Recreational Area Road Noise Research

- Two main topics

Motorcycle Noise

Quieter Pavements
(not intended to reduce motorcycle noise)
Guidance document
TNM implementation and demo
Rumble strip noise synthesis
Motorcycle Noise – motivation for study

- Can adversely impact people in the vicinity of highways, including visitors to recreational areas

- Lack of information available, particularly in terms of categories

- Need to understand how motorcycle noise is contributing to sound environment

“... few other factors contribute more to misunderstanding and prejudice against the motorcycling community than excessively noisy motorcycles …”

– American Motorcyclist Association
Motorcycle Noise – categorized motorcycles

- 5 categories based on visible and audible similarities

Cruiser

Dual Purpose

Moped/Scooter

Sport

Touring
Motorcycle Noise – measurements

- Blue Ridge Parkway National Park chosen for data collection
  - Many motorcyclists use the road (385 passed by in 5-hour period)
  - Adjacent recreational locations (overlook, hiking trails, picnic areas, visitor centers, campgrounds)
Motorcycle Noise – instrumentation

- Primary microphone position:
  - Distance from road = 50 ft, height = 5 ft

- Other instrumentation:
  - Vehicle pass-by log, meteorological sensors, radar gun, video cameras
Average and range of sound levels for each motorcycle category
(speed ranges indicated)

<table>
<thead>
<tr>
<th>Category</th>
<th>L_Amax (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cruiser</td>
<td>80-85</td>
</tr>
<tr>
<td>Sport</td>
<td>65-70</td>
</tr>
<tr>
<td>Dual Purpose</td>
<td>60-65</td>
</tr>
<tr>
<td>Touring</td>
<td>55-60</td>
</tr>
<tr>
<td>Moped/Scooter</td>
<td>50-55</td>
</tr>
</tbody>
</table>

(speed ranges indicated)
Broadband comparison of categories

avg LAmax (dBA) based on linear regression, speeds 30-50 mph

- 1995 REMEL
- Cruiser
- Sport
- Dual purpose
- Touring
- Moped/scooter
Dominant low frequency content $\Rightarrow$ propagation of sound farther from road
Using TNM, predicted sound levels as a function of distance (normalized results so levels match at 50 ft)
Motorcycle Noise – conclusions

- Differences were found among 5 motorcycle categories

- Cruiser category on average the loudest
  - Exhibits dominant low-frequency content
  - Propagates the farthest

- Groups of motorcycles can be heard for a substantial amount of time, possibly interfering with recreation and communication
Quieter Pavement Guidance Document

- Provides guidance and better practice recommendations for selecting pavement surfaces to minimize tire-pavement noise

- Includes:
  - Basic principles that lead to quieter pavement

Quieter pavement technologies invoke one or more of these principles

- Surface texture: small, flat, negative
- Pavement porosity: high
- Pavement stiffness: low
Quieter Pavement Guidance Document

- Provides guidance and better practice recommendations for selecting pavement surfaces to minimize tire-pavement noise

- Includes:
  - Basic principles that lead to quieter pavement
  - Common quieter technologies for flexible and rigid pavements

Flexible pavement (asphalt) & Rigid pavement (concrete)

- Flexible pavement (asphalt): PFC, OGAC
- Rigid pavement (concrete): drag, diamond ground, narrower joint design

![Images of PFC, OGAC, drag, diamond ground, narrower joint design]
Quieter Pavement Guidance Document

- Provides guidance and better practice recommendations for selecting pavement surfaces to minimize tire-pavement noise

- Includes:
  - Basic principles that lead to quieter pavement
  - Common quieter technologies for flexible and rigid pavements
  - Regional considerations
  - Descriptions of recent research
  - State DOT noise and pavement contacts
Quieter Pavement – TNM implementation and demonstration

- Demonstration in Death Valley National Park

- Examined:
  - Existing tire-pavement noise levels at various locations
  - Existing vehicle pass-by noise levels at sensitive receiver locations
  - Predictions of noise levels with quieter pavement applied
    - Applied specific pavement effects using OBSI data
Zabriskie Point

LAmax (dBA) measured at site vs. predicted with quieter pavement.

- **near road (50 ft)**
- **walking/photography area (550 ft)**
- **outlook/photography area (1050 ft)**
Badwater

- measured at site
- predicted with quieter pavement

Near road (50 ft):
- Measured LAmax (dBA) is around 80.
- Predicted LAmax (dBA) is around 70.

Walking area (470 ft):
- Measured LAmax (dBA) is around 40.
- Predicted LAmax (dBA) is around 30.
Rumble Strip Noise Synthesis

- Roadway departure warning indicators (rumble strips) can successfully decrease vehicle collisions or run-off-the-road crashes

- Basic types of rumble strips:
  - milled
  - rolled
  - formed
  - raised
Rumble Strip Noise Synthesis – design elements to minimize noise and maximize safety

- include offset
- short length
- narrow width
- large spacing
- shallow depth
- large clearance
- include gap

Quietest types … traditional: rectangular milled, experimental: sinusoidal
Questions?