

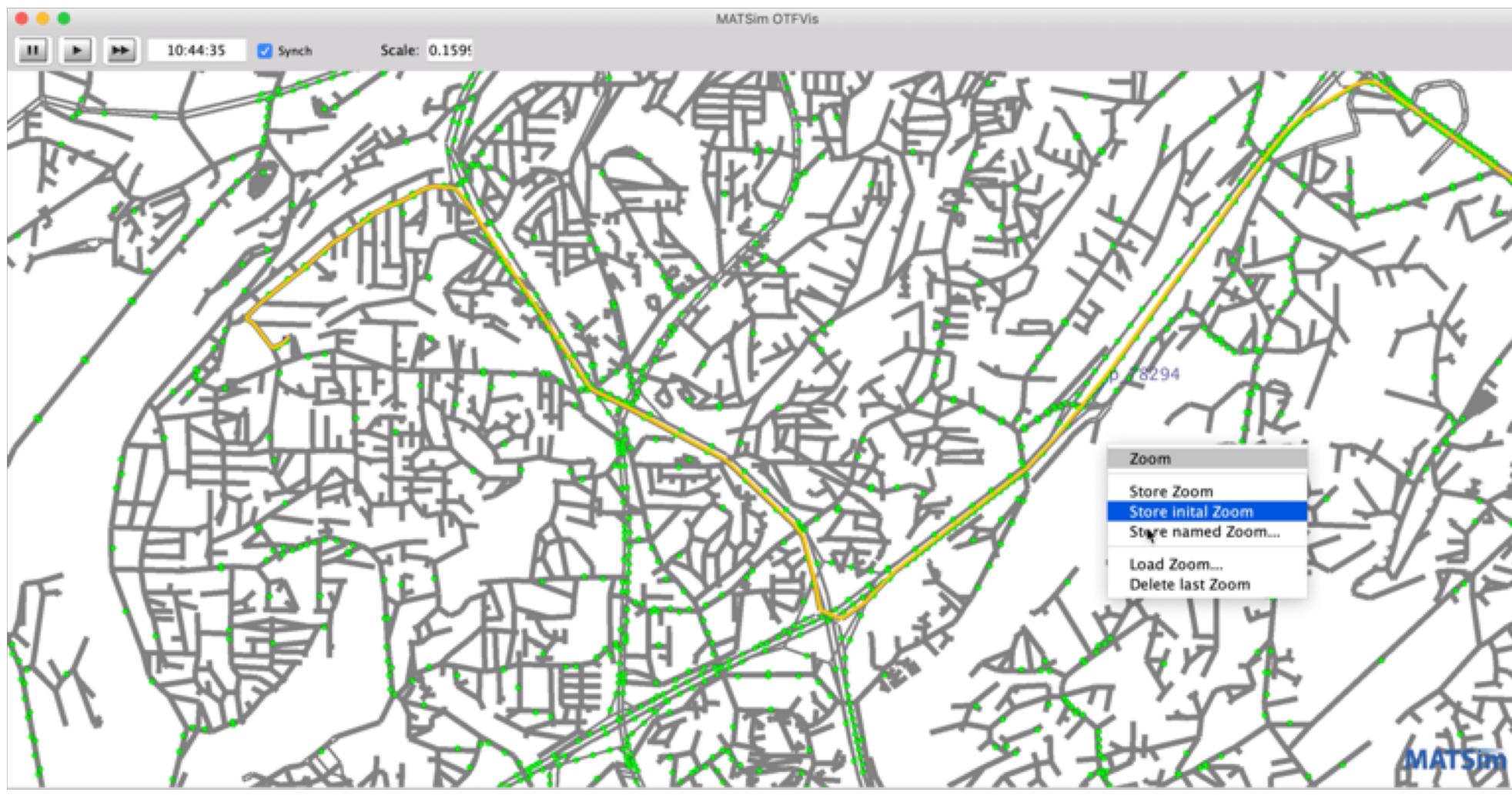
Realistic Transport Simulation with Open Data

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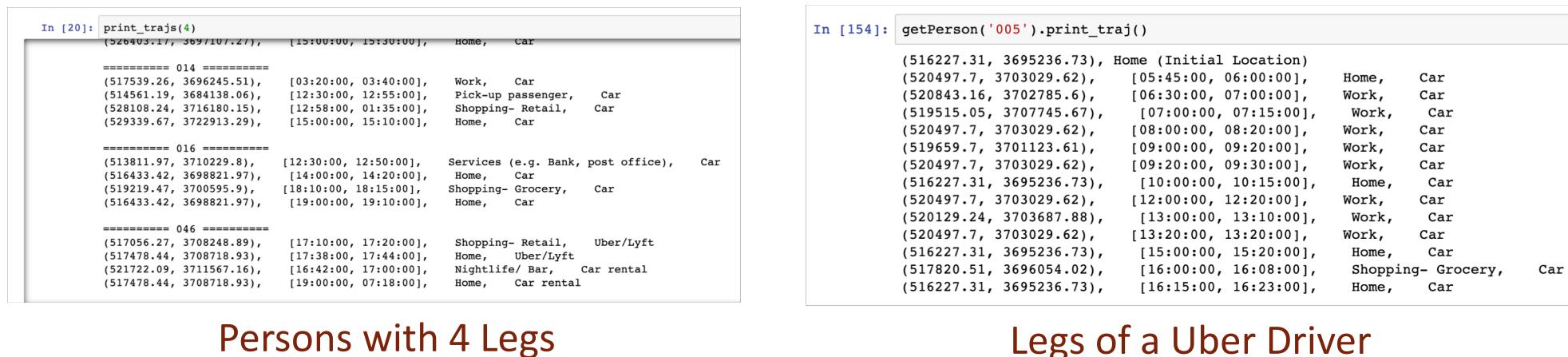
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The Problem

MATSim: agent-based transport simulation



User survey: 451 people with their day plans



Persons with 4 Legs

Legs of a Uber Driver

The Problem: to generate a realistic population from the survey as an input to MATSim for simulation

The simulation model can be used to study traffic problems such as road congestions, and impact of Uber traffic flow

The Challenges

Conventional Approach: Iterative Proportional Fitting (IPF) according to agents' attribute distribution in the US Census

Challenges: the small data problem (tackled with open data)

IPF only generates # of people in each region; missing details like locations and activities

Sampling day plans?

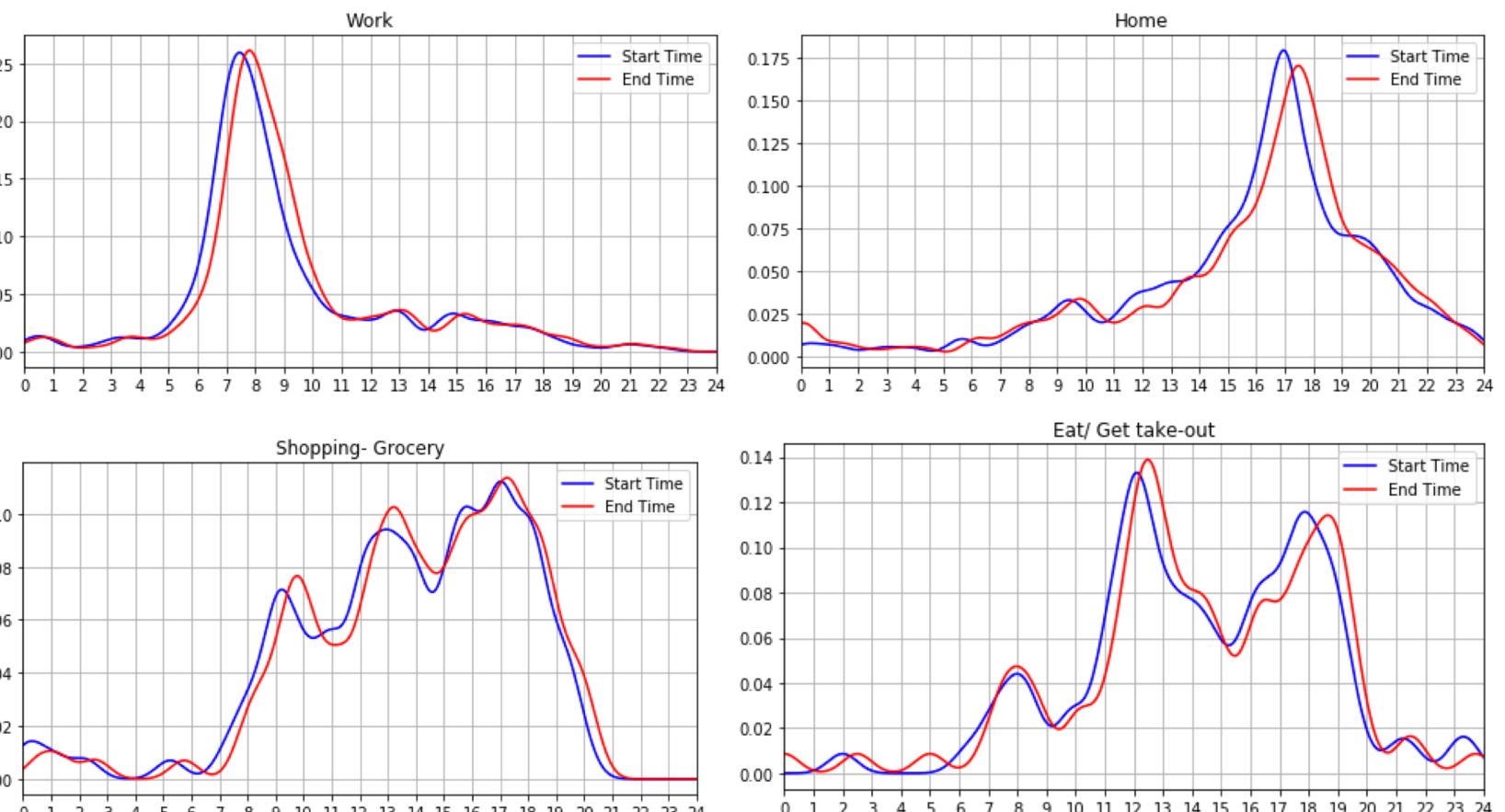


Our Solution

Data-Driven Approach: modeling (1) time, (2) location, (3) activities and (4) mode using generative machine learning models, with the help of open data.

Time Modeling using Kernel Density Estimation (KDE)

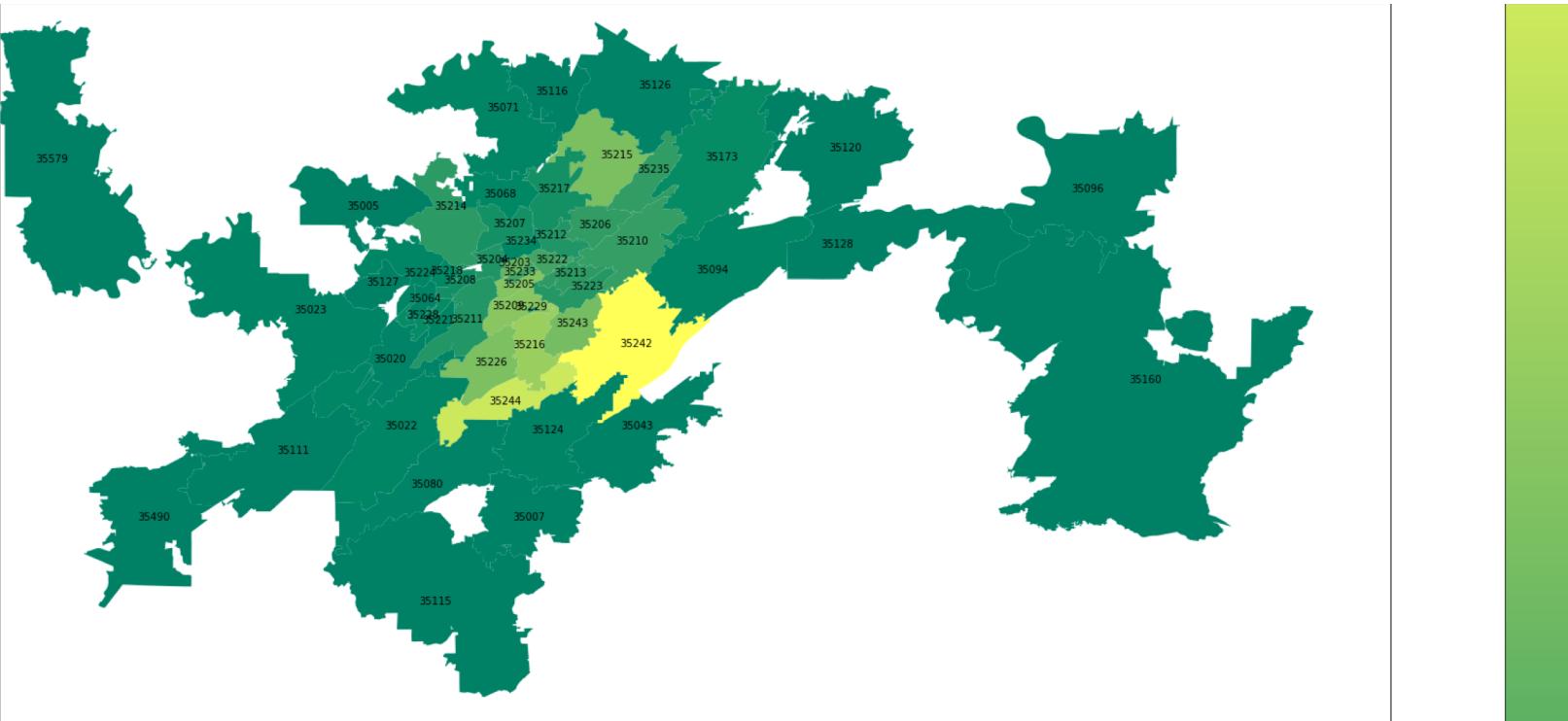
Activity start and end time distributions:



We can model the travel time using KDE similarly

Location Modeling with Open Data

Zip Code Tabulation Areas (ZCTA) from TigerWeb



Real addresses from OpenAddresses

IPF Source ZCTA marginal:

From American Community Survey (ACS), Variable "P03_0018E: COMMUTING TO WORK"

NAME	DP03_0018E	zip code tabulation area
0	ZCTA5 35401	11636
1	ZCTA5 35071	7141
2	ZCTA5 35005	2777
3	ZCTA5 35213	6409
4	ZCTA5 35215	20017
5	ZCTA5 35111	7809
6	ZCTA5 35124	12974
7	ZCTA5 35203	947
8	ZCTA5 35206	6862
9	ZCTA5 35209	16154
10	ZCTA5 35218	2583

Destination ZCTA marginal: Birmingham Business Alliance

EMPLOYER RANK	EMPLOYER	ESTIMATED NUMBER OF EMPLOYEES	PRODUCTS OR SERVICES	COUNTRY	MUNICIPALITY
1	University of Alabama at Birmingham	23,000	Education and health care services	Birmingham	Birmingham
2	Regions Financial Corporation	9,000	Financial services, banking, corporate headquarters	Birmingham	Birmingham
3	St. Vincent's Health System	5,000	Health care services, hospital network serving metro Birmingham	Birmingham	Birmingham
4	AT&T	5,000	Telecommunications, regional telephone company	Birmingham	Birmingham
5	Honda Manufacturing of Alabama	4,500	Manufacturing, assembly plant	Talladega	Lincoln
6	Brookwood Baptist Health	4,459	Health care services, management	Birmingham	Birmingham
7	Jefferson County Board of Education	4,400	Government, public education	Birmingham	Birmingham
8	City of Birmingham	4,200	Government, city administration	Birmingham	Birmingham
9	McWane Gas Transmission, Inc.	3,600	Manufacturing, gas transmission plant	Tuscaloosa	Vance
10	One Cross Blue Bridge of Alabama	3,500	Transportation, railroads, corporate headquarters	Birmingham	Birmingham
11	Alabama Power Company	3,092	Utilities services, electrical, corporate headquarters	Birmingham	Birmingham
12	Birmingham Board of Education	2,721	Government, public education	Birmingham	Birmingham
13	Jefferson County Commission	2,500	Government, county administration	Birmingham	Birmingham
14	Satellites Unlimited, Inc.	300	Telecommunications, corporate headquarters, wired telecommunications	Birmingham	Birmingham
15	STERIS Corporation	300	Manufacturing, medical, surgical appliance and supplies	Birmingham	Birmingham
16	US Security Associates, Inc.	300	Wholesale distribution, parts and equipment	Birmingham	Birmingham
17	U.S. Securities Association, Inc.	300	Wholesale distribution, parts and equipment	Birmingham	Birmingham
18	Wood-Fruethier Grocery Company	300	Wholesale distribution, food	Birmingham	Birmingham
19	Yerush Automotive Alabama Inc.	300	Manufacturing, vehicle assembly plant supplier	Walker	Jasper
20	Yerush Automotive	300	Manufacturing, vehicle assembly plant supplier	Walker	Jasper

BBA Top Employer List

35215	6979	997	2493	499	0	499	0	0	0	997	...
35173	2458	4916	1229	1229	0	1229	0	0	0	589	589
35206	2357	295	589	295	0	295	0	0	589	589	...
35209	522	0	0	4441	2090	1567	2090	784	261	1045	...
35226	446	0	0	2674	4457	446	1783	0	446	891	...
35205	210	210	0	1468	0	3145	419	0	0	1887	...
35242	0	281	281	1684	1403	561	16557	281	0	1123	...
35223	0	0	0	227	0	453	227	1812	0	227	...
35207	0	0	277	0	0	0	0	0	555	0	...
35233	45	0	23	136	23	181	0	0	23	0	113
35211	1381	0	691	691	1381	0	0	0	0	691	...
35235	3337	667	667	0	0	0	667	0	0	0	...
35222	181	0	181	363	181	363	181	181	0	363	...
35243	0	0	167	1004	167	1004	2175	335	0	836	...

IPF Output Matrix

Generating agents' day plans using the IPF output matrix

Evaluation

Comparison with real traffic data

MATSim ID	Interstate	Monitored Speed	Simulation Speed
50779678_0	I-65 N	59	58.17957611
50779764_0	I-65 N	57	55.39014001
50780374_1	I-20 W/ I-59 S	67	67.23911964
119869822_0	I-20 W/ I-59 S	63	68.11513108

Future Work

OpenStreetMap POI

```
In [222]: root.print_maxDepth(3)
+-- ROOT, 443
  +-- Home, 422
    +-- Home, 23
      | +-- Home, 23
      | +-- Work, 170
      | +-- Eat/ Get take-out, 16
      | +-- Work, 10
      | +-- Pick-up passenger, 9
      | +-- Shopping- Grocery, 16
      | +-- Services (e.g. Bank, post office), 9
      | +-- Drop-off passenger, 4
      +-- Shopping- Grocery, 49
        +-- Home, 23
        +-- Shopping- Grocery, 8
        +-- Services (e.g. Bank, post office), 43
        +-- Home, 12
        +-- Shopping- Grocery, 6
```

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Video Demo



<https://youtu.be/Zlm0WsmKB4E>

