SHIP DETECTION AND MEASUREMENT USING THE TERRASAR-X DUAL-RECEIVE ANTENNA MODE

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1. INTRODUCTION

The detection of ships and the retrieval of parameter like vessel velocity, heading and size are important techniques for ocean and shore surveillance systems. The state of the art with SAR technology bases on the use of single channel amplitude data [1][2]. This paper reports about the results obtained with the TerraSAR-X (TS-X) Dual Receive Antenna (DRA) mode. Beside the Radarsat-2, the TS-X is the only satellite, which has the ability of high resolution (3m in strip map mode) and Along-Track Interferometry (ATI). This makes it very attractive for the detection of relatively small ships with low RCS hidden in sea clutter. In fact, the ATI-mode on TerraSAR-X can be realized in two different ways: either by switching the attenuation of different antenna parts on a pulse-by-pulse basis (Aperture Switching, AS mode) or by splitting the antenna and the use of two receiver chains (DRA mode). It allows for the detection and measurement of ground moving objects and has been successfully demonstrated for road traffic and surface current mapping [3]-[5].

2. RESULTS

This paper presents first results of exploiting DRA-mode data for ship detection and velocity measurement. Using a modified version of the TerraSAR-X Traffic Processor TTP [4], ships are automatically detected and their velocity is estimated by means of ATI phase. By this, they are derived from a directly accessible quantity and not by the sometimes difficult exploitation of the wake signatures and distance to the ship. Due to the relatively low ship velocities, the interferometer needs to be very sensitive, i.e. the effective along-track separation of the receive phase centres must be as large as possible. The DRA mode is used in this application since it offers the longest baselines (typically 1.2 - 1.4 m) among the available ATI modes of the sensor. We briefly describe how data are processed and present first results.

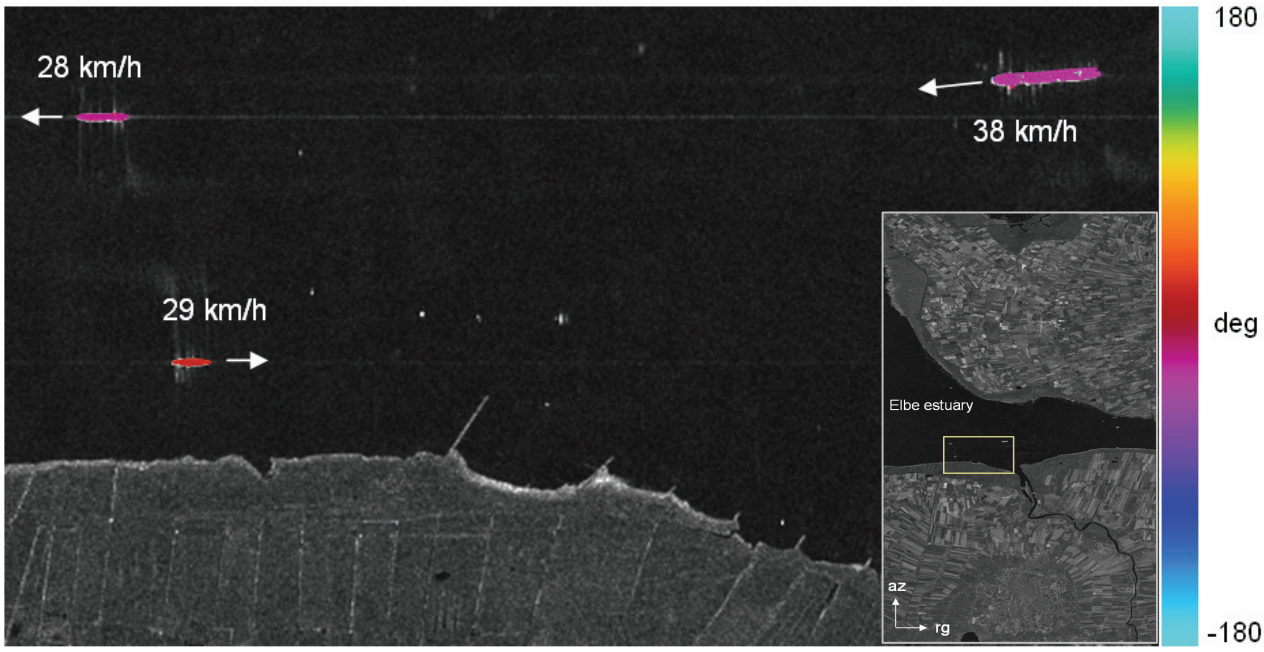

Figure 1: Ships detected with the TerraSAR-X DRA mode (DT11108, 29.4.2009) in the Elbe estuary. The ATI phase of the detected objects is shown color-coded and overlaid on the SAR amplitude. Annotated are the ship ground-range velocities, estimated from the phase.

Within a DRA campaign in spring 2009, several data takes over the Elbe estuary near Hamburg, Germany with its dense ship traffic were acquired and processed. Figure 1 shows an example. There are three major ships in the marked image area that have been automatically detected by the processor. ATI phase for detections is overlaid color-coded on the SAR amplitude. Ship velocities are calculated by evaluating the ATI phase statistics on the pixel cluster of the detected moving object. Until the conference, a second DRA campaign will be conducted, in which we plan to make more acquisitions and compare the satellite ship detection and measurement results with ground truth measurements.

3. CONCLUSION AND OUTLOOK

The detection and velocity measurement of ships with SAR Along-track Interferometry has been demonstrated with an operational space based SAR sensor. The sensitivity of the method will be increased significantly with the TanDEM-X mission where TerraSAR-X and a new satellite will fly in a close formation [6]. It will also be of interest how the ability to detect ship wakes improves [7]. Such multi-channel SAR data are only available from this satellite configuration but are very promising and need to be investigated.

11. REFERENCES

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