A software platform for maritime monitoring and prompt target characterization

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The main purpose of the work described here concerns the development of a software platform dedicated to sea surveillance, capable of detecting and identifying illegal maritime traffic. This platform results from the cascade implementation of several image processing algorithms that take as input Synthetic Aperture Radar (SAR) and Optical maps captured by satellite-borne sensors.

Inspired by a computer vision approach, the mentioned platform consists of a pipeline of processing steps devoted to i) the detection of vessel targets in the input map, ii) the extraction of the vessel descriptive features and finally, iii) the estimation of the kinematics of the targets by identifying and analyzing the wake patterns on the water surface. The first task in the processing chain concerns the identification in the input map of potential vessel targets. This is obtained by a dedicated detector, based on a signal thresholding method. The threshold value is conceived as a spatially varying parameter, in order to adapt the algorithm sensitivity to the nonstationary properties of noise. A second step in the processing pipeline focuses on the analysis of the individual vessel images in order to perform morphological and radiometric measurements. At this stage, the signal is processed to refine the identification of the image pixels belonging to the vessel silhouette and to perform meaningful measurements on them. The extracted features provide quantitative attributes (length, width, pixel radiometry distribution) that can also be exploited to implement a classification module. The final stage of the processing pipeline concerns the analysis of the areas surrounding the vessel silhouette, where, in case of ship motion, a surface wake pattern is expected to be observed. A proper processing of these surface patterns allows us to estimate the route and, whenever the image resolution is large enough to observe the internal wake components, the ship velocity.

By integrating the information returned by the procedures described so far, a system for maritime surveillance and vessel traffic monitoring can be developed. Given the quantitative approach inspiring each link of the processing chain, this software platform represents a reliable tool that can be exploited by concerned decision makers in critical maritime frameworks, such as unauthorized fishing counteractions or irregular migration and smuggling activities.

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