Tracking Marine Oil Pollutants from Spaceborne SAR Imagery

Yongtao Yu (China, PR), Jonathan Li (Canada), Haiyan Guan and Cheng Wang (China, PR)

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SUMMARY

Satellite-borne synthetic aperture radar (SAR) has proved the only feasible means for monitoring the vast marine environment, since SAR is an active sensor capable of capturing marine surface scenes day and night in all-weather conditions. Deliberate oil spills occur more often on the sea surface than oil spills associated with ship accidents in recent years The negative impact of oil spills on marine environment may become significant with the expected increased ship traffic in the main waterways and a corresponding impact on seabirds, aquatic animals, and coastal ecology along shorelines. There is no doubt that intentional spills must be quickly identified and associated with particular ships to support legal proceedings against the offenders and act as a deterrent. Automated monitoring is an essential part of identifying oil spills given the vastness of the marine environment. SAR is well suited to scene capture of oil slicks but current technology suffers from automated identification of oil slicks due to false positives and false negatives. This paper presents our experience in developing automated algorithms to robustly identify oil spills in SAR imagery. The innovation of our development lies mainly in oil slick detection using a tensor voting approach. In the first step, a thresholding algorithm that well maximizes the ratio of between-class variance to within-class variance is used to detect potential dark spot candidates. In the second step, a tensor voting framework integrated with sparse and dense ball votings is carried out to suppress noise while maintaining dark spots. In the third step, a saliency map that reflects the probability of a pixel being located within a dark spot is generated using the saliencies of ball tensors. In the fourth step, a segmentation method is applied to ascertain dark spots based on the saliency map. The performance of our approach was evaluated by using a set of RADARSAT-1 ScanSAR Narrow Beam mode intensity images. The quantitative results demonstrate that the average commission error, omission error, and quality of the proposed approach are 0.0027, 0.0373, and 0.9563, respectively.