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[Guo, Xufeng, Dean, David, Denman, Simon, Fookes, Clinton, & Sridharan, Sridha](#)

(2011)

Evaluating automatic road detection across a large aerial imagery collection.

In Gal, Y, Bradley, A, Jackway, P, & Salvado, O (Eds.) *Proceedings of the 2011 International Conference on Digital Image Computing: Techniques and Applications*.

Institute of Electrical and Electronics Engineers Inc., Australia, pp. 140-145.

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<https://doi.org/10.1109/DICTA.2011.30>

# Evaluating automatic road detection across a large aerial imagery collection

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7 December 2011



## Evaluating automatic road detection ...



(matched extraction, false extraction, missed reference)

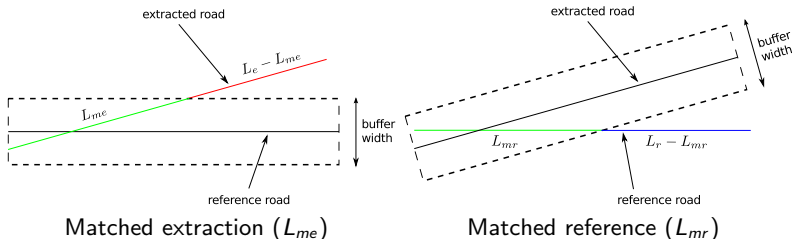
## ... across a large aerial imagery collection



- 300 regions
- 3 'zoom levels'
  - Zoom 16 :  $4.46m^2 / pixel$
  - Zoom 17 :  $1.12m^2 / pixel$
  - Zoom 18 :  $0.28m^2 / pixel$
- Licensed CC-BY-SA from NearMap

# Measuring road detection performance

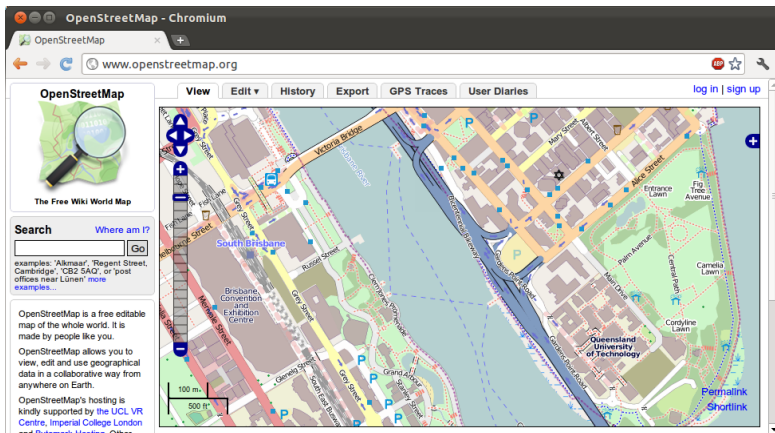
Road detection performance evaluation was performed according to Harvey [1]:



- Completeness (matched reference road network):  $C_p = \frac{L_{mr}}{L_r}$
- Correctness (matched extracted road network):  $C_r = \frac{L_{me}}{L_e}$
- Quality (matched reference + extracted road network):  
$$Q = \frac{L_{me}}{L_e + L_r - L_{mr}}$$

# Reference road network

- Road network centrelines captured from OpenStreetMap.org under CC-BY-SA license.
- Non-road data ignored



# Proposed road detection algorithm

Based upon work presented by Hu et. al [2].

- Seed detection
- Road following
- Skeletonisation and vectorisation



Aerial image



Seed detection



Road following



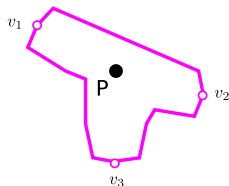
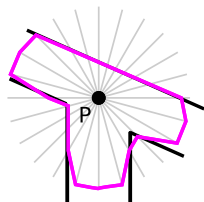
Skeletonisation

# Seed detection and road following

Seed footprints are detected based on randomly placed 'spoke operators'

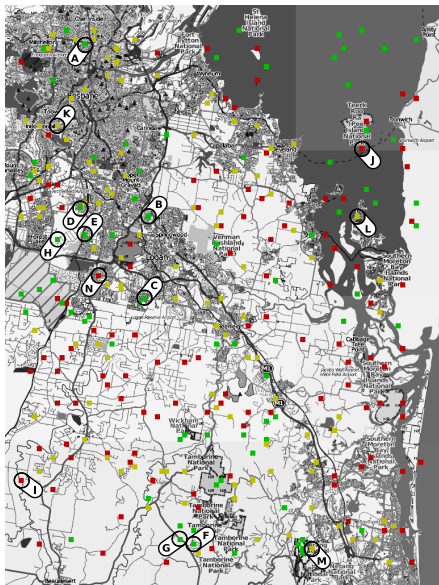
- Spokes are terminated where the saturation passes a locally-determined threshold
- Footprints are subject to three tests to weed out unlikely footprints
  - Rectangularity
  - Average saturation
  - Network expansion ability

Road following is performed by detecting new footprints at peaks of previous footprints





# Road detection evaluation



Average road detection performance over the entire database:

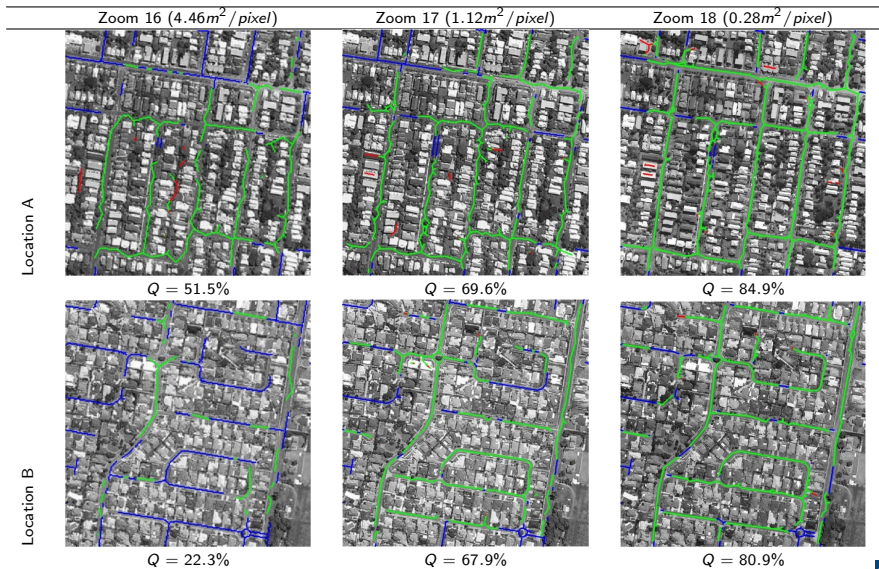
Zoom Level	$C_p$	$C_r$	$Q$
16	50.91%	47.90%	32.77%
17	63.03%	46.58%	36.58%
18	68.03%	54.50%	43.39%

Quality ( $Q$ ) scores of the proposed system across all locations at Zoom 18.

( $Q < 20\%$ ,  $20\% \leq Q \leq 60\%$ ,  $Q > 60\%$ )



# Road detection at different resolutions



(matched extraction, false extraction, missed reference)

# Examples of high quality road detection (Zoom 18)



Location C ( $Q = 82.7\%$ )



Location D ( $Q = 79.5\%$ )



Location E ( $Q = 85.5\%$ )



Location F ( $Q = 75.2\%$ )



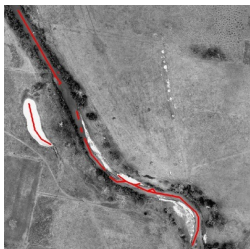
Location G ( $Q = 74.3\%$ )



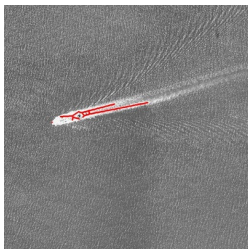
Location H ( $Q = 84.8\%$ )

(matched extraction, false extraction, missed reference)

# Examples of low/medium quality road detection (Zoom 18)



Location I ( $Q = 0.0\%$ )



Location J ( $Q = 0.0\%$ )



Location K ( $Q = 29.5\%$ )



Location L ( $Q = 43.8\%$ )



Location M ( $Q = 34.7\%$ )



Location N ( $Q = 14.3\%$ )

(matched extraction, false extraction, missed reference)

# Accessing the database

We believe that this database will provide a very useful framework for automatic detection of roads (and other objects) from aerial imagery.

- Much larger than other available databases
  - Including urban, residential, rural and even non-road areas
- Multiple capture resolutions available
- Multiple capture dates available (coming soon)
- Annotated for free by OpenStreetMap community (constantly improving)

Researchers interested in obtaining a copy should get in contact with Sridha Sridharan ([s.sridharan@qut.edu.au](mailto:s.sridharan@qut.edu.au)).

# References



W. Harvey, "Performance evaluation for road extraction," *Bull. Soc. Franc Photogramm et. TeledBull. Soc. Franc Photogramm et. Teledetection* 153, 1999.



J. Hu, A. Razdan, J. Femiani, M. Cui, and P. Wonka, "Road network extraction and intersection detection from aerial images by tracking road footprints," *Geoscience and Remote Sensing, IEEE Transactions on*, vol. 45, no. 12, pp. 4144–4157, dec. 2007.

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