

Synthetic Data Products for Societal Infrastructures and Proto-Populations: Data Set 3.0

Network Dynamics and Simulation and Science Laboratory
Virginia Polytechnic Institute and State University
1880 Pratt Drive, Building XV
Blacksburg VA 24061
<http://ndssl.vbi.vt.edu>

NDSSL-TR-07-010

1 Introduction and Summary

This technical report describes data sets that are being released to the larger academic community for research. The data sets are based on detailed microscopic simulation-based modeling and integration techniques and are being released as **Data Set Version 3.0**. Data Sets Version 1.0 and 2.0 were previously made available. [7?]. We expect to make available new and enhanced synthetic data products, including new cities and regions, on a regular basis. The data set provided here represents a synthetic ad-hoc vehicular radio network in the city of **Washington, DC**. The data takes the form of a movie showing how the network topology changes as the vehicles carrying the radios move. The reader is referred to [2, 3, 6, 7, 11, 12] for additional details about the construction of these datasets. The data set is released as an avi file.

The synthetic data is produced using **Simfrastructure**: a high-performance, service-oriented, agent-based modeling and simulation system for representing and analyzing interdependent infrastructures. Simfrastructure is used for the representation and analysis of interdependent urban infrastructures such as transportation, public health, energy, financial (commodity markets) in a service-oriented environment. Simulation environments such as Simfrastructure allow analysis of urban infrastructure interdependencies through integrated functional data flow architectures. Simfrastructure can be viewed as representing functioning virtual cities. One of its unique features is its ability to represent entire urban populations at the level of individuals, including their activities, movements and locations. The ability to generate an urban population, move each person on a second-by-second basis, and monitor the individual's interaction with other individuals, as well as with the physical infrastructure, enables greater understanding of infrastructure operations and interdependencies at an extreme but practical level of detail.

This and other data sets are available from <http://ndssl.vbi.vt.edu/opendata/> for academic purposes and are released under a Creative Commons Attribution Noncommercial-ShareAlike license (<http://creativecommons.org/licenses/by-sa/2.5/>). Non-commercial use is allowed as long as the source of the data is acknowledged and any derivative data sets are released under the same license. For use in situations not covered under this license, please contact NDSSL. Any individual or organization using this data is (i) required to cite this technical report as the source of data, (ii) requested to, whenever possible, cite one of the appropriate technical papers that contain additional information about the models and methods (iii) requested to, whenever possible, send a citation and/or a copy of their work to ndssl-data@vbi.vt.edu.

2 Ad-hoc Vehicular Radio Network

For this data set, we have used the second-by-second estimates of the locations of vehicles to synthesize an ad-hoc network. We placed a disk with a fixed radius around each vehicle and drew an edge between the index vehicle and any other vehicle within the disk. The induced network at each time is displayed in each frame of the movie.

An ad-hoc radio network's topology depends on the movements of the participating radios. In this case, we have assumed that every radio is associated with a vehicle. Two vehicles are connected by a line in the movie if and only if they are within range of each other's radios at a specific time in the traffic microsimulation. Furthermore, we have assumed that every radio broadcasts isotropically (i.e. no directional antennae) with the same range, and have not taken into account radio interference in the urban landscape. Thus, this network is not meant to be an exact representation of an actual network, but to demonstrate the dynamic nature of topology in any such networks.

References

- [1] K. Atkins, C. Barrett, C. Homan, A. Marathe, M. Marathe and S. Thite. “Agent Based Economic Analysis of Deregulated Electricity Markets”, *6th IAEE European Conference*, Zurich, Switzerland, September 2004.
- [2] C. Barrett, R. Beckman, K. Berkgigler, K. Bisset, B. Bush, K. Campbell, S. Eubank, K. Henson, J. Hurford, D. Kubicek, M. Marathe, P. Romero, J. Smith, L. Smith, P. Speckman, P. Stretz, G. Thayer, E. Eeckhout, and M.D. Williams. TRANSIMS: Transportation Analysis Simulation System. Technical Report LA-UR-00-1725, Los Alamos National Laboratory Unclassified Report, 2001. An earlier version appears as a 7 part technical report series LA-UR-99-1658 and LA-UR-99-2574 to LA-UR-99-2580.
- [3] R J Beckman et al, TRANSIMS-Release 1.0: The Dallas-Fort Worth Case Study, Technical Report LA-UR-97-4502, Los Alamos National Laboratory, 1997.
- [4] C. Barrett, S. Eubank, V. Anil Kumar, M. Marathe. Understanding Large Scale Social and Infrastructure Networks: A Simulation Based Approach, in *SIAM news*, March 2004. Appears as part of Math Awareness Month on The Mathematics of Networks.
- [5] Barrett C, Marathe M, Smith J, Ravi S, (2002) A mobility and traffic generation framework for modeling and simulating ad hoc communication networks. *ACM Symposium on Applied Computing (SAC)*, pp. 122-126
- [6] R. J. Beckman, K. A. Baggerly, and M. D. McKay, Creating synthetic base-line populations, *Transportation Research Part A – Policy and Practice* 30 (1996) 415–429.
- [7] Synthetic Data Products for Societal Infrastructures and Proto-Populations: Data Set 1.0, Technical Report NDSSL-TR-06-006, Network Dynamics and Simulation and Science Laboratory, Virginia Tech, 2006. <http://ndssl.vbi.vt.edu/Publications/ndssl-tr-06-006.pdf>
- [8] S. Eubank, H. Guclu, V.S. Anil Kumar, M. Marathe, A. Srinivasan, Z. Toroczkai and N. Wang,.Modeling Disease Outbreaks in Realistic Urban Social Networks, *Nature*, 429, pp. 180-184, May (2004).
- [9] S. Eubank, V.S. Anil Kumar, M. Marathe, A. Srinivasan and N. Wang. Structural and Algorithmic Aspects of Large Social Networks, *Proc. 15th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pp. 711-720, (2004).
- [10] S. Eubank, V.S. Anil Kumar, M. Marathe, A. Srinivasan and N. Wang. Structure of Social Contact Networks and their Impact on Epidemics. to appear in *AMS-DIMACS Special Volume on Epidemiology*, (2005).
- [11] Speckman P, Vaughn K, Pas E (1997) Generating Household Activity-Travel Patterns (HATPs) for Synthetic Populations. *Transportation Research Board 1997 Annual Meeting*.
- [12] Speckman P, Vaughn K, Pas E (1997) A Continuous Spatial Interaction Model: Application to Home-Work Travel in Portland, Oregon. *Transportation Research Board 1997 Annual Meeting*