Travel Latency Cost Function and Map of the Eastern Massachusetts Highway Network

1 Cost function

By use of the inverse VI formulation in [1, 2, 3, 4], the following travel latency cost function was estimated based on the actual traffic data from the Eastern Massachusetts network for the PM period of Apr. 2012:

$$f(x) = 1.0 - 0.00303133x + 0.0577207x^2 - 0.195677x^3 + 0.620789x^4 - 0.905919x^5 \\ + 0.935921x^6 - 0.469131x^7 + 0.108528x^8.$$

Note that the well-known BPR counterpart is $f(x) = 1 + 0.15x^4$.

For link a, the complete travel time function is then $t(x_a) = t_{0a} f(x_a/m_a)$, where t_{0a} is the free-flow travel time on link a and m_a is the flow capacity of link a.

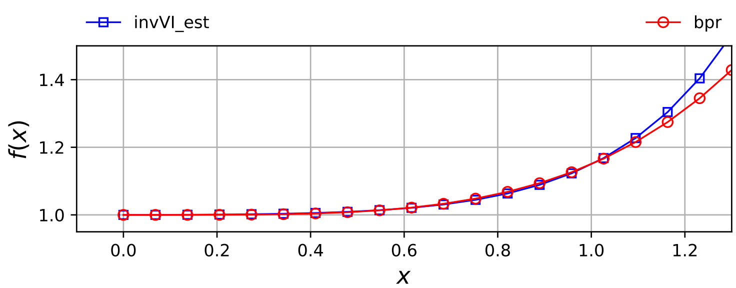

Figure 1: Comparison of the inverse VI estimation and the BPR cost function.

2 Map

We clarify here that in Fig. 3 each "node" corresponds to a "ZONE" in the net file EMA_net.tntp; a "zone" in Fig. 3 is actually an area integrating several "nodes." For details, the reader is referred to [4].

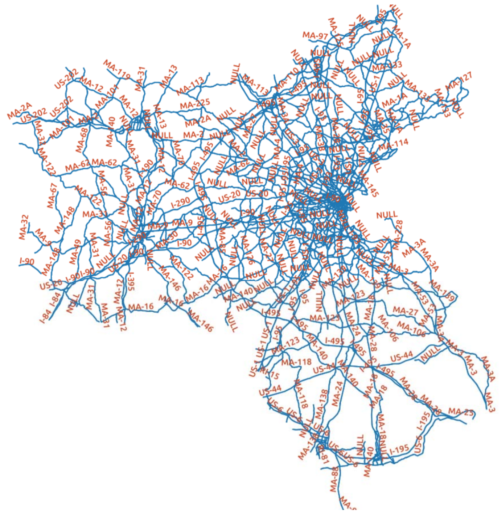

Figure 2: All available road segments in Eastern Massachusetts.

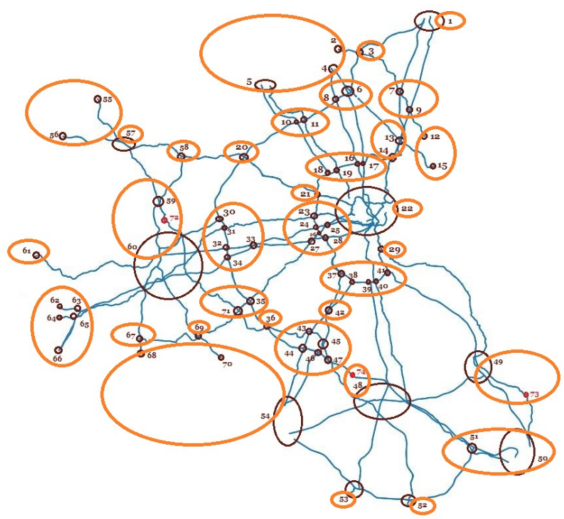

Figure 3: Eastern Massachusetts highway subnetwork (“nodes:zone” pairs – {1}: Seabrook (NH); {2, 4, 5}: NH; {3}: Haverhill; {6, 8}: Lawrence; {7, 9}: Georgetown; {10, 11}: Lowell; {12, 15}: Salem; {13, 14}: Peabody; {16, 17, 18, 19}: Burlington; {20}: Littleton; {21}: Lexington; {22}: Boston; {23, 24, 25, 26, 27, 28}: Waltham; {29}: Quincy; {30, 31, 32, 33, 34}: Marlborough/Framingham; {35, 71}: Milford; {36}: Franklin; {37, 38, 39, 40, 41}: Westwood/Quincy; {42}: Dedham; {43, 44, 45, 46, 47}: Foxborough; {48, 74}: Taunton; {49, 73}: Plymouth; {50, 51}: Cape Cod; {52}: Dartmouth; {53}: Fall River; {54, 68, 70}: RI; {55, 56}: VT; {57}: Westminster; {58}: Leominster; {59, 60, 72}: Worcester; {61}: Amherst; {62, 63, 64, 65, 66}: CT; {67}: Webster; {69}: Uxbridge.)

References

[1] J. Zhang, S. Pourazarm, C. G. Cassandras, and I. C. Paschalidis, "The price of anarchy in transportation networks by estimating user cost functions from actual traffic data," in *2016 IEEE 55th Conference on Decision and Control (CDC)*, Dec 2016, pp. 789–794.

[2] ——, "Data-driven estimation of origin-destination demand and user cost functions for the optimization of transportation networks," in *The 20th World Congress of the International Federation of Automatic Control,* accepted as Invited Session Paper*, arXiv:1610.09580*, July 2017.

[3] J. Zhang and I. C. Paschalidis, "Data-driven estimation of travel latency cost functions via inverse optimization in multi-class transportation networks," in *2017 IEEE 56th Conference on Decision and Control (CDC),* submitted*, arXiv:1703.04010.*

[4] J. Zhang, S. Pourazarm, C. G. Cassandras, and I. C. Paschalidis, "The price of anarchy in transportation networks: Data-driven evaluation and reduction strategies," in *Proceedings of the IEEE: special issue on "Smart Cities,"* in preparation.