Weijia Li

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Education

Tsinghua University *Beijing, China*

PH.D. IN DEPARTMENT OF EARTH SYSTEM SCIENCE *Sep. 2014 - July 2019*

- Supervisor: Prof. Haohuan Fu
- I lead the remote sensing image analysis group in our lab. My research focus on deep learning based remote sensing image classification, object detection, and semantic segmentation on high performance platform.

Imperial College London *London, UK*

JOINT PH.D. IN DEPARTMENT OF COMPUTING *Nov. 2016 - Nov. 2017*

- Supervisor: Prof. Wayne Luk (`https://www.doc.ic.ac.uk/~wl/`)
- Topic: FPGA-based real-time remote sensing image processing

Sun Yat-sen University *Guangdong, China*

B.S. IN DEPARTMENT OF COMPUTER SCIENCE *Sep. 2010 - Jun. 2014*

WORK EXPERIENCE

The Chinese University of Hong Kong *Hong Kong, China*

POSTDOC IN DEPARTMENT OF INFORMATION ENGINEERING *Nov. 2019 - Present*

- I'm a postdoc researcher of the CUHK-Senstime Joint Lab (MMLab, `http://mmlab.ie.cuhk.edu.hk/`), working with Prof. Dahua Lin.
- I'm also a part-time researcher of the Senstime Group Limited, collaborating with the remote sensing business unit.
- My research focus on developing novel and practical methods for remote sensing image understanding. I'm currently working on interactive annotation, semantic segmentation, and 3D reconstruction of buildings from large-scale and high-resolution satellite images.

Teaching and Academic Services

Guest Editor *Remote Sensing*

Remote Sensing Journal *Jul. 2020 - Present*

- Special Issue on "Applications of Individual Tree Detection"
- Special Issue on "Deep Learning in Remote Sensing Application"

Reviewer

REVIEWER OF THE FOLLOWING SCI JOURNALS: *Jan. 2017 - Present*

- Remote Sensing of Environment, IEEE Transactions on Geoscience and Remote Sensing, Remote Sensing, IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, International Journal of Remote Sensing, Computers and Electronics in Agriculture, etc.

Session Chair *IEEE*

IEEE INTERNATIONAL GEOSCIENCE AND REMOTE SENSING SYMPOSIUM *Jul. 2017*

- In charge of the session of road and traffic detection

Teaching Assistant *Tsinghua*

COURSE OF GEOSCIENCE BIG DATA ANALYSIS *Feb. 2018 - Jun. 2018*

- In charge of preparing course assignments and participate in preparing course slides

Selected Awards

2017 **Scholarship,** National Scholarship for Graduate Student *China*

2016 **Scholarship,** Schlumberger Scholarship for Computing Earth Science *Schlumberger*

2013 **1st place,** IEEE/IBM International Smarter Planet Challenge *IEEE/IBM*

2011 **3th place,** Microsoft Kinect Pioneer *Microsoft*

Research Projects

My research interests include deep learning based land cover classification, object detection, semantic/instance segmentation, and 3D reconstruction for remote sensing images. I am also experienced in high performance computing for large-scale remote sensing data processing. Participated projects include:

Land Cover and Land Use Mapping

Classification/Mapping

- We design a novel deep convolutional neural network based land cover mapping approach, which **integrates the free and public Google Earth high-resolution images with Landsat data** to improve 30m-resolution land cover mapping in China. Our proposed method achieves the classification accuracy of 84.4% on the whole validation dataset in China, **improving the previous state-of-the-art accuracy by another 4.5%**. Related work was published in **Remote Sensing of Environment**.
- We propose **the first deep learning based framework for large-scale land cover mapping** in Africa. Our proposed Stacked Auto-encoder based method achieves an overall classification accuracy of 79%, which is higher than the accuracy achieved by other three classifiers based on the whole test dataset of Africa. Related work was published in **International Journal of Remote Sensing**.
- We design and implement a multi-class MIC-SVM (MMSVM), a highly efficient **parallel SVM for multi-core and many-core architectures**, such as the Intel Ivy Bridge CPUs and Intel Xeon Phi co-processor (MIC).Compared with the widely used LIBSVM, our MMSVM achieves 6.3–31.1 and 4.9–32.2 times (training/classification) speedups on MIC, and 6.9–14.9 and 5.5–22.1 times speedups on Ivy Bridge CPUs, for several real-world remote sensing datasets. Related work was published in **IEEE J-STARS**.
- We propose a novel deep learning-based semantic segmentation approach, named RCANet, to obtain **finer oil palm plantation maps** from high-resolution satellite images. Experiment results on our proposed Malaysian Oil Palm Plantation Dataset (MOPPD) show that RCANet achieves the OA of 96.88% and the mean IoU of 90.58%, improving the OA by 2.03%-3.96% and the mean IoU by 2.13%-5.44% compared with the other semantic segmentation methods. Related work was published in **International Journal of Remote Sensing**.

Individual Tree Detection from High-Resolution Satellite and UAV Images

Object Detection

- We propose **the first deep learning based framework for large-scale oil palm tree detection** using high-resolution satellite images. Our proposed approach achieves a much higher average F1-score of 95% in a large-scale study area compared with existing oil palm detection methods, and much fewer confusions with other vegetation and buildings. Related work was published in **Remote Sensing** in 2016 and 2019.
- We propose an adaptive object detector named MADAN for oil palm tree detection across different satellite images, which is **the first work for large-scale domain adaptive tree crown detection** using multi-source and multi-temporal remote sensing images. MADAN improved the detection accuracy by 14.98% compared with the Baseline method (without DA), and 3.55%-14.49% compared with six existing domain adaptation methods. Related work was published in **ISPRS Journal of Photogrammetry and Remote Sensing**.
- We propose a Multi-class Oil PAlm Detection approach (MOPAD) to reap **both accurate detection of oil palm trees and accurate monitoring of their growing status**. MOPAD achieves an F1-score of 87.91% (Site 1) and 99.04% (Site 2) for overall oil palm tree detection, and outperforms other state-of-the-art object detection methods by a remarkable margin of 10.37%–17.09% and 8.14%-21.32%. Related work was published in **ISPRS Journal of Photogrammetry and Remote Sensing**.
- We proposed an approach for **real-time tree crown detection from large-scale remote sensing images on FPGAs**. A pipelined-friendly and resource-economic tree crown detection algorithm (PF-TCD) is designed through reconstructing and modifying the workflow of the original algorithm. Compared with a fully-optimized implementation on an Intel 12-core CPU, our proposed PF-TCD obtains the speedups of 18.75 times and 12.17 times for images in 12000 × 12000 pixels and 8000 × 8000 pixels. Related work was published in **Remote Sensing**.

Building Footprint Extraction and 3D Building Reconstruction

Instance Segmentation and 3D Reconstruction

- We propose a U-Net based method for building footprint extraction from high-resolution satellite images. We explored the potential of **integrating public GIS map data with satellite images for building extraction** in four cities. Our method won the fifth place in the Building Extraction Track of DeepGlobe - CVPR 2018 Satellite Challenge. Related work was published in **CVPR Workshop 2018** and **Remote Sensing**.
- We propose **a polygonal building segmentation method**, including a multi-task segmentation network and a vertex generation module for producing initial polygon vertices, and a polygon refinement network that automatically moves the initial vertices into more accurate locations. Results demonstrate that our approach achieves significant improvements for both **building instance segmentation (with 2% F1-score gain) and polygon vertex prediction (with 6% F1-score gain)** compared with current state-of-the-art. Related work was published on **AAAI 2021**.
- We design **a multi-task building reconstruction network, named MTBR-Net**, to learn the geometric property of oblique images, the key components of a 3D building model and their relations via four semantic-related and three offset-related tasks. The network outputs are further integrated by a prior knowledge based optimization method to produce the the final 3D building models. Results on a public 3D reconstruction dataset and a novel released dataset demonstrate that our proposed method **improves the height estimation performance by over 40% and the segmentation F1-score by 2% - 4%** compared with current state-of-the-art. Related work was accepted by **ICCV 2021**.
- We design **a semi-supervised building reconstruction network, named SSBR-Net**, which fully explores the relation between different components of a 3D building instance and the property of off-nadir remote sensing images. We design a hybrid loss function that enables the SSBR-Net to effectively use the training samples with different annotation levels, i.e., complete 3D annotations, 2D footprint annotations, and image-level angle annotations. Results demonstrate that our method achieves competitive performance when **using 50% fewer 3D-annotated samples, and improves the footprint segmentation F1-score by over 10%** compared with current state-of-the-art. Related work is under review by **IEEE-TPAMI**.

Publications

10 SCI papers as the first/corresponding author:

[10] Juepeng Zheng, Haohuan Fu, **Weijia Li***, Wenzhao Wu, Le Yu, Shuai Yuan, et al. Growing status observation for oil palm trees using Unmanned Aerial Vehicle (UAV) images. ISPRS Journal of Photogrammetry and Remote Sensing. 2021 Mar 1;173:95-121. (IF: 8.979)

[9] **Weijia Li**, Runmin Dong, Haohuan Fu*, Jie Wang, Le Yu, and Peng Gong. Integrating Google Earth imagery with Landsat data to improve 30-m resolution land cover mapping. Remote Sensing of Environment. 2020 Feb 1;237:111563. (IF: 10.164)

[8] Juepeng Zheng, Haohuan Fu, **Weijia Li***, Wenzhao Wu, Yi Zhao, Runmin Dong, Le Yu. Cross-regional oil palm tree counting and detection via a multi-level attention domain adaptation network. ISPRS Journal of Photogrammetry and Remote Sensing. 2020 Sep 1;167:154-77. (IF: 8.979)

[7] Runmin Dong, **Weijia Li***, Haohuan Fu, Lin Gan, Le Yu, Juepeng Zheng, and Maocai Xia. Oil palm plantation mapping from high spatial-resolution remote sensing images using deep learning. International Journal of Remote Sensing. 2020 Mar 3;41(5):2022-46. (IF: 3.151)

[6] **Weijia Li**, Conghui He, Haohuan Fu*, Juepeng Zheng, Runmin Dong, Maocai Xia, Le Yu and Wayne Luk. A Real-Time Tree Crown Detection Approach for Large-Scale Remote Sensing Images on FPGAs. Remote Sensing, 2019, 11(9), p.1025. (IF: 4.848)

[5] **Weijia Li**, Conghui He, Jiarui Fang, Juepeng Zheng, Haohuan Fu* and Le Yu. Semantic Segmentation-Based Building Footprint Extraction Using Very High-Resolution Satellite Images and Multi-Source GIS Data. Remote Sensing, 2019, 11(4), 403. (IF: 4.848)

[4] **Weijia Li**, Runmin Dong, Haohuan Fu*, and Le Yu*. Large-Scale Oil Palm Tree Detection from High-Resolution Satellite Images Using Two-Stage Convolutional Neural Networks. Remote Sensing, 2019, 11(1),11. (IF: 4.848)

[3] **Weijia Li**, Haohuan Fu*, Yang You, Le Yu, and Jiarui Fang. Parallel Multiclass Support Vector Machine for Remote Sensing Data Classification on Multicore and Many-Core Architectures. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 2017, 10(10), pp.4387-4398. (IF: 3.784)

[2] **Weijia Li**, Haohuan Fu*, Le Yu, and Arthur Cracknell. Deep Learning Based Oil Palm Tree Detection and Counting for High-Resolution Remote Sensing Images. Remote Sensing, 2016, 9 (1), 22. (IF: 4.848, Citations: 232, **ESI highly cited paper**)

[1] **Weijia Li**, Haohuan Fu*, Le Yu, Peng Gong, Duole Feng, Congcong Li, and Nicholas Clinton. Stacked Autoencoder-based deep learning for remote-sensing image classification: a case study of African land-cover mapping. International Journal of Remote Sensing, 2016, 37 (23), pp.5632-5646. (IF: 3.151, Citations: 107)

3 papers at top conferences as the first/corresponding author:

[3] **Weijia Li**, Lingxuan Meng, Jinwang Wang, Conghui He, Gui-Song Xia, and Dahua Lin. 3D Building Reconstruction from Monocular Remote Sensing Images. ICCV 2021. (CCF-A).

[2] Zhuoming Liu, Hao Ding, Huaping Zhong, **Weijia Li***, Jifeng Dai, and Conghui He. Influence Selection for Active Learning. ICCV 2021. (CCF-A).

[1] **Weijia Li**, Wenqian Zhao, Huaping Zhong, Conghui He, and Dahua Lin. Joint Semantic-Geometric Learning for Polygonal Building Segmentation. AAAI 2021. (CCF-A).

Other publications (EI, collaborative paper, etc.):

[6] Lixian Zhang, Runmin Dong, Shuai Yuan, **Weijia Li**, Juepeng Zheng, and Haohuan Fu. Making Low-Resolution Satellite Images Reborn: A Deep Learning Approach for Super-Resolution Building Extraction. Remote Sensing. 2021 Jan;13(15):2872. (SCI, IF: 4.848)

[5] Juepeng Zheng, Wenzhao Wu, Shuai Yuan, Haohuan Fu, **Weijia Li**, and Le Yu. Multisource-Domain Generalization-Based Oil Palm Tree Detection Using Very-High-Resolution (VHR) Satellite Images. IEEE Geoscience and Remote Sensing Letters. 2021 Mar 9. (SCI, IF: 3.966)

[4] Runmin Dong, Cong Li, Haohuan Fu, Jie Wang, **Weijia Li**, Yi Yao, Lin Gan, Le Yu and Peng Gong. Improving 3-m Resolution Land Cover Mapping through Efficient Learning from an Imperfect 10-m Resolution Map. Remote Sensing. 2020 Jan;12(9):1418. (SCI, IF: 4.848)

[3] **Weijia Li**, Conghui He, Jiarui Fang, and Haohuan Fu. Semantic Segmentation based Building Extraction Method using Multi-source GIS Map Datasets and Satellite Imagery. In IEEE Conference on Computer Vision and Pattern Recognition Workshops, pp. 18-22, 2018. (CVPRW 2018)

[2] **Weijia Li**, Conghui He, Haohuan Fu and Wayne Luk. An FPGA-based tree crown detection approach for remote sensing images. In IEEE International Conference on Field Programmable Technology, pp. 231-234, 2017. (FPT 2017)

[1] **Weijia Li**, Haohuan Fu, and Le Yu. Deep convolutional neural network based large-scale oil palm tree detection for high-resolution remote sensing images. IEEE International Geoscience and Remote Sensing Symposium, pp. 846-849, 2017. (IGARSS 2017)