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論文要旨

THESIS SUMMARY

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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

Because of the high demand for the construction of new residential and business areas, especially in developing countries, the accurate monitoring of the urban area expansion is needed for the management of urban planning. The remote sensing data from optical sensors are commonly used to perform such monitoring because of their ability to capture a clear image of Earth surface which allow the easy creation of maps. Despite the excellence of optical data, some developing countries are located in tropical areas where clouds cover parts of the area all year round and optical sensors are unable to capture Earth surface below these clouds. Because synthetic-aperture radar (SAR) captures images using microwave signals that can penetrate clouds, it is a good substitute for handling the problem in such situation. However, the identifying of locations of new constructions is much harder because of a difficulty in the interpretation of SAR images and cause most of the conventional methods are incapable for this objective. The deep learning, however, is different from those conventional methods that used the fixed mathematical condition to locate the change of new constructions from the pixel intensity between bitemporal SAR images which tends to fail when facing an unordinary intensity change behavior. Instead of limiting to the fixed condition, deep learning simulate the experience-based learning mechanism of the human brain using training data and ground truth data in the same way that humans learn. This property makes the trained deep learning model robust against a diverse range of intensity change behaviors, geographical terrains and other physical properties of SAR images. However, to reach the mentioned robustness, the deep learning requires a large amount of training data and the corresponding ground truth in term of quantity and variation, which are, unfortunately, difficult to be obtained. As a result, this thesis proposes a novel deep learning architecture that can generate an accurate result under the circumstance of limited training data for the purpose of newly built construction detection in SAR images. The proposed architecture is based on the assumption that regardless of whether the changes are found from before-after (Time 1-Time 2) or after-before (Time 2-Time 1) in bitemporal SAR time-series images, the changes are still at the same spots with the same shape, which means that both types can be correctly associated with the same ground truth data. While normally, the detection of new buildings is supposed to use the data in Time 1-Time 2 format, the proposed architecture takes both Time 1-Time 2 and Time 2-Time 1 formats of data as training data to allow learning based on both of the changing features to make it more viable. With this architecture, the amount of training data of the network appears to be doubled with more variation while the actual used data were in the same quantity. The proposed architecture adopts the advantage of U-net which is skip connection that passing the low-level features from encoders to decoders to allow it to generate a result with more solid boundaries. The model trained with dataset of SAR images of Bangkok area captured by ALOS-PALSAR has demonstrated the successful of the proposed architecture as it is able to detect the newly built constructions in multiple geographical terrains including Bangkok, Hanoi and Xiamen area with higher accuracy than U-net, one of the state-of-the-art methods, at the same number of training set. Moreover, the model can perform the detection on SAR images at Chiang Mai, Thailand, which is capture by the Sentinel-1 satellite with mostly different properties, including radar wavelength, spatial resolution and polarization. The experiments in this thesis further show that the model trained with proposed architecture can be used with images taken from the different orbit direction of a satellite and also robust against noisy images.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note：Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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