City-Scale Road Extraction from Satellite Imagery v2: Road Speeds and Travel Times - Supplemental Material

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Appendix A. Road Speed Assignment

See [4] for details on the precise labeling guidelines and road type definitions. We utilize road type (motorway, primary, secondary, tertiary, residential, unclassified, cart track) and road surface type (paved, non-paved) to assign speed to each edge.

Speed is assigned with Table 1, using the Oregon guidelines for road speed [3].

Table 1: Road Speeds (mph)

Road Type	1 Lane	2 Lane	3+ Lane
Motorway	55	55	65
Primary	45	45	55
Secondary	35	35	45
Tertiary	30	30	35
Residential	25	25	30
Unclassified	20	20	20
Cart Track	20	20	20

For each non-paved roadway, the speed from Table 1 is multiplied by 0.75 to give the final speed.

Appendix B. Large Area Test Data

Details of the large are testing regions for SpaceNet data are shown in Table 2, and an example test area displayed in Figure 1.

Table 2: Test Regions

Test Region	Area (Km^2)	Road Length (Total Km)
Khartoum_0	3.0	76.7
Khartoum_1	8.0	172.6
Khartoum_2	8.3	128.9
Khartoum_3	9.0	144.4
Las_Vegas_0	68.1	1023.9
Las_Vegas_1	177.0	2832.8
Las_Vegas_2	106.7	1612.1
Paris_0	15.8	179.9
Paris_1	7.5	65.4
Paris_2	2.2	25.9
Shanghai_0	54.6	922.1
Shanghai_1	89.8	1216.4
Shanghai_2	87.5	663.7
Total	608.0	9064.8

Figure 1: SpaceNet road vector labels over Shanghai (purple). The label boundary is discontinuous and irregularly shaped, so we define rectangular regions for testing purposes (e.g. the blue region denotes test region Shanghai_0).

Appendix C. OSM / SpaceNet Model Comparison

Figure 2 displays comparisons of models trained on OSM data and SpaceNet data.

Figure 2: **SpaceNet compared to OSM.** Road predictions (yellow) and ground truth SpaceNet labels (blue) for a sample image chips, with SpaceNet models on the left and OSM-trained models on the right. Top: SpaceNet model predictions (left) score $APLS_{length} = 0.60$, while OSM model predictions (right) yield $APLS_{length} = 0.48$. Bottom: SpaceNet model predictions (left) score $APLS_{length} = 0.92$, while OSM model predictions (right) yield $APLS_{length} = 0.37$.
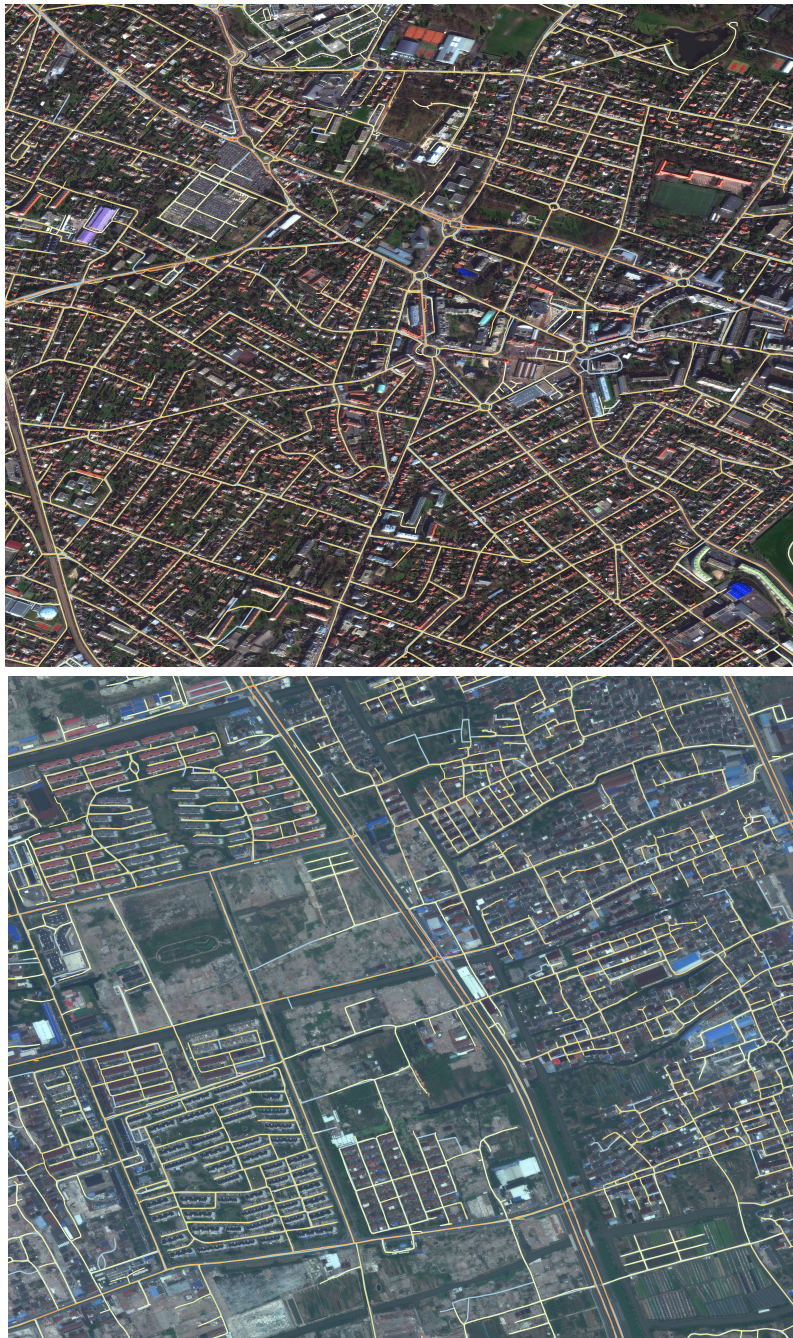
Appendix D. CRESIv2 Road Speed Plots

Figure 3: **Road speed.** Output of CRESIv2 inference as applied to large SpaceNet test regions (from top: Paris, Shanghai). Roads are colored by inferred speed limit, from yellow (20 mph) to red (65 mph), with ground truth in gray.

Appendix E. CRESIv2 / RoadTracer Visual Comparison

Figure 4: **RoadTracer / CRESIv2.** Performance comparison between RoadTracer (left column, OSM labels in gray, predictions in yellow [2]) and CRESIv2 (right column, predictions in yellow) for various cities. From top: Denver, Toronto, Vancouver.

Appendix F. RoadTracer / CRESIv2 / DeepRoadMapper Zooms

A qualitative comparison of three methods over various cities is shown in Figure 5.

Figure 5: Qualitative comparison of three methods over various cities, (see Figure 10 of [1]).

References

[1] F. Bastani, S. He, M. Alizadeh, H. Balakrishnan, S. Madden, S. Chawla, S. Abbar, and D. DeWitt. RoadTracer: Automatic Extraction of Road Networks from Aerial Images. In *Computer Vision and Pattern Recognition (CVPR)*, Salt Lake City, UT, June 2018.

[2] M. CSAIL. Roadtracer: Automatic extraction of road networks from aerial images. `https://roadmaps.csail.mit.edu/roadtracer/`, 2018.

[3] OpenStreetMap. Osm tags for routing/maxspeed. `https://wiki.openstreetmap.org/wiki/OSM_tags\_for\_routing/Maxspeed\#United\_States\_of\_America`, 01 2019.

[4] A. Van Etten, D. Lindenbaum, and T. M. Bacastow. SpaceNet: A Remote Sensing Dataset and Challenge Series. *ArXiv e-prints*, July 2018.