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Azimuth Model of Sea Vessel Radar Image That Accounts for Its Geometrical Dimensions

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Abstract—Azimuth model of sea vessel radar image is obtained based on the developed experimental regression dependence between length and width of sea vessel that allows estimating azimuthal dimensions of the observed sea object using only range measurements and under unknown movement direction as well as decreasing the number of azimuth correlation processing channels.

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INTRODUCTION

During coordinate processing of radar signals scattered by long sea objects a multi-channel scheme of range and azimuth correlation processing is usually used [1–3]. Such scheme is universal, but redundant.

Redundancy is caused by the fact that the mentioned procedures account only for range and azimuth resolution of shore observation station, but ignore such constructive statistically stable peculiarity of sea vessel as the ratio between their length and width.

Meanwhile consideration of such additional prior information has the following benefits:

– decrease the required mean number of azimuth correlation processing channels and decrease the burden on the primary radar processing subsystem;

– eliminate or significantly decrease processing of passive interference signals from long targets, whose dimensions exceed the character dimensions of sea vessels.

PROBLEM DEFINITION

This paper aims to improve coordinate processing of radar signal scattered by long object by decreasing the number of azimuth correlation processing channels using the obtained experimental regression dependence of the observed geometric dimensions of object, as well as to eliminate or to decrease the influence of passive interference, created by hydrometeors and ruffled sea surface, whose geometric dimensions exceed character dimensions of sea vessels.

MAIN PART

1. Experimental estimation of regression dependence between length L and width B of a sea vessel is obtain using a database with ratios of geometric dimensions for sea vessels that visited Asov–Black Sea in Ukraine during last 11 years.

The list of vessels was ordered by length. Then the ordered list was divided into 30 sets with 200 vessels in each, which provided statistical significance of each set. Then for each set medians of vessels' lengths and widths were determined. Medians secured estimates of geometric dimensions from possible sporadic spikes in initial data.

Thus, 30 experimental sets of mutual regression dependence of vessel's length L and width B were obtained. Approximation of such dependence using least squares method results in the following formula:

$$L = a_1 B - a_0, \tag{1}$$

where $a_1 = 7.06$ and $a_0 = 6.54$ are linear approximation coefficients.

The obtained results are depicted in Fig. 1.