DETECTING WATER BODIES ON RADARSAT IMAGERY

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This paper presents a novel geodesic active contour (GAC) model based on an edge detector for rapid detection of water bodies from spaceborne synthetic aperture radar (SAR) imagery with high speckle noise. The original edge indicator function based on gradients is replaced by an edge indicator function based on the ratio of exponentially weighted averages (ROEWA) operator. Thus, the capability of edge detection and the accuracy of locating edges are greatly improved, which makes the model more appropriate for SAR images. In addition, an enhancing term is added to the original model's energy function in order to boost the strength for the contour's evolution. An unconditionally stable additive operator splitting (AOS) scheme and a fast algorithm for re-initialization of the level set function are adopted, which not only enhances the model's stability, but also speeds up the model's convergence remarkably. The experimental results on simulated and real RADARSAT-1/-2 images show its efficiency and accuracy.

Cet article présente un nouveau modèle de contour actif géodésique (GAC, de l'anglais geodesic active contour) fondé sur un détecteur de contours pour détection rapide des plans d'eau à partir d'images radar à synthèse d'ouverture (RSO) spatioporté avec bruits de chatoiement élevés. La fonction originale d'indicateur de contours fondée sur les gradients est remplacée par une fonction d'indicateur de contours fondée sur le rapport d'un opérateur de moyennes pondérées de façon exponentielle (ROEWA). Par conséquent, la capacité de détection des contours et l'exactitude des contours localisés sont grandement améliorées, ce qui rend le modèle plus adéquat pour les images RSO. De plus, une modalité d'amélioration s'ajoute à la fonction d'énergie du modèle original dans le but de renforcir la puissance de l'évolution des contours. On a adopté un scénario de séparation d'opérateur additif (SOA) inconditionnellement stable et un algorithme rapide pour la réinitialisation des surfaces de niveau, ce qui non seulement améliore la stabilité du modèle, mais accélère aussi la convergence du modèle de façon remarquable. Les résultats expérimentaux sur des images simulées et réelles RADARSAT-1/-2 démontrent son efficience et son exactitude.

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1. Introduction

Water resources play an important role in environmental, transportation and regional planning, disaster management, industrial and agricultural production. Detecting water bodies is the first step for any planning, especially for Ontario, Canada, where the land-cover is dominated by water bodies. Earth observation data, including spaceborne synthetic aperture radar (SAR) images, when used jointly with in situ data, can provide an essential contribution for the creation of inventories of surface water resources, the extraction of thematic maps relevant for hydrogeographical studies and models (e.g., land cover, surface geomorphology) or for the retrieval of (bio)geographical parameters (e.g., water quality and temperature, soil moisture) [*Shultz and Engman* 2000]. SAR data are suitable for mapping water bodies, as the signal is principally sensitive to moisture and to surface roughness. These data can be preferred to optical imagery taking into consideration the cloud penetration capabilities that are fundamental when mapping transient waters typically associated to rainy periods. However, speckle noise usually occurs in SAR images due to the nature of coherent imaging. It makes feature extraction from SAR image much more difficult than that from optical imagery. In order to eliminate the speckle effects, a significant research effort has been devoted to the design of effective segmentation methods over last few decades. Among them, four types of the segmentation methods have been commonly used, namely, the edge-based scheme [*Oliver et al*. 1996; *Collins and Kopp* 2008], the Markov random field (MRF) model [*Fjortoft et al*. 2003], level set theory [*Shu et al.* 2010], and the region merging / region growing family of methods [*Cook et al*. 1994]. The edge-based scheme aims to find transitions between uniform areas, rather than directly identifying them.

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