Abstract

Application of the orthogonal matching pursuit algorithm for determining the clutter covariance matrix in space-time adaptive signal processing

Author: mgr inż. Anna ŚLESICKA

Supervisor: prof. dr hab. inż. Adam KAWALEC

The dissertation presents a new method of estimating the clutter covariance matrix (CCM) used in space-time adaptive processing (STAP) of a radar signal. The STAP technique is used to detect targets moving on the earth's surface through a radar system mounted on a flying platform. This technique allows the detection of a moving targets against the background of two-dimensional interferences. The key step in the STAP processing algorithm is the correct determination of the CCM.

In the literature on the subject, you can find various methods of estimating the CCM. The general division into statistical and non-statistical methods is applied. In the first case, the estimation of the CCM is derived from data from training distance cells surrounding the target cell being tested. As it turns out, in real conditions it is difficult to determine CCM and its inverse in this way. Furthermore, statistical algorithms fail when the data contained in training cells do not reflect the statistical clutter properties of the test cell, especially in a non-uniform clutter environment. Therefore, an increasing number of scientists focuses their efforts on developing non-statistical methods of estimating the CCM in a heterogeneous environment.

This paper presents a new method of estimating the CCM based on the use of the Multiple Input, Multiple Output (MIMO) radar geometry model, as well as the orthogonal matching pursuit (OMP) algorithm. The developed technique allows for suppression of interferences and detection of an object in a heterogeneous environment. Moreover, the proposed method uses a single snapshot of the radar data cube, which eliminates the need to access multiple training cells.

The paper presents a thorough analysis of STAP processing due to the method of determining the CCM. The theoretical results obtained during the dissertation were verified by means of computer simulations. The simulation results confirmed the correctness of the theoretical analysis presented in the paper.

Anna Ślesicka
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