Monitoring the Performance of Unpaved Roads Using GPS Surveys – Practical Exercise

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GPS Monitoring of Unpaved Road Performance

Overview

- Why we need new ways to measure unpaved road performance.
- Why use a GPS?
- What are the objectives?
- The Steps in the Process.
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Need for New Monitoring Instruments

- Rural road networks provide basic accessibility
- Most indicators focus on road condition and do not measure accessibility
- Road Funds, financing agencies, and other stakeholders need simple, consistent measures of how well Unpaved roads satisfy the needs of users.
- Monitoring units need reliable year on year measure to identify actual progress
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Why Use a GPS?

- GPS records the journey along the road
- Inexpensive
- Driving needs to be controlled in order to reduce inconsistencies between drivers
- Data can be analysed to extract information about the journey and hence the performance of the road
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Coefficients of Unpaved Roads Accessibility

- **Speed Efficiency Coefficient (SEC)**
  
  *Extent*
  
  How much of the network is substandard?

- **Time Efficiency Coefficient (TEC)**
  
  *Intensity*
  
  How bad is the problem?

- **Road Accessibility Coefficient (RAC)**
  
  *Reach*
  
  How much of the network is made inaccessible?
Threshold speed: the minimum acceptable speed for a low-volume Unpaved road
- Most users of Unpaved roads don’t need to go fast
- Threshold speeds should usually be lower than design or legal speeds
- Use of thresholds eliminates the influence of potential faster sections of road.

Rupture Point: an impediment in the roadway that prevents normal traffic from passing
- Many rupture points result from the absence of water-crossing structures
- Rupture points may in fact be longer sections that are impassable.
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**Speed Efficiency Coefficient**

- SEC – the **extent** of road or network that performs at least as well as the target or threshold speed

\*

![Figure: Speed Profiles: Actual Versus Target](image)

In this case the value for the coefficient is:

\[
SEC = \frac{(AB + CD)}{AD}
\]
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Time Efficiency Coefficient

- **TEC** – a measure of how close to the target travel time the road performs, the **intensity** of the problem areas

In this case the value for the coefficient is:

\[ \text{TEC} = \frac{\text{OADK}}{\text{OADK} + \text{BEFC}} \]

![Figure: Time Profiles: Actual versus Target](image-url)
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Road Accessibility Coefficient

- **RAC** - measures the share of the network that is accessible by normal vehicles, effectively the **REACH** of the network.

In this case the value for the coefficient is:

\[
\text{RAC} = \frac{\text{Accessible Network}}{\text{Total Network}} = \frac{A\sim K - (EF + GH + HI + HJ + JK)}{A\sim K}
\]

Figure: Measuring Intransitable Sections
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The GPS and the Data

- Affordable and available navigation tool
- Low training requirements
- Compatible with Excel and GIS
**GPS Monitoring of Unpaved Road Performance**

**The Survey Form**

<table>
<thead>
<tr>
<th>GPS Road Transitability Survey</th>
<th>Sheet __________ of ______</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road:</td>
<td>Date:</td>
</tr>
<tr>
<td>GPS Coordinates at Start:</td>
<td>GPS Coordinates at End:</td>
</tr>
<tr>
<td>GPS Mode: (Auto/Distance...)</td>
<td>Road Surface: (Gravel/Soil)</td>
</tr>
</tbody>
</table>

**Low Velocity Sections**

<table>
<thead>
<tr>
<th>GPS Waypoint at start of section</th>
<th>Km at start</th>
<th>Km at End</th>
<th>Poor Condition or not?</th>
<th>Obstacle and comment</th>
</tr>
</thead>
<tbody>
<tr>
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</table>
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Data Manipulation

- GPS sample output

<table>
<thead>
<tr>
<th>Index</th>
<th>Date and Time</th>
<th>Altitude</th>
<th>Leg length</th>
<th>Leg time</th>
<th>Leg speed</th>
<th>Bearing</th>
<th>Latitude E</th>
<th>Longitude E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>02/04/2009 07:13</td>
<td>7 m</td>
<td>55 m</td>
<td>00:06:21</td>
<td>0.5 km/h</td>
<td>172° true</td>
<td>S25 58.969</td>
<td>E32 33.505</td>
</tr>
<tr>
<td>2</td>
<td>02/04/2009 07:19</td>
<td>4 m</td>
<td>60 m</td>
<td>00:00:07</td>
<td>31 km/h</td>
<td>179° true</td>
<td>S25 58.998</td>
<td>E32 33.510</td>
</tr>
<tr>
<td>3</td>
<td>02/04/2009 07:19</td>
<td>4 m</td>
<td>61 m</td>
<td>00:00:06</td>
<td>37 km/h</td>
<td>177° true</td>
<td>S25 59.031</td>
<td>E32 33.511</td>
</tr>
<tr>
<td>4</td>
<td>02/04/2009 07:19</td>
<td>4 m</td>
<td>51 m</td>
<td>00:00:05</td>
<td>37 km/h</td>
<td>177° true</td>
<td>S25 59.063</td>
<td>E32 33.513</td>
</tr>
</tbody>
</table>

- Identifying the section of road
- Converting to numerical data where text is included
- Calculating the SEC and TEC
- Calculating the RAC (network value)
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The GPS and the Data

GPS output as a plot
GPS Monitoring of Unpaved Road Performance
The GPS and the Data

GPS output as a truncated plot

SEC = 0.27; TEC = 0.73 & RAC = 1.0
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THANK YOU!