engineering proceedings

MDPI

Abstract

MNET: Semantic Segmentation for Satellite Images Based on Multi-Channel Decomposition †

MD Samiul Islam [1,*], Xinyao Sun [1], Zheng Wang [2], Parwant Ghuman [2] and Irene Cheng [1]

[1] Multimedia Research Centre, University of Alberta, Edmonton, AB T6G 2E8, Canada
[2] 3vGeomatics Inc., Vancouver, BC V5Y 0M6, Canada
* Correspondence: mdsamiul@ualberta.ca
† Presented at the 9th International Symposium on Sensor Science, Warsaw, Poland, 20–22 June 2022.

Abstract: With the advancements in remote sensing, satellite images have become a popular data modality and are widely used in many applications. Among others, satellite images are used by surveyors and engineers for urban planning and asset management, e.g., for rapidly growing cities, urban sprawl, and informal settlement. A preliminary step in satellite image analysis is identifying the regions of interest or target objects in the scene and extracting them from irrelevant objects for further processing. This image segmentation task is challenging due to various factors, e.g., occlusions, lighting conditions, and noises. To address these issues, many researchers have proposed different approaches, e.g., UNET, which is regarded as a state-of-the-art method. However, it has high memory consumption, low accuracy, and poor quality prediction when applying satellite images. Thus, we propose a multi-channel decomposition semantic segmentation method, MNET, for object classification. We used the dataset obtained by MBRSC satellites and divided the scene objects into six classes (vegetation, water, road, building, land, unused). The study area is in Dubai. We compared our approach with UNET++, U2NET, and 2D-VNET. Experimental findings show that: (1) MNET outperforms others with a mIoU score of 79.4%, whereas UNET gives 75.1%, and (2) accurate patch generation is a crucial part of the model performance, as ignoring less informative patches during training increases the accuracy by 5%. In conclusion, our proposed method offers a lightweight structure, is a computationally less expensive model, and is simple to deploy in industry applications. In this work, we conducted an extensive analysis of domain transferability, class bias, and class co-occurrence. We also compared the best and worst predictions with a number of current methods. We believe that our MNET can also benefit other domains, such as in floodwater detection using Interferometric Synthetic Aperture Radar (InSAR) data, building extraction, and crop segmentation, due to the prediction accuracy and memory consumption efficiency of MNET.

Keywords: image segmentation; semantic segmentation; satellite image; urban planning; asset management

check for updates

Citation: Islam, M.S.; Sun, X.; Wang, Z.; Ghuman, P.; Cheng, I. MNET: Semantic Segmentation for Satellite Images Based on Multi-Channel Decomposition. *Eng. Proc.* **2022**, *21*, 26. https://doi.org/10.3390/engproc2022021026

Academic Editors: Piotr Lesiak, Tomasz Woliński and Leszek Jaroszewicz

Published: 26 August 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

Author Contributions: Conceptualization, M.S.I.; methodology, M.S.I.; software, M.S.I.; validation, M.S.I.; formal analysis, M.S.I.; investigation, Z.W.; resources, P.G.; data curation, M.S.I.; writing—original draft preparation, M.S.I.; writing—review and editing, X.S.; visualization, M.S.I.; supervision, I.C.; project administration, I.C.; funding acquisition, I.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by MITACS/CARIC grant number IT09347 and NSERC grant number DGDND-2018-00020.

Informed Consent Statement: Not Applicable.

Conflicts of Interest: The authors declare no conflict of interest.