Semantic Segmentation for Urban Planning Maps Based on Full Convolutional Networks

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(1) Motivation: The urban planning maps, which provide abundant information of land use, are quite indispensable resource for different fields. However, such kind of maps is often outdated or only nondigital version provided, the digitization has become a significant task. As a very important part of urban planning maps digitization, semantic segmentation is always conducted by human beings, which would be very time consuming and inevitably causes many problems. The automatic semantic segmentation for urban planning maps with high accuracy and efficiency is still a big challenge.

(2) Approach: In this study, we present a novel method for urban planning maps semantic segmentation based on full convolutional networks (FCN), which can conduct end-to-end and pixel-to-pixel semantic segmentation with high efficiency. First, data argumentation method is implemented to increase the diversity of training dataset. Second, to optimize and mine the capability of FCN for urban planning map sematic segmentation, the original FCN was carefully optimized and enhanced. Third, the proposed model can learn from the training dataset patterns and output a trained one that captures these relationships. Thereafter, Cross Validation was implemented to verify the feasibility and performance of the models. Finally, the generated FCN model was applied to the semantic segmentation for urban planning maps, and a few of post processing methods were implemented to enhance semantic segmentation results.

(3) Results and Discussions: Experimental results of the test area at Shibuya-ku in Tokyo show that our proposed method can achieve an Jaccard similarity coefficient of 92.52% for semantic segmentation, which indicate the proposed method can be a viable tool for urban planning map semantic segmentation task with high accuracy and efficiency.

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(5) References:

Ronneberger, Olaf, Philipp Fischer, and Thomas Brox. "U-net: Convolutional networks for biomedical image segmentation." In *International Conference on Medical Image Computing and Computer-Assisted Intervention*, pp. 234-241. Springer, Cham, 2015.

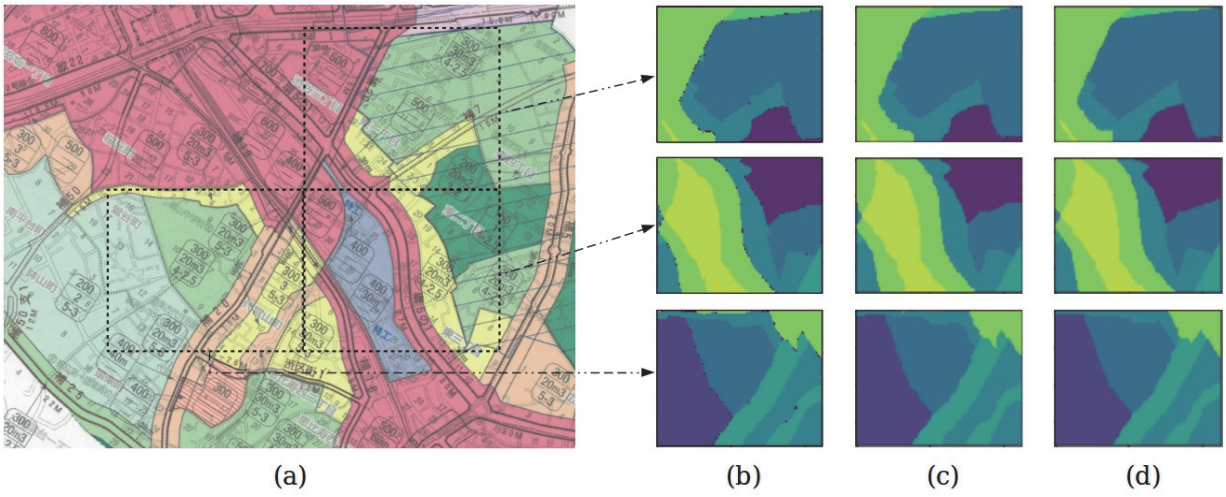

Figure 1: Semantic segmentation results for urban planning maps. (a) Urban planning map of Shibuya-ku, Tokyo. (b) Semantic segmentation results by full convolutional networks. (c) Denoised results. (d) Ground truth images.