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 $f(x) = 1 + 0.15x^4$.

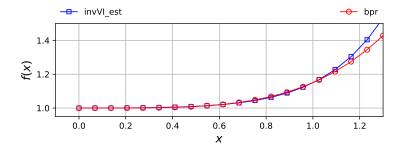


Figure 1: Comparison of the inverse VI estimation and the BPR cost function.

2 Map

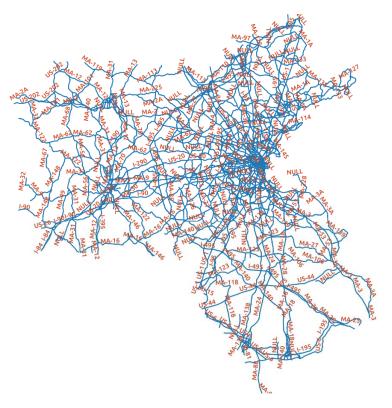


Figure 2: All available road segments in Eastern Massachusetts.

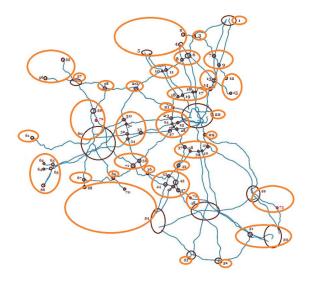


Figure 3: Eastern Massachusetts highway subnetwork ("nodes:zone" pairs – $\{1\}$: Seabrook (NH); $\{2, 4, 5\}$: NH; $\{3\}$: Haverhill; $\{6, 8\}$: Lawrence; $\{7, 9\}$: Georgetown; $\{10, 11\}$: Lowell; $\{12, 15\}$: Salem; $\{13, 14\}$: Peabody; $\{16, 17, 18, 19\}$: Burlington; $\{20\}$: Littleton; $\{21\}$: 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.