Summary of UMTRI World SID Testing

Jonathan Rupp
Carl Miller
Nathaniel Madura
Larry Schneider
Goals

1. Conduct low- and high- speed side-impact testing of cadavers and WorldSID.
2. Compare cadaver and WorldSID responses
3. Publish results (ESV 2011)
Test Methods

- Impacted each cadaver twice using a door-shaped padded impact wall
  - First impact at 3 m/s
  - Second impact at 8 m/s
- Padding force-deflection characteristics set so that mean ATD responses from SNCAP tests were reproduced when impactor and occupant sled masses and velocities were tuned to reproduce door and vehicle velocity histories from SNCAP tests.
- Do not load shoulder (loading the shoulder adds potential variability and does not represent worse case scenario for thoracic or abdominal injury)
- CT scan before and after 3 m/s test to verify that no rib fractures were present.
Test Methods, cont.

• Record forces applied to anatomic regions including: thorax, abdomen, iliac crest, greater trochanter, and mid femur. Scale height of impactor plates with subject size to ensure that each segment of the impact wall loads the same body region across tests.

• Record thorax and abdomen deflection using 59-channel chest bands.

• Use a redundant measures of thoracic deflection:
  – Digitized spine and impactor locations from HS video, measure foam deformation using potentiometer that passes through the foam
  – Measure rib and spine accelerations

• Record rib fracture timing using strain gages.
Dual sled side impact facility

- Pneumatic accelerator
- Impactor sled
- Segmented load wall
- Occupant sled
Dual sled side impact facility

Pneumatic accelerator

Segmented load wall

Impactor sled

Occupant sled
# Cadaver Test Matrix

<table>
<thead>
<tr>
<th>Test Series ID</th>
<th>Gender</th>
<th>Age (Yr)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>t-score</th>
<th>Impact Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBA0901</td>
<td>M</td>
<td>86</td>
<td>170</td>
<td>77</td>
<td>-1.8</td>
<td>x</td>
</tr>
<tr>
<td>NBA0902</td>
<td>M</td>
<td>61</td>
<td>185</td>
<td>82</td>
<td>-0.9</td>
<td>x</td>
</tr>
<tr>
<td>NBA0903</td>
<td>M</td>
<td>50</td>
<td>173</td>
<td>64</td>
<td>1.6</td>
<td>x</td>
</tr>
<tr>
<td>NBA1004</td>
<td>M</td>
<td>66</td>
<td>173</td>
<td>79</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>NBA1005</td>
<td>M</td>
<td>51</td>
<td>183</td>
<td>97</td>
<td>1.2</td>
<td>x</td>
</tr>
<tr>
<td>NBA1006</td>
<td>M</td>
<td>34</td>
<td>188</td>
<td>102</td>
<td>2.0</td>
<td>x</td>
</tr>
<tr>
<td>NBA1007</td>
<td>M</td>
<td>87</td>
<td>175</td>
<td>73</td>
<td>-</td>
<td>x</td>
</tr>
</tbody>
</table>
Cadaver Corridor Development

• Normalized using equal-stress equal velocity scaling based on total body mass.
• Calculated ±1SD responses using Maltese method
3-m/s Impacts: Abdomen Responses
3-m/s Impacts: Thorax Responses
3-m/s Impacts: Applied Pelvic Force Responses
8-m/s Impacts: Abdomen Responses
8-m/s Impacts: Thorax Responses

- Thorax Deflection vs. Time (ms)
- Half Thorax Deflection (%)
- 8 m/s Thorax Force vs. Thorax Deflection (mm)

Graphs showing the response of the thorax to impacts at 8 m/s, including deflection and force measurements over time.
3-m/s Impacts: Applied Pelvic Force Responses

IW = Iliac wing, GT=greater trochanter
WorldSID test matrix

- 3 m/s, 8 m/s, and 10 m/s impact velocities
- Two impactor wall configurations
  - Padded with abdomen offset and
  - Padded with pelvis plus abdomen offset (more like FMVSS 214)
- 4 repeats in each test condition.
- Measure abdomen and chest deflection with chestbands and IR-TRACCs
- Recalibrate at halfway point in test matrix and after all tests are completed.
Preliminary Comparison of WorldSID Force Responses to Force Corridors from 3 m/s Impacts

IW = Iliac wing, GT=greater trochanter
Preliminary Comparison of WorldSID Pelvis Y-Axis Acceleration Response to Force Corridors from 3 m/s Impacts
Preliminary Comparison of WorldSID to 8 m/s Responses

IW = Iliac wing, GT=greater trochanter
• Thoughts on differences in 8 m/s pelvis response
  – *Findings are preliminary*
  – Suggest that pelvis may be too stiff and may have too much tightly coupled mass.
Next Steps

• Compare thoracic and abdominal deflection measurements from cadavers (chestband) to WorldSID deflection measurements (IR-TRACC and chestband)

• Complete World SID testing and better identify reasons for response differences.

• Write ESV paper comparing WorldSID and cadaver 3 m/s and 8 m/s responses.