Modeling spatial uncertainty with random sets for edge detection from satellite images

A. Stein[1], D. Sediropoulou Velidou[1,*], A. Ghofrani Esfahani[1,*]and V. Tolpekin[1]

[1] *University of Twente, Faculty of Geo-information Science and Earth Observation, PO Box 217, 7500 AE Enschede, the Netherlands alfred.stein@utwente.nl*
[*] *Corresponding author*

Abstract. *Random sets are common spatial statistical concepts that allow to quantify uncertainty in spatial objects. For objects extracted from remote sensing images, quantification of the uncertainty is important, as many objects are relatively small with respect to the pixel size and are sometimes poorly defined. Remote Sensing (RS) data, however, are attractive for land cover identification, classification and estimation. In this presentation we aim to address the presence of edges. Such edges occur on images in different shapes, for example as geological lineaments and as borders between agricultural parcels.*

Keywords. *Random sets; Remote sensing; Lineaments; Parcels; Edges*

Edge detection is interesting for automatic identification of geological lineaments such as faults and ridges that appear as linear features on remote sensing images [1]. Efforts to establish an automatic method involve the use of a standard edge detection algorithm. A novel edge detection method for automatic geological lineament mapping is based on human visual perception as defined by Gestalt theory. A new condition is introduced that distinguishes real objects from artifacts. Optimal parameters on the classifier are to be estimated, including their uncertainties. Such uncertainty is largely determined by the nature of the geological edges and their appearance on RS images. In a study around Lake Magadi in Kenya we used an ASTER scene. Lineaments were observed that have a noisy gradient angle. Moreover, shadows, presence of some vegetation and irregular slopes resulted in the presence of narrow polygons rather than clear lines. This all resulted in the introduction of random sets to model the lineaments. The algorithm was developed in the open source platform R.

Edges also occur in studies on crop yield estimation of agricultural fields. Modeling agricultural fields as spatial objects helps to identify the extensional uncertainties and therefore to characterize inaccuracy in parcel size estimation [2]. We used random sets for modeling agricultural parcels as extracted from an NDVI map of a Landsat 5 TM image on a field study in the Sharifabad region in Iran. Field boundaries are irregular and often transitional and their extensional uncertainty was quantified. Gaussian thresholding of image segmentation was applied to generate random sets for six agricultural fields. Quan-

tification of extensional uncertainty presented two parcels with a larger extensional uncertainty than the other four parcels. A question we addressed in this study was identification of the boundaries between two adjacent parcels. An overall accuracy of 91% shows that random sets were effective for modeling the extensional uncertainty of the agricultural fields and for the delineation of the agricultural field boundaries. The geometric model used to delineate the agricultural field boundaries is handling irregular shape boundaries, thus making the approach applicable to similar cases.

References

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