

# FEATURE EXTRACTION AND TRACKING OF CNN SEGMENTATIONS FOR IMPROVED ROAD DETECTION FROM SATELLITE IMAGERY

## Introduction

- Road detection from high-resolution satellite images is challenging for contrast-based detection methods due to the complexity of road networks, such as noise and occlusions from cars, trees, etc.
- U-Net based methods can provide well-segmented binary images, but there still might be some connection problems, as in Fig 1. [Zhou et al, CVPRW'18]
- We propose a road extraction and tracking method based on road segmentation results from a convolutional network, using a marked point process (MPP) model. [Li et al, ICIP'18]



Fig 1. Road Segmentation by convolutional network

## Framework and Algorithm

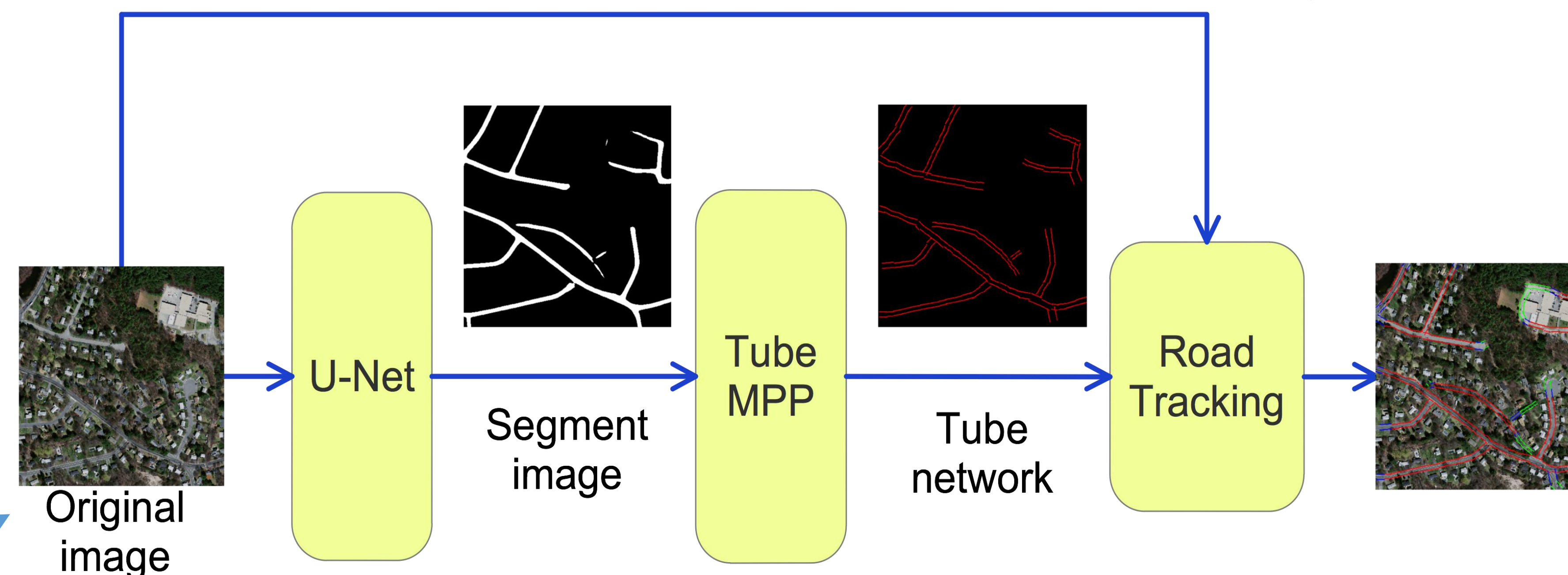


Fig 2. The framework of the proposed method.

- Step 1. Segment the road by U-Net based convolutional network.
- Step 2. Apply our connected tube MPP model to the segmented binary image to extract the tube network.
- Step 3. Pick the open and half open tubes as tracking seeds, then track the road to complete the extracted road network.

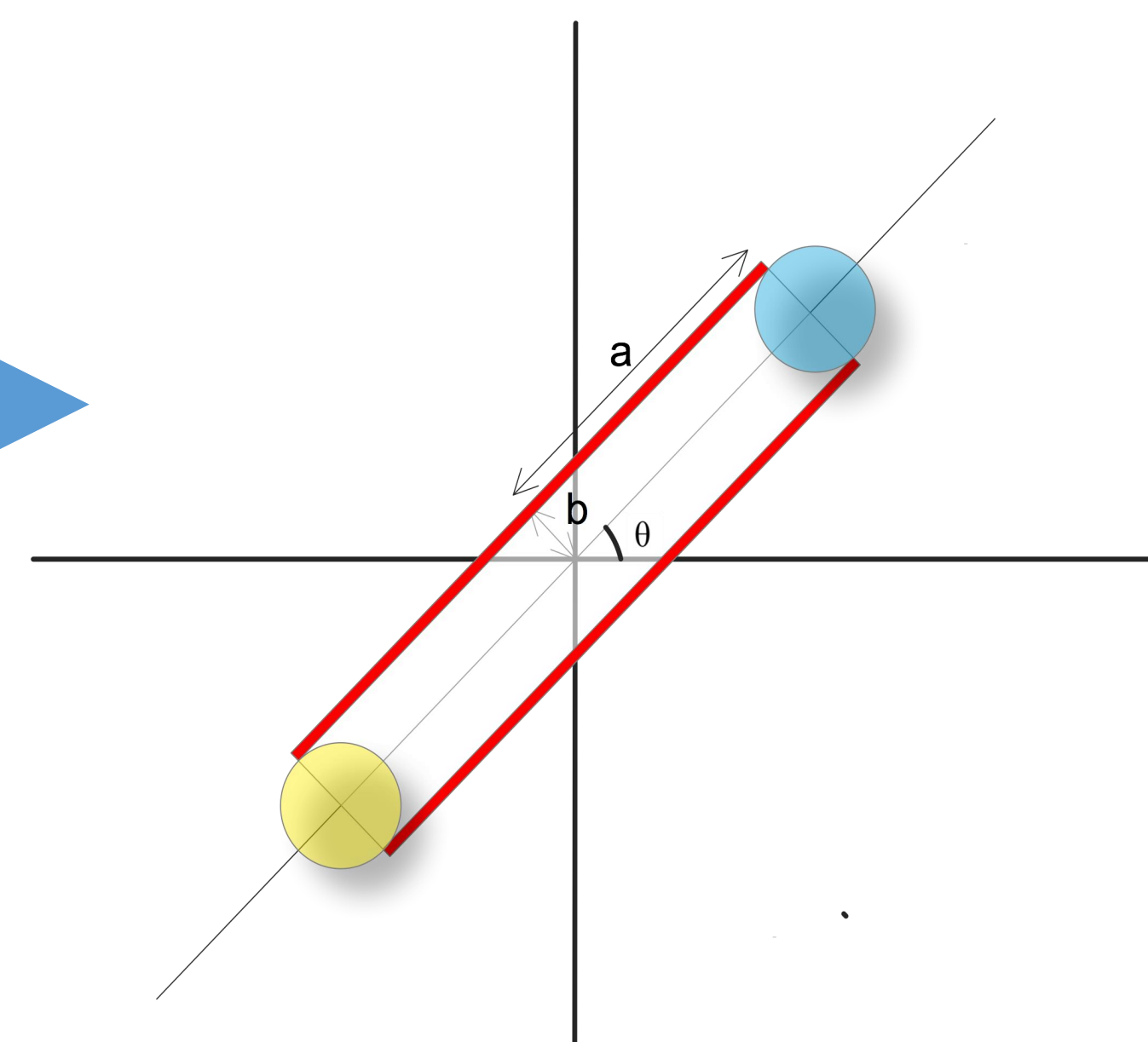


Fig 3. Single tube model

A single tube model, which is comprised of a body area and two connected areas. When one of its connected areas does not overlap with other tubes, it would be considered as half open.

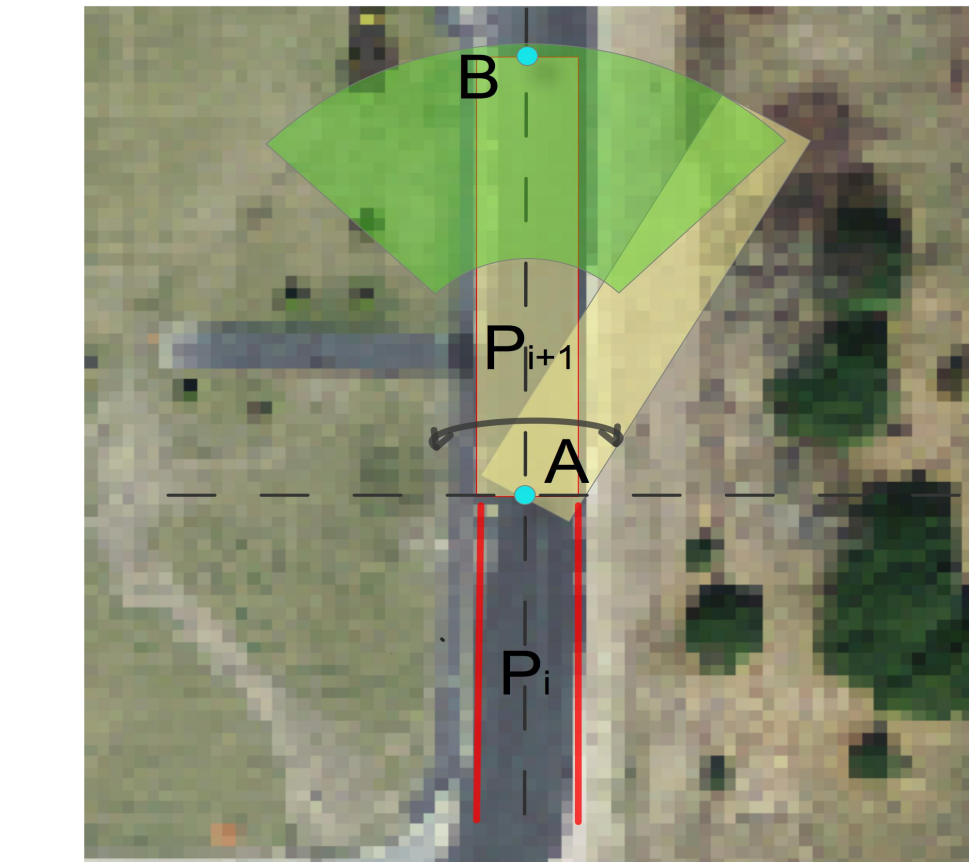


Fig 4. Tracking illustration

Tracking roads is an iterative process. Given a tube object  $P_i$ , our goal is to find an object  $P_{i+1}$ , which is connected to  $P_i$  and has similar features to  $P_i$ . We repeat this process until no new tube object can be found.

## Results



Fig 5. From left to right: original image, road extraction result, binary segmentation with extraction result. (Red: Closed tubes; Blue: Open tubes; Green: Tracking tubes)

## Conclusion

- The proposed method relieves the problem of disconnection in road segmentation.
- Also it provides a connected-tube network for higher level road analysis. (e.g. obtaining the statistics of road network, such as the width, length, start and end of each road)