Analyzing Employment Accessibility in a Multimodal Network using GTFS:

A Demonstration of the Purple Line, Maryland

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Where this new transit investment can get people to?
Three methods measuring accessibility

1. time-based index

\[ A_{1-2} = \frac{S_1}{T_{1-2}} \]  

\[ A_{i}^{\text{trans}} = \sum_j \sum_k [\alpha_k W_k f(C_{ij}^{\text{trans}})] + \left(1 - \alpha_k\right)W_k f(C_{kj}^{\text{trans}}) \]  

(Hansen, 1959)  

(Shen, 2000)
2. Space – based mapping

- Euclidean metric
- Manhattan metric
- Network based
Literature Review

3. A time-space combination

- Time-based transit schedule
- Network-based walkable area
A Good Multimodal Commuteshed Model

- Detailed data
  - Transit schedule
  - Street network

- Model tool
  - ArcGIS Multimodal Network Analyst
GTFS -- Benefits

- Open data
- Consistency
- High detail level
- Multi transit types
Characters

- Created and edited by volunteer mappers,
- Elements include roads, trails, stations, and so on,
- Open data, free to use

Image Source: OpenStreetMap.org
Application to Purple Line

- Light rail
- 21 stations
- 16 miles
- 5 subareas
- 4 employment centers
- 2 counties

- March 2014 – FTA’s Decision of Record
- March 2014 – recommended to New Starts
- 2015 – Construction starts
- 2020 – Completion and use
## Models’ Input

<table>
<thead>
<tr>
<th>Transit Schedule</th>
<th>“Before” Model</th>
<th>“After” Model</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMATA GTFS</td>
<td>WMATA GTFS</td>
<td>WMATA GTFS</td>
<td>WMATA GTFS</td>
</tr>
<tr>
<td>MTA GTFS</td>
<td>MTA GTFS</td>
<td>MTA GTFS</td>
<td>MTA GTFS</td>
</tr>
<tr>
<td>Montgomery RideOn GTFS</td>
<td>Montgomery RideOn GTFS</td>
<td>Montgomery RideOn GTFS</td>
<td>MTA RideOn</td>
</tr>
<tr>
<td>Prince George’s TheBus GTFS</td>
<td>Prince George’s TheBus GTFS</td>
<td>Prince George’s TheBus GTFS</td>
<td>Self-Made</td>
</tr>
<tr>
<td>Purple Line GTFS</td>
<td>Purple Line GTFS</td>
<td>Purple Line GTFS</td>
<td>Self-Made</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Street Network</th>
<th>“Before” Model</th>
<th>“After” Model</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>OpenStreetMap street shapefile</td>
<td>OpenStreetMap street shapefile</td>
<td>OpenStreetMap street shapefile</td>
<td>OpenStreetMap FEIS MTA</td>
</tr>
</tbody>
</table>
### Purple Line Planned Schedule

<table>
<thead>
<tr>
<th>Day of Week</th>
<th>Hours of Operation</th>
<th>Peak-Hour Headway</th>
<th>Off-Peak Headway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday – Thursday</td>
<td>5:00 am – 12:00 am</td>
<td>6 minutes</td>
<td></td>
</tr>
<tr>
<td>Friday</td>
<td>5:00 am – 3:00 am</td>
<td></td>
<td>10 minutes</td>
</tr>
<tr>
<td>Saturday</td>
<td>7:00 am – 3:00 am</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunday</td>
<td>7:00 am – 12:00 am</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Model Steps

1. **Prepare data**
   - Raw GTFS
   - GTFS with consistent service period

2. **Generate transit stations and route**
   - Transit stations and routes

3. **Create snaps and connectors**
   - Connected street network and transit system

4. **Create Multi-modal network**
   - Multimodal network with transit schedule

5. **Add transit schedule**
   - Commutesheds

6. **Create service area**
   - Employment accessibility

7. **Overlay with employment**
   - LEHD

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**Flow of Data**
- **Input**
- **Output**
## Employment Accessibility

<table>
<thead>
<tr>
<th></th>
<th>30 minutes</th>
<th>45 minutes</th>
<th>60 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
<td>Change</td>
</tr>
<tr>
<td>Low Skill Jobs</td>
<td>2,689</td>
<td>4,829</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>10,156</td>
<td>14,363</td>
<td>41%</td>
</tr>
<tr>
<td></td>
<td>47,681</td>
<td>72,922</td>
<td>53%</td>
</tr>
<tr>
<td>Medium Skill Jobs</td>
<td>10,123</td>
<td>18,254</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>37,561</td>
<td>53,110</td>
<td>41%</td>
</tr>
<tr>
<td></td>
<td>160,358</td>
<td>269,157</td>
<td>68%</td>
</tr>
<tr>
<td>High Skill Jobs</td>
<td>9,915</td>
<td>16,065</td>
<td>62%</td>
</tr>
<tr>
<td></td>
<td>29,781</td>
<td>40,231</td>
<td>35%</td>
</tr>
<tr>
<td></td>
<td>118,546</td>
<td>236,957</td>
<td>100%</td>
</tr>
</tbody>
</table>
Bethesda Commutesheds

MultiModal Transit Commuteshed of Planned Bethesda Station

Before Purple Line

After Purple Line

- Bethesda
- Silver Spring
- Langley Park
- New Carrollton

- 30 minutes
- 45 minutes
- 60 minutes
Future Research

• To include more modes:
  – Biking
  – Automobile

• Online tool
Thank You!

Ting Ma

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Research Assistant

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University of Maryland, College Park