User Guide

This document serves as a simple user guide for the GMNS data format version of Big data-driven Transportation Computational graph (BTCG) framework.

1. Introduction

BTCG (Wu et al., 2018) is a forward and backward propagation algorithmic framework on a layered computational graph, which can perform hierarchical travel demand estimation using multiple data sources. BTCG can be viewed as an implementation of conceptual Hierarchical Flow Networks (HFN). By applying the back propagation (BP) algorithm, one can view each variable as a vertex and the edge between vertexes to translate the calculation process between variables as a computational graph.

The specific relationship between the layers of HFN is shown in Fig 1., which covers the input/output variables of each layer and the relationship between layers.

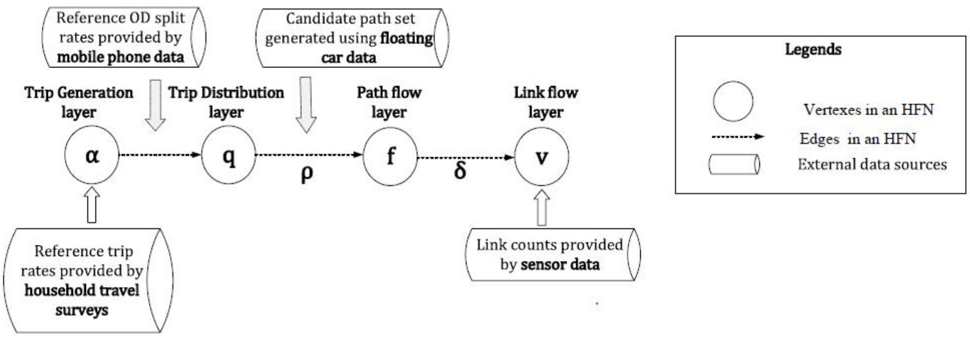


Fig. 1. HFN of Traffic Demand Flow Estimation (TDFE) model

To minimize the loss function, parameters such as α, π and θ are updated during the training process. Finally, the traffic flow of each layer (e.g., α of ozone layer, γ of OD layer, v of link layer) are estimated jointly.

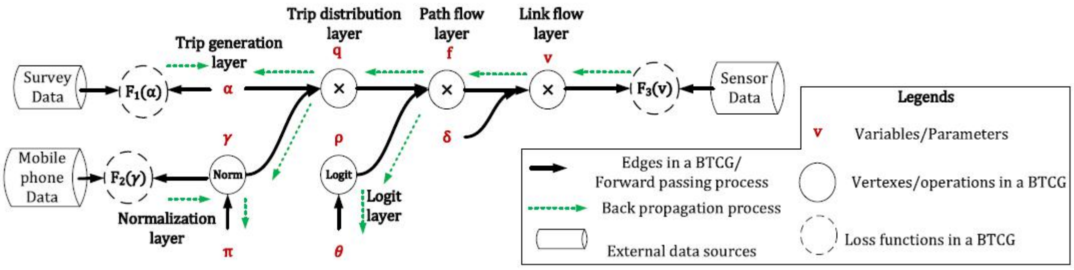


Fig. 2. Corresponding BTCG of HFN

2. Data flow

<table>
<tr><th>Input files</th><th>Output files</th></tr>
<tr><td>node.csv</td><td rowspan="3">output_ozone.csv
output_od.csv
output_path.csv
output_link.csv</td></tr>
<tr><td>agent.csv
agent_type.csv</td></tr>
<tr><td>road_link.csv</td></tr>
</table>

File node.csv

This file of node.csv includes the basic node information about the test network, such as name, node_id, zone_id, node_type, ctrl_type, x_coord, y_coord, and geometry.

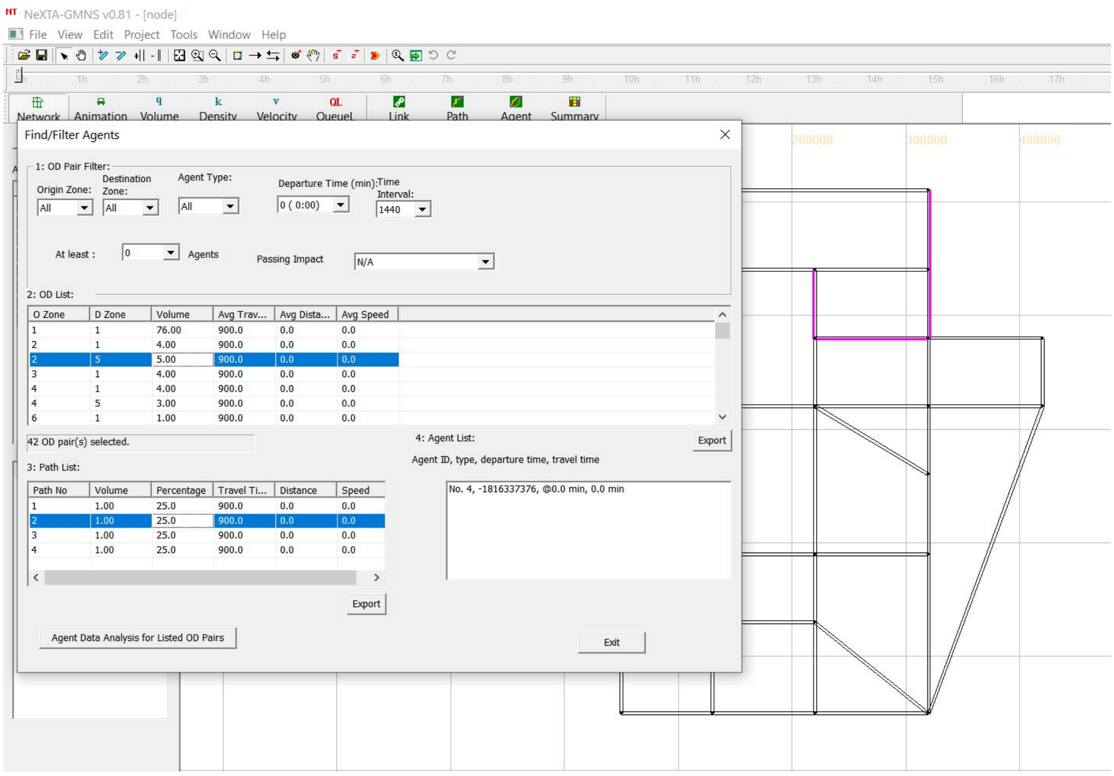
name	node_id	zone_id	node_typ	ctrl_type	x_coord	y_coord	geometry
	1	0			1523373	1003235	POINT (1523373.000000 1003235.000000)
	2	0			1523873	1003225	POINT (1523873.000000 1003225.000000)
	3	0			1524263	1003205	POINT (1524263.000000 1003205.000000)
	4	0			1524224	1002265	POINT (1524224.000000 1002265.000000)
	5	0			1523854	1002765	POINT (1523854.000000 1002765.000000)
	6	0			1523354	1002745	POINT (1523354.000000 1002745.000000)

road_link.csv, which includes basic link-level information.

name	roadlink_i	from_nod	to_node_i	facility_ty	link_type	direction	length	lanes	free_spee	capacity	demand_t	geometry
	1	1	100002	HOT	1	1	277	1	25	1800		LINESTRING (1523373.000000 1003235.000000 ,1523448.678000 1002967.757000)
	1	1	101990	HOT	1	1	239	1	25	1800		LINESTRING (1523373.000000 1003235.000000 ,1523365.110000 1003474.169000)
	1	1	101997	HOT	1	1	293	1	25	1800		LINESTRING (1523373.000000 1003235.000000 ,1523666.177000 1003224.848000)
	1	1	101998	HOT	1	1	230	1	25	1800		LINESTRING (1523373.000000 1003235.000000 ,1523143.000000 1003235.000000)
	2	2	100004	HOT	1	1	264	1	25	1800		LINESTRING (1523873.000000 1003225.000000 ,1523854.344000 1002961.414000)
	2	2	101992	HOT	1	1	226	1	25	1800		LINESTRING (1523873.000000 1003225.000000 ,1523854.344000 1003450.648000)
	2	2	101996	HOT	1	1	277	1	25	1800		LINESTRING (1523873.000000 1003225.000000 ,1524150.707000 1003215.440000)
	2	2	101997	HOT	1	1	206	1	25	1800		LINESTRING (1523873.000000 1003225.000000 ,1523666.177000 1003224.848000)
	3	3	101995	HOT	1	1	170	1	25	1800		LINESTRING (1524263.000000 1003205.000000 ,1524432.957000 1003196.623000)

input_agent.csv

There are different types of measurements stored in agent.csv, and one can use NeXTA to visualize the path trajectories.



Our source code considers an integration of multiple data sources, namely the household survey data (ozone data), the OD reference volume or the OD split rate (mobile phone data), the link count (sensor data), and the path information such as its node sequences.

agent_id	agent_type	from_zone_id	to_zone_id	from_node_id	to_node_id	od_flow	node_sequence	path_flow	time_peroid	observations
1	1	3	-1	3	-1	-1	-1	-1	1	70
2	1	12	-1	12	-1	-1	-1	-1	1	60
3	1	4	-1	4	-1	-1	-1	-1	1	90
4	1	6	-1	6	-1	-1	-1	-1	1	70
5	1	8	-1	8	-1	-1	-1	-1	1	30
6	1	9	-1	9	-1	-1	-1	-1	1	50
7	1	10	-1	10	-1	-1	-1	-1	1	60
8	1	11	-1	11	-1	-1	-1	-1	1	100
9	1	16	-1	16	-1	-1	-1	-1	1	90
10	1	2	-1	2	-1	-1	-1	-1	1	80
11	1	7	-1	7	-1	-1	-1	-1	1	50
12	1	18	-1	18	-1	-1	-1	-1	1	80

agent_type.csv

File agent_type.csv is used to specify the agent/information type in the measurements in input_agent.csv. Currently, we consider 4 information types: 1. household survey samples; 2. OD reference volume; 3. path proportions; 4. link counts. The field of “attribute 1” means the number of observations, and the field of “attribute 2” means the number of time periods. In our current implementation, we consider one day or peak period of traffic volume, thus the number of time periods is set to 1.

agent_type_id	agent_type	attribute1	attribute2
1	household survey	22	1
2	od reference volume	33	1
3	path proportion	126	1
4	link count	76	1

3. **Case study**

As shown in Fig. 3, the illustrative Sioux Falls network is used as the test case, with 22 zones, 24 nodes, 33 OD pairs, 76 links and 132 paths. The GMNS format data set is provided in the sub folder of /SiouxFalls network.

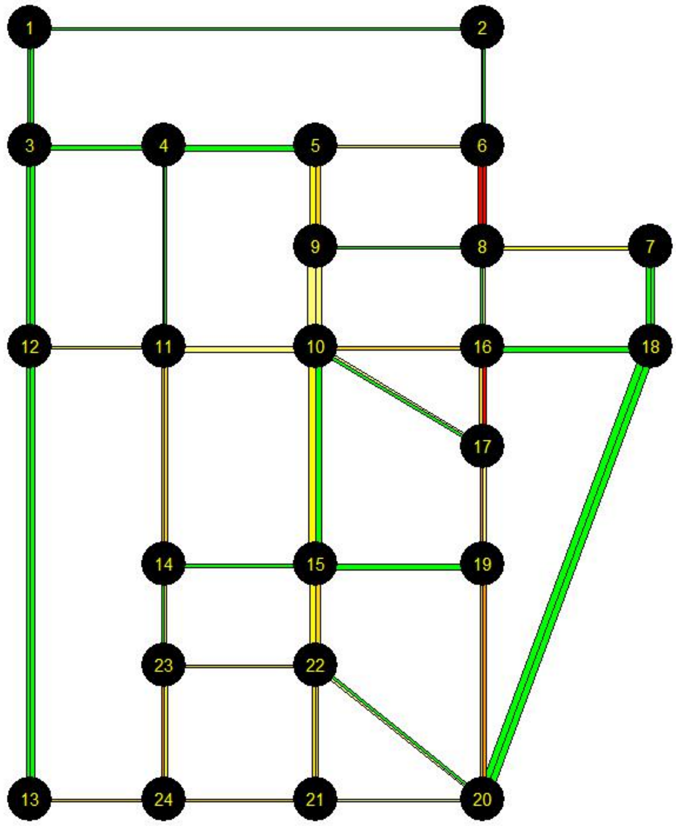
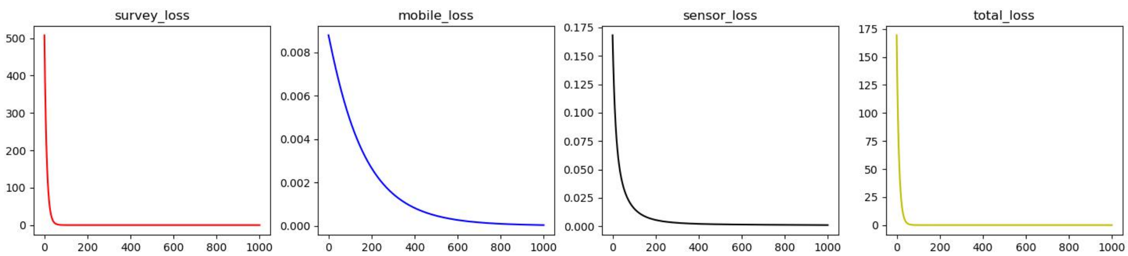


Fig. 3. Sioux Falls Network

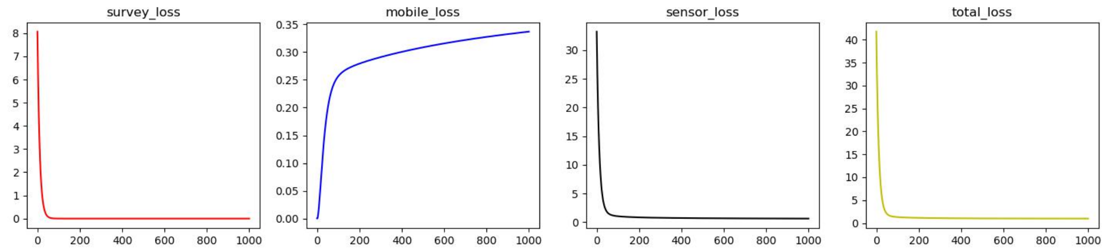
Training results (1000 epochs):

BTCGLite_GMNS.py. Tthis simplified version does not use the logit model and related class objects, to speed up the computational time.



step 1000 :survey error= 6.983434152935154e-08
step 1000 :mobile error= 3.8845606447143905e-05
step 1000 :sensor error= 0.0010404423796513053
step 1000 :total error= 0.0010792072388590332

BTCG_GMNS.py In this standard version with embedded non-convex logit functgions, the loss associated with mobile data (i.e. OD splits) increases to a certain degree, but the total loss function has been reduced as a result ot the optimization process performed by Tensorflow.



step 1000 :survey error= 3.1824046e-09
step 1000 :mobile error= 0.3365797
step 1000 :sensor error= 0.6412415
step 1000 :total error= 0.9778478

References.

Wu, X., Guo, J., Xian, K., Zhou, X., 2018. Hierarchical travel demand estimation using multiple data sources: A forward and backward propagation algorithmic framework on a layered computational graph. Transportation Research Part C: Emerging Technologies 96, 321-346.