Deadhead Minimization with a Flexible Facility Locator Tool

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Overview

1. Background
2. Process and methods
3. Case study results
4. Implications
5. Future work
Background

• For MARTA
  • Buses currently stored in 3 depots
    • Many routes start and end service north of these depots
    • Increased deadhead time and costs

• At large
  • Capability limited to certain commercial software
    • Giro’s HASTUS and Minibus
  • Skill barrier to enact solutions seen in literature
Analysis Process

1. GTFS Data
   - Identify pull-on and pull-off locations for each vehicle block ID

2. OpenStreetMap and R dodgr package
   - Produce deadhead OD matrices for existing and proposed depots

3. Repeat with each candidate depot site
   - Match each vehicle to depot that minimizes deadhead time

4. Driver wage and per mile operating cost
   - Calculate total system deadhead travel time
   - Identify winning site and calculate time, distance, & cost savings
Data

- GTFS
- OpenStreetMap
- Current facility locations

Assumptions
- Candidate sites
- Hourly costs
- Per mile operating cost
- Street network reduction
User Interface

<table>
<thead>
<tr>
<th>Upload GTFS routes.txt file:</th>
<th>Upload GTFS stops.txt file:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Browse... routes.txt</td>
<td>Browse... stops.txt</td>
</tr>
<tr>
<td>Upload complete</td>
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<tr>
<th>Upload GTFS times.txt file:</th>
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<tr>
<td>Browse... stop_times.txt</td>
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<td>Upload complete</td>
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</table>

Finally, upload the .csv files with the coordinates of your existing depots and the vacant properties you want to consider.

Each file should have a column titled ‘lat’ with latitude coordinates and a column titled ‘lon’ with longitude coordinates.

<table>
<thead>
<tr>
<th>Upload a .csv file with the coordinates of your existing depot:</th>
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<tbody>
<tr>
<td>Browse... MARTA_garages.csv</td>
</tr>
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<td>Upload complete</td>
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<table>
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<tr>
<th>Upload a .csv file with the coordinates of the vacant properties you’re considering:</th>
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<tr>
<td>Browse... fulton_vac_prop_data.csv</td>
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<td>Upload complete</td>
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The new depot should be located at: Windward Parkway
This would save ~29.82 hours or 1422.98 miles of deadhead travel per weekday.
This translates to saving about $488.45 in wage costs and $12024.18 in operating costs per weekday.

Download
Model Assumptions: Current Depots

MARTA's Allocation

Minimized Deadhead
Results

Existing Scenario

Four-Depot Model
Results

Without Residential Roads
• Winward Park & Ride
  • 67 vehicles reassigned
  • 29.74 deadhead hours saved
  • Saves ~$12,000/day based on assumptions

With Residential Roads
• 11343 Alpharetta Hwy
  • 68 vehicles reassigned
  • 29.34 deadhead hours saved
  • Saves ~$12,000/day based on assumptions
Implications

- **Successes:**
  - Open-source and adaptable
  - Inputs can be updated over time
  - No coding knowledge required from the user
- **Collaboration through GitHub**
- **Potential for transit agencies**
- **Potential for researchers**
Future work

- Facility vehicle capacity
- Emissions and environmental considerations
- Connect different fuel types and maintenance needs
- Consider battery range and charging station locations
- Turn penalties
- Integrated address geocoding

Photo: Kristain Baty, https://flic.kr/p/hTKGr

• https://github.com/karagtodd/depot_locator

• https://freyjabt.me