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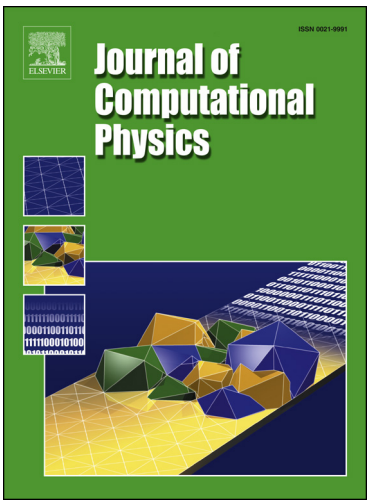

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A Linear Sampling Method for Through-the-Wall Radar Detection

Matthew Charnley[1,2] and Aihua Wood[3,4]

Abstract

The through-the-wall inverse scattering problem is analyzed via the linear sampling method. The reciprocity gap formulation of the linear sampling method is used to reconstruct an object within a closed-off room. In order to apply this method, a numerical method to model a point source is needed, along with knowledge of how the numerical fundamental solution differs from the analytic one. Application of the linear sampling method to the Finite Difference Time Domain solution is described and illustrated, and results to reconstruct objects in the through-the-wall setting are shown.

Keywords: FDTD, Through-the-wall imaging, Inverse problems, Linear sampling method, Delta function, Fundamental solution.

1. Introduction

Inverse problems have continually been of mathematical interest for their potential physical applications. One important example of this type of problem is the inverse scattering. Methods for solving the inverse scattering problem have been developed over the last few decades, and are fairly extensive [7]. In particular, the so called 'linear sampling method' has been developed in an attempt to construct a linear problem that can indicate the solution to the very non-linear inverse problem. This method was originally proposed in [6] and expanded upon in [8], [3], and [5], to name a few.

An inverse problem of particular physical interest is that of through-the-wall imaging. In this problem, one wants to use scattered data where both the transmitter and receiver are positioned outside of a solid room to locate and analyze an object inside the room. Previous work has used Doppler-type radar to detect and analyze humans in the through-the-wall setting, whether it be studying human motion with standard Doppler radar [15], noiseforms [14], or micro-Doppler radar, which looks for smaller scale movements such as arm movement [13] and heartbeats [1]. More recent work in this area took place in the master's thesis

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