Inverse Problem in Pulse Radar Imaging Techniques

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Abstract

Radar imaging techniques have a great advantage for a high range resolution, which cannot be obtained with optical methods. They are efficient for a non-destructive measurement of industrial products (e.g. antennas and vehicles), also suitable for target locating techniques of rescue robots in a dark smoke. Moreover, Ultra Wide-Band (UWB) signal has a great potential for a high-resolution imaging in near field, which has been approved in 2002 at Federal Communications Commission. However, in general, an imaging with radar is known as an ill-posed inverse problem, because received signals have an insufficient information of the target shape. While various imaging algorithms for radars have been proposed to resolve this problem, they require an intensive computation with a parametric approach. Contrarily, we have already proposed a fast and non-parametric imaging algorithm [1]. It utilizes an reversible transform between the time delay and the target boundary, and is efficient for a real-time imaging. However, the resolution of the image is determined with the scattered waveform deformations. In this paper, we propose a fast and high-resolution imaging algorithm with iterating the shape and waveform estimations. The accuracy of the image with the proposed method is within 1/100 center wavelength of the pulse including the target edges, which cannot be obtained by the conventional imaging algorithm.

[1] T. Sakamoto and T. Sato, "A target shape estimation algorithm for pulse radar systems based on boundary scattering transform," IEICE Trans. Commun., vol. E87-B, no. 5, pp. 1357–1365, 2004.