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Road Network Detection

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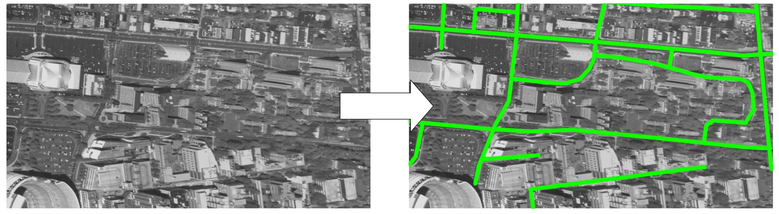
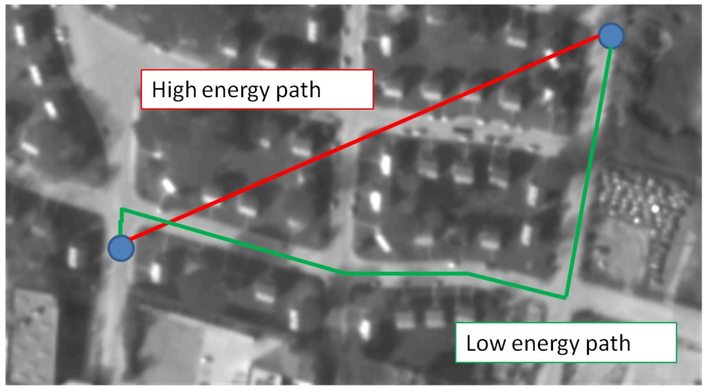
Problem



- Reliable detection and tracking of vehicles is a major challenge in the exploitation of aerial imagery
- Previous work has shown the usefulness of road network information in improving detection and tracking performance, as well as geo-registration

Strategy

- Detect road network in a single image
- Exploit road network connectedness, not appearance

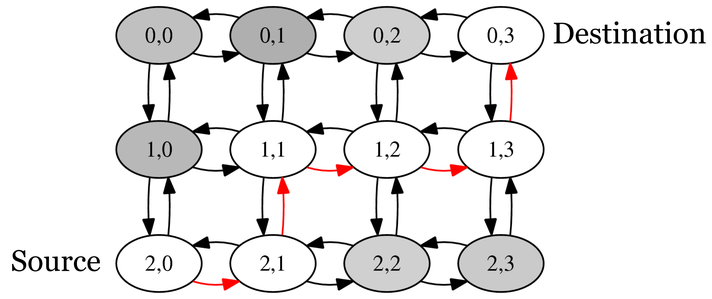


- Repeated low energy paths for travel between random locations are strong indicators of roads
- Path energy in image: sum of gradient magnitudes at all positions on the path

$$E(src,dst) = \sum_{x,y \in path} \|\nabla I(x,y)\|$$

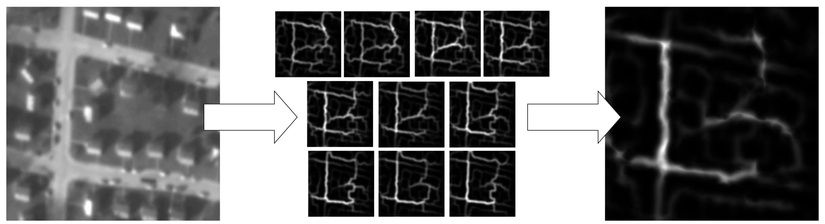
Algorithm

1. Generate a graph from the image
   - Vertices are pixels, 4-connected
   - Assign distance to every edge based on gradient magnitude
2. Randomly sample M vertices
3. Find shortest paths to all other vertices
4. Count the number of times a vertex is on any shortest path
   - "bandwidth" or "flow"

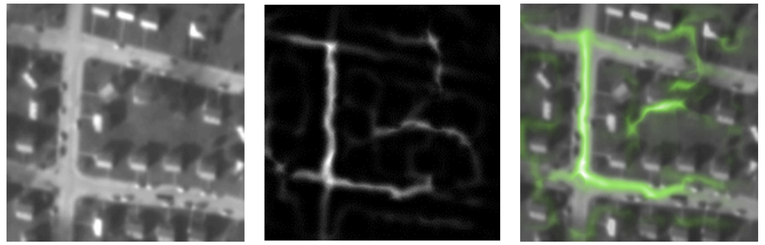


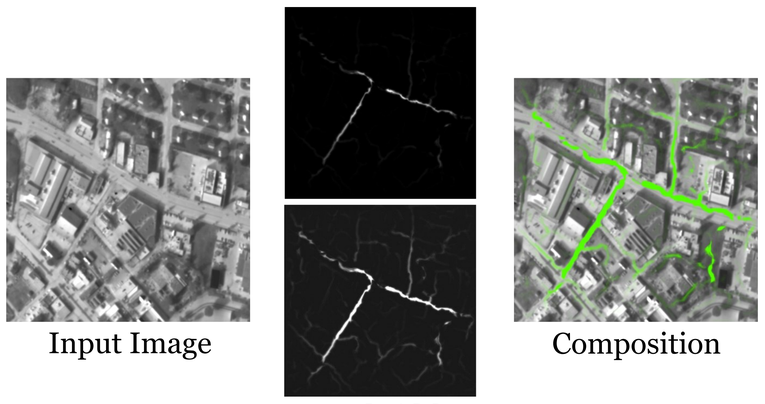
Improving Robustness

- Paths may be chaotic in texture-less areas
- Smooth image to eliminate noise, resulting in stable paths



Results





≈ 30 sec. on a 200x200 image, $M = 20$

Conclusions and Future Work

- The proposed algorithm successfully finds paths that might be taken by moving objects
- Enhanced vehicle detection and tracking by mitigating spurious detects
- Future Work:
  - Obtain more uniform flow
  - Optimizations to make the algorithm scalable

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