Planning bicycle infrastructure based on quickest route method

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PLANNING BICYCLE INFRASTRUCTURE BASED ON THE QUICKEST OR EASIEST ROUTE METHOD

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Purpose of the Research: To develop a model for bicycle infrastructure planning that allows choosing the quickest route considering that speed varies according to human physical abilities.

Objectives:
- Identify the criteria that have the most significant influence on bicycling travel time.
- Develop a model of estimating travel time that accounts for maximum power available to the rider.
- Solve bicycle route choice problem to minimize travel time.
- Propose location of bicycle ways based on fastest routes.

Findings from Literature:
- Safety is an important concern for all types of riders.
- Time is the most important factor for utilitarian cyclists.
- Bicyclists ride faster if they feel safe on the road.
- A commuter cyclist would rather cycle 1.76 miles on a flat route than bicycling one mile on an uphill slope of 2-4 percent.
- Women prefer flat or moderate terrain while men prefer moderate to steep slopes.
- Speed varies significantly based on the topography.

Lack of existing methods:
Infrastructure planning framework does not consider travel time along the routes proposed. Current bicycle models assume average speed along the route and among routes and travel time is proportional to average speed along the route and among routes. There is no method that determines the realistic cycling travel time based on change in speed due to topography.

1 Identify the criteria that have the most significant influence on bicycling travel time
Factors that affect bicycling travel time

2 Develop a model of estimating travel time that accounts for maximum power available to a rider
Conceptual Model of Route Choice

3 Solve bicycle route choice problem to minimize travel time
Two scenarios of Route Travel Time

4 Prioritize bikeways location

Scenario 1—Travel time calculated based on Power Model
Scenario 2—Travel time calculated based on constant speed

Route Characteristics

<table>
<thead>
<tr>
<th>Route</th>
<th>Total Travel Time, min</th>
<th>Total Length, m</th>
<th>Total Work, 0.6 J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>11</td>
<td>2934</td>
<td>1820</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>10</td>
<td>3000</td>
<td>1460</td>
</tr>
</tbody>
</table>

Key Results:
- Developed a model to estimate bicycling speed based on relationship between human power and road topography.
- Model allows to predict realistic bicycling travel time.
- Optimal route can be solved with time (quickest) or work (easiest) impedance.

Application to Practice:
- To calculate time for travel forecasting models.
- To estimate time for integrating transit and cycling.
- To prioritize bikeway infrastructure.
- To evaluate the levels of difficulty for different routes.
- Can be integrated into personalized route planning software.

References: