DATA ACQUISITION OF VESSEL ISAR DATA WITH ASSISTANCE OF AUTOMATIC IDENTIFICATION SYSTEM

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1. INTRODUCTION

Radar imaging from air and space based platforms has become very popular during the last years. Today, a couple of systems are in operation for remote sensing like TerraSAR-X [1] and Radarsat-2 [2]. While these systems are providing good results of static scenes, they are not able to image moving vehicles and vessels because of the unknown motion of these objects.

Efforts have been made to overcome these problems. Experimental data of moving ground vehicles are relatively easy to acquire and some methods have been proposed to estimate the motion of such targets [3]. Maritime vehicles data acquisition for ISAR imaging with high resolution from an airborne platform turns out to be a problem because cooperative ships can hardly be involved into experiments. Only few results can be found in the literature, e.g. [4], [5] and [6], dealing with motion estimation and focussing strategies of ship ISAR data.

To overcome the problems of data acquisition of ship ISAR data, we integrated an AIS receiver (Automatic Identification System) into our experimental SAR sensor PAMIR. This enables us to select a ship of interest during the flight and to perform ISAR acquisition with respect to the selected target.

2. AUTOMATIC IDENTIFICATION SYSTEM

The Automatic Identification System (AIS) is a coastal tracking system used on ships and by Vessel Traffic Services. Ships, which are equipped by an AIS transponder transmit their identity and location information. Position, course, and speed can be received by other ships which can use these information for navigation.

Marinetraffic.com operates an internet service which receives AIS signals in wide sea areas and provides some received infomation online. Figure 1 depicts a typical sea situation in the North Sea area.

3. DATA ACQUISITION

ISAR data acquisition of moving vehicles requires knowledge about the position of a target at a specific time. While this requirement can be fulfilled for ground moving vehicles by organising cooperative vehicles or constantly illuminating an area with appreciable traffic, similar strategies are usually impractical when dealing with vessels. Trials involving targets of opportunity can be performed in the area of a waterway. But, as can be seen in figure 1, the traffic density even on frequently used seaways is low. Vessels are spread in two dimensions and distances between them amount to some kilometres. Having an operational radar system in mind, the best way to acquire vessel ISAR data would be to perform ship detection first using a suitable wide

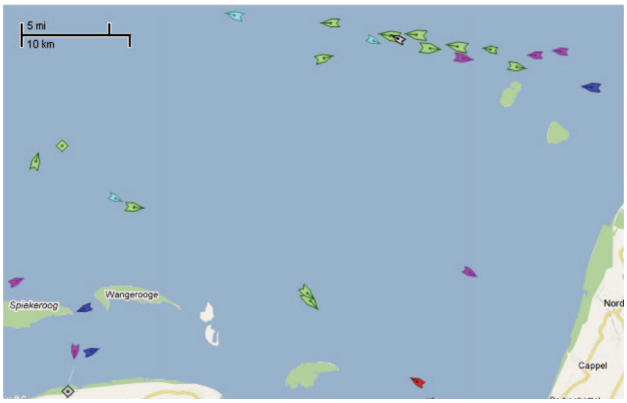

Fig. 1. Snapshot of a typical traffic situation in the North Sea (source: MarineTraffic.com)

area MTI mode and start ISAR acquisition thereafter. If such an MTI capability is not available, the only possibility to acquire vessel data without other support is to perform data takes on large areas with seaways, hoping to gather echoes of a vessel.

In this case, data rate had to be wasted to cover a large sea area and in the lucky case of illuminating a ship, the target observation time was limited. With assistance of an AIS receiver, the position of a ship can be taken into account when the data take is performed. Data rate can be invested into high PRF and multi channel operation.

4. AIS INTEGRATION

To overcome the limitation, an AIS receiver available as yachting equipment has been built into the frontend of our experimental airborne radar system PAMIR. The VHF antenna is mounted near the optical camera between two of the interferometric receiving antennas. The AIS receiver has been installed behind the radar antennas and is connected to the control computer of the optical camera. This computer forwards the received AIS messages to the navigation console. AIS messages will be decoded and vessels are displayed on the navigation screen. According to the parameters of the ships which are shown after reception and decoding, a target can be selected and a prepared recording parameter file can be chosen. When the platform reaches the selected target, a data take will be triggered.

5. FIRST RESULTS

First flights after the AIS integration have been conducted over the North Sea recently. Ships were depicted on the navigation screen and could be selected for recording. Figure 2 shows a first range-Doppler image of one ship. Further investigation to these data will be done to increase the resolution in range direction by combination of multiple subbands and in cross range direction by motion estimation and compensation. A nice byproduct of the AIS information is the reception of the unique identification number of the observed ship. The internet service vesseltracker.com provides optical images of a huge number of ships which can be searched using the identification number of a vessel. Thus, a kind of ground truth can be achieved during the offline data processing.

6. CONCLUSION

The AIS receiver which has been integrated into the PAMIR system enables us to acquire ISAR data of moving ships well-directed. Thanks to this feature we are now able to achieve multi-channel data of such targets. This feature will be used to enhance motion estimation methods and to perform interferometric ISAR data takes.

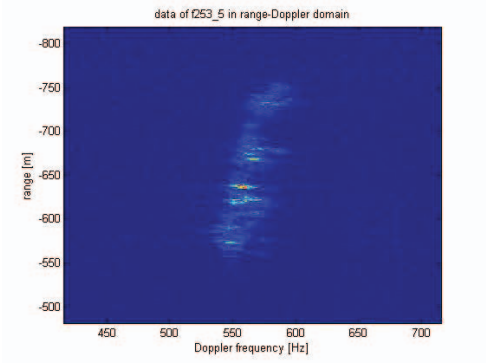

Fig. 2. Range-Doppler image of a ship which was selected with AIS assistance and recorded afterwards

7. REFERENCES

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