. Raimundo, " Monostatic imaging of an embedded object using a confocal algorithm," International Journal of Numerical Modelling: Electronic Networks, Devices and Fields, vol. 31, no 5, p. e2338, sept. 2018.

[5] L. Chommeloux, "Application de l'imagerie micro-onde active à la détection d'objets enfouis dans un milieu homogène ou stratifié", Thèse de doctorat, Université Paris- Sud 11, 1987.

[6] Rapport Benhamadi, "documents.tips/documents/rapport-benhamadi.html"