Dynamic Geometric Options

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GTR Meeting

8th November, 2007
Dynamic Geometric Seat Testing

• Using a biofidelic dummy in terms of
  • Seat back interaction
  • Head-neck motion
  • i.e. BioRID II
  • To ensure correct actuation of reactive head restraints

• Three main measurement options
  • Head restraint movement - relative to initial position
  • Backset at a certain time - relative to back of dummy’s head
  • Retraction of dummy’s head
Dynamic Geometric Seat Testing

• **Option 1: Head restraint movement - relative to initial position**
  - Relatively straightforward to calculate from marker tracking
  - Could give equivalent test to static geometric

• **Option 2: Backset at a certain time - relative to back of dummy’s head**
  - Most difficult to implement - dynamic distance between two curved surfaces that may not always be in view

• **Option 3: Retraction of dummy’s head**
  - Relatively straightforward to calculate from marker tracking (relative to seat back angle)
  - More relevant to real-world safety than static backset
BioRID Kinematic Reproducibility

BioRID Head Angle (zeroed)
Two Dummies - IIWPG Pulse - One Laboratory Seat

![Graph showing BioRID Head Angle (zeroed) for different subjects over time.](image-url)
Option 1: HR Movement

- Use lower seat back marker as origin
- Translate upper seat back and both head restraint markers to origin
- Rotate upper seat back and both head restraint markers to original seat back angle
- Measure maximum HR x-axis displacement up to head contact

- E.g. …
Option 1: HR Movement
Option 1: HR Movement

- HR superior
- HR inferior
- Seat back superior
- Seat back inferior (recliner)
Option 3: BioRIRD Retraction

- **Same process as head restraint movement**
- **Calculate maximum x-axis retraction**
  - Movement of OC marker relative to T1 marker
- **Reproducibility with**
  - 4 or 5 different labs
  - 4 or 5 different BioRID IIg dummies
  - Deceleration and HyGe sleds
  - On-board and off-board cameras
  - No control over marker placement (tests run for other reasons)
  - Highly compressed .avi films
Option 3: BioRID Retraction

BioRID Retraction - S3 Seats - Pulse 2 - Five Laboratories and BioRID II's
2 Deceleration Sleds - 3 HyGe : 2 On-board Cameras - 3 Off-board Cameras

![Graph of BioRID Retraction](image-url)
Option 3: BioRID Retraction

BioRID retraction - S5 seats - Pulse 2 - Four Laboratories and BioRID II's
2 Deceleration Sleds - 2 HyGe : 1 On-board Camera - 3 Off-board Cameras
Option 3: BioRID Retraction

BioRID retraction - S4 seats - Pulse 2 - Four Laboratories and BioRID II's
2 Deceleration Sleds - 2 HyGe : 1 On-board Camera - 3 Off-board Cameras
Option 3: BioRID Retraction

- **Comparison with 202a validation data**
  - Kleinberger *et al.* [ESV 2007]

- **Four seats with reactive head restraint systems**
  - 2006 model year
    - Saab 9-3
    - Honda Civic
    - Subaru Outback
    - Nissan Altima
Option 3: BioRID Retraction

- **Comparison with 202a validation data**
  - Kleinberger *et al.* [ESV 2007]

- **Four seats with reactive head restraint systems**
  - 2006 model year
  - Comparison of Hybrid III head angle and IIWPG rating

<table>
<thead>
<tr>
<th>Seat</th>
<th>IIWPG Rating</th>
<th>Hybrid III Head Angle</th>
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</thead>
<tbody>
<tr>
<td>Saab 9-3</td>
<td>Good</td>
<td>4.1</td>
</tr>
<tr>
<td>Honda Civic</td>
<td>Good</td>
<td>7.7</td>
</tr>
<tr>
<td>Subaru Outback</td>
<td>Good</td>
<td>4.1</td>
</tr>
<tr>
<td>Nissan Altima</td>
<td>Acceptable</td>
<td>19.9</td>
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</tbody>
</table>
Option 3: BioRID Retraction

BioRID Retraction - Kleinberger et al. [2007] Seats

- Saab Retraction
- Civic Retraction
- Legacy Retraction
- Altima Retraction
Option 3: BioRID Retraction

- S3 retraction graphs…
Option 3: BioRID Retraction

- OC pin
- T1 pin
- Seat back superior
- Seat back inferior (recliner)
Option 3: BioRID Retraction

Diagram showing the horizontal and vertical positions of various components such as OC pin, T1 pin, seat back superior, and seat back inferior (recliner).
Option 3: BioRID Retraction

- OC pin
- T1 pin
- Seat back superior
- Seat back inferior (recliner)
Option 3: BioRID Retraction
Option 3: BioRID Retraction

- OC pin
- T1 pin
- Seat back superior
- Seat back inferior (recliner)
Option 3: BioRID Retraction

BioRID Retraction - S3 Seats - Pulse 2 - Five Laboratories and BioRID II's
2 Deceleration Sleds - 3 HyGe : 2 On-board Cameras - 3 Off-board Cameras

![Graph showing Retraction over Time](image-url)
Dynamic Geometric Options

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