Accepted Manuscript

Some properties of subspace migrations in the limited-view inverse scattering problems

Young Mi Kwon, Won-Kwang Park

PII: S0893-9659(13)00164-X
DOI: http://dx.doi.org/10.1016/j.aml.2013.05.015
Reference: AML 4391

To appear in: *Applied Mathematics Letters*

Received date: 18 April 2013
Revised date: 29 May 2013
Accepted date: 29 May 2013

Please cite this article as: Y.M. Kwon, W.-K. Park, Some properties of subspace migrations in the limited-view inverse scattering problems, *Appl. Math. Lett.* (2013), http://dx.doi.org/10.1016/j.aml.2013.05.015

Some properties of subspace migrations in the limited-view inverse scattering problems

Young Mi Kwon, Won-Kwang Park*

Department of Mathematics, Kookmin University, Seoul, 136-702, Korea.

Abstract

An analysis of subspace migration occurs in the limited-view inverse scattering problem is considered herein. Based on the structure of singular vectors associated with the nonzero singular values of Multi-Static Response (MSR) matrix, we establish a relationship between subspace migration imaging function and Bessel functions of integer order of the first kind. The revealed structure and numerical examples answer that why subspace migration is applicable for imaging of small scatterers in the limited-view inverse scattering problems.

Key words: Subspace migration, limited-view inverse problem, Multi-Static Response (MSR) matrix, Bessel functions, numerical examples

1. Introduction

This work focuses on the subspace migration for imaging of small scatterers located in the homogeneous two-dimensional space $\mathbb{R}^2$ in the limited-view inverse scattering problems. Subspace migration is simple and effective imaging technique so it is applied to a lot of inverse scattering problems. Due to this reason, various remarkable properties are studied and investigated in many researches. Related works can be found in [1, 2, 6, 7, 9, 10, 11, 12, 13] and references therein.

Based on these researches, it turns our that subspace migration can be applied not only in the full-view but also limited-view inverse scattering problems. However, the use of the subspace migration based imaging technique has been applied heuristically. Due to this reason, in [1, 7], the structure of subspace migration in the full-view inverse scattering problems has been established. However, in the limited-view problems, it still applied heuristically hence, a mathematical identification of its structure in the limited-view problems still needs to be performed, which is the motivation of our work.

In this paper, we extend the research [7] of structure analysis of subspace migration in the full-view problem to the limited-view problem for imaging of perfectly conducting cracks of small length. This is based on the fact that far-field pattern can be represented by the asymptotic expansion formula in the presence of such cracks (see [4] for instance). From the identified structure, we find a condition for successful imaging performance. Subsequently, the structure of multi-frequency subspace migration should be analyzed. This shows how application of multi-frequency enhances its applicability.

This paper is organized as follows. In Section 2, we survey two-dimensional direct scattering problems, asymptotic expansion formula in the existence of small crack, and subspace migration. In Section 3, we investigate the structure of single- and multi-frequency subspace migration in the limited-view problems by finding a relationship with Bessel functions of integer order of the first kind.In Section 4, some numerical examples are exhibited to support our investigation. A short conclusion is mentioned in section 5.

*Tel: +82 2 910 5748; fax: +82 2 910 4739.
Email addresses: himang0912@kookmin.ac.kr (Young Mi Kwon), parkwk@kookmin.ac.kr (Won-Kwang Park)