Application of Deep Learning Technique to Rice Lodging Identification

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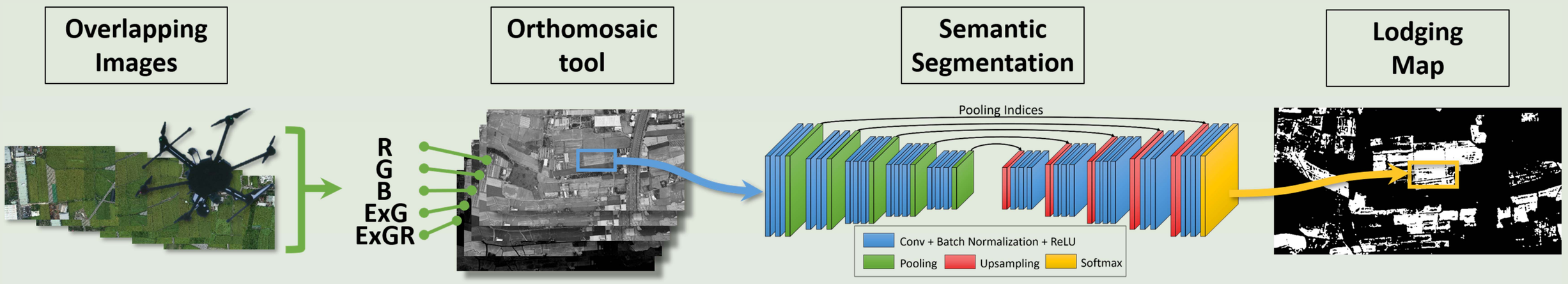
Graphical Abstract



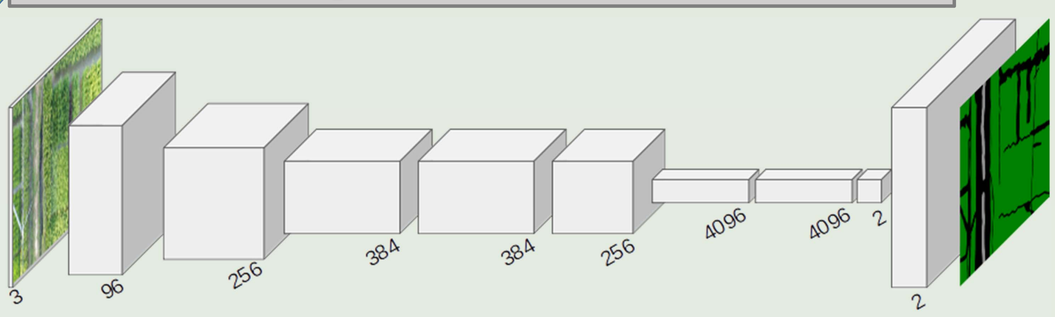
Study Area

Wu Feng, Taichung
- 2,600 ha
- 2,500 images
- 180 m
- 4.68cm/pixel
- 11.8 Terapixels

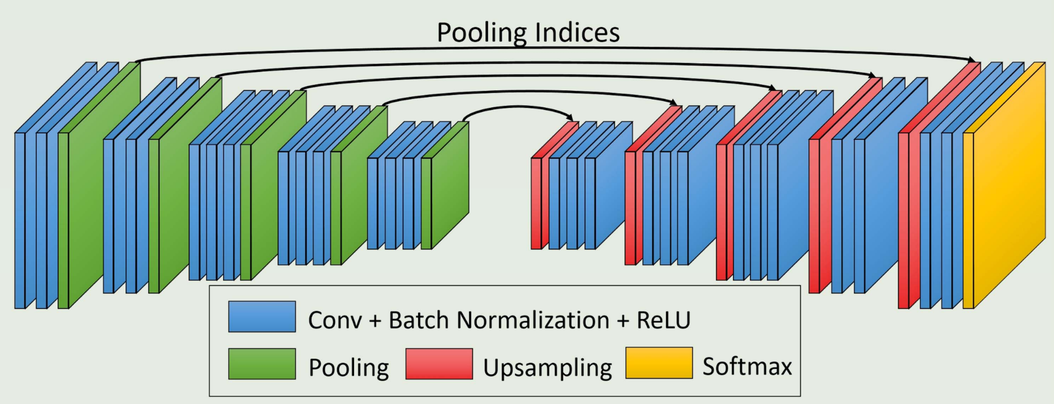
Image Collection
- Fixed wing drone
- FF mirrorless cam
- 44 Megapixels

Orthomosaic Process
- Agisoft Metashape
- 1 hour for stitching

Semantic Segmentation Architectures



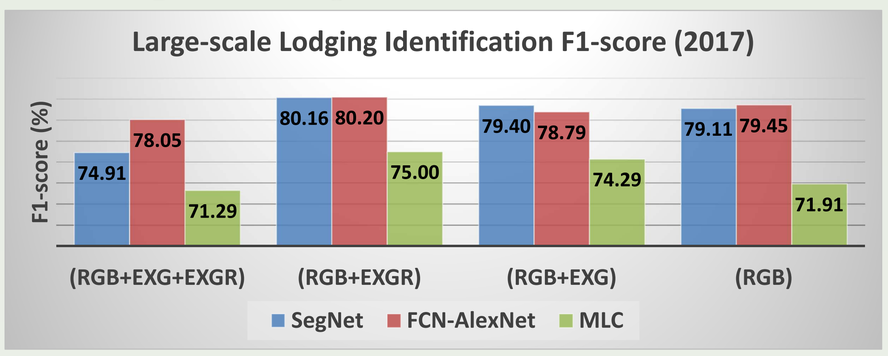
FCN-AlexNet
- based on AlexNet
- 8 conv. layers
- 1 upsampling layer
- no pooling indices

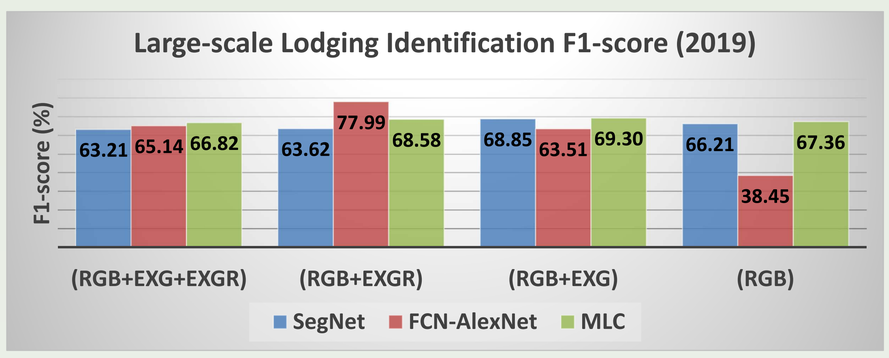


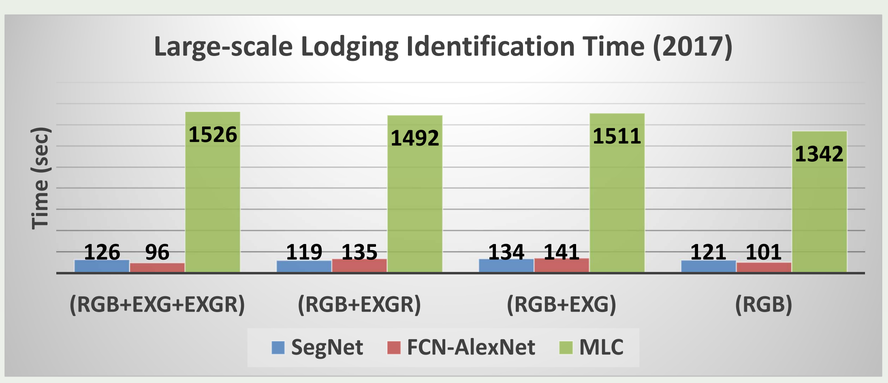
SegNet
- based on VGG16
- 26 conv. layers
- 5 upsampling layers
- + pooling indices

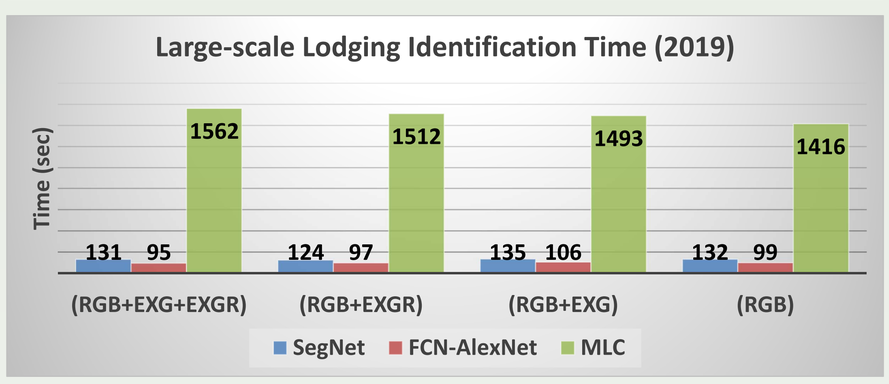
Result

- Identification F1-score both get 0.8 in 2017, and FCN-AlexNet performs well in 2019.
- Adding vegetation index makes classification model robust.
- Image tile eliminates the memory insufficient problem of processing large-scale images.
- Processing time of DL methods are 10-15x faster than MLC method.
- Deep learning lets data reusable and the classifier can be reinforced.









* The time were the result of processing a 40ha mosaic image.
** MLC = Maximum Likelihood Classification
*** ExG = Excess Green index
**** ExGR = Excess Green minus Excess Red index

Future Plans

- More semantic segmentation architectures for comparison.
- Near-infrared for precision agriculture information.
- Distributed computing for classifying large-scale image.
- Paddy field mapping for individually lodging rate calculation.
- Optimal flight-path calculating for auto routing.

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