

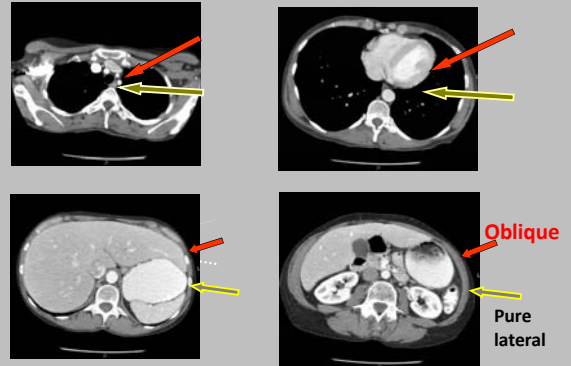
# Oblique Testing with WorldSID, ES2-re, & PMHS

N. Yoganandan  
 John R. Humm  
 James Rinaldi  
 Frank Pintar

Department of Neurosurgery  
 Milwaukee, WI



## Oblique versus Pure Lateral Loading



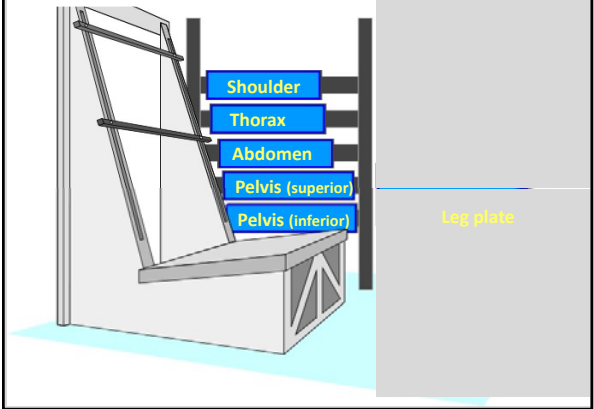
## Modular Scalable Load Wall



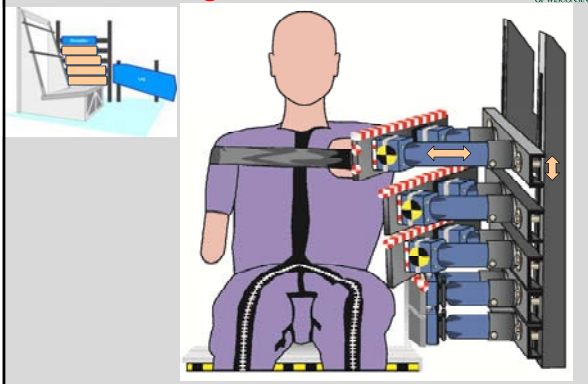
- For oblique side impact tests
- Region-specific responses
- Modular load wall design
- Dummy biofidelity issues



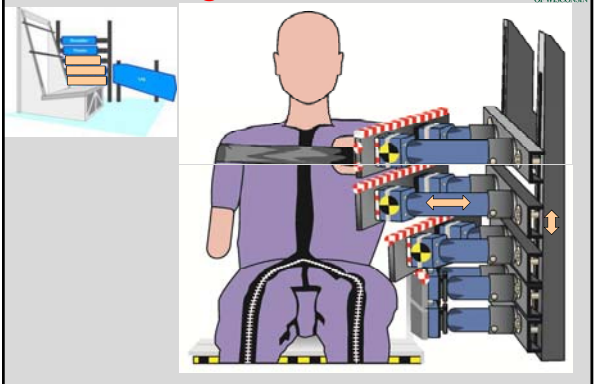
## Modular, Scalable Load Wall

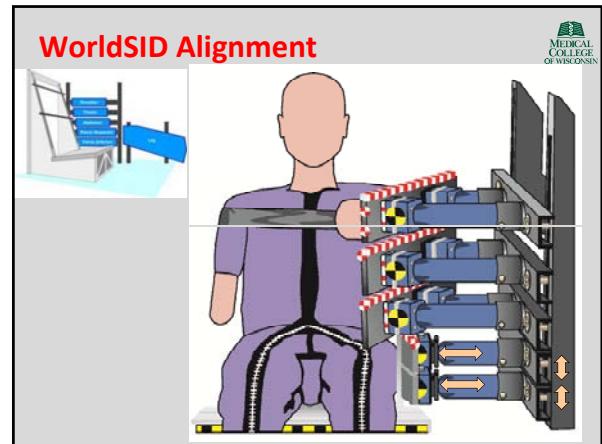
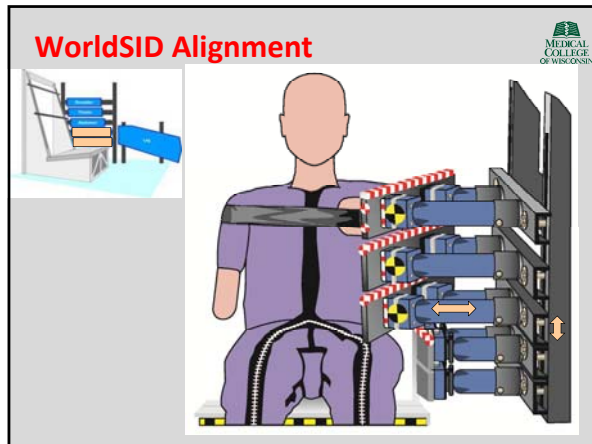


## WorldSID Alignment

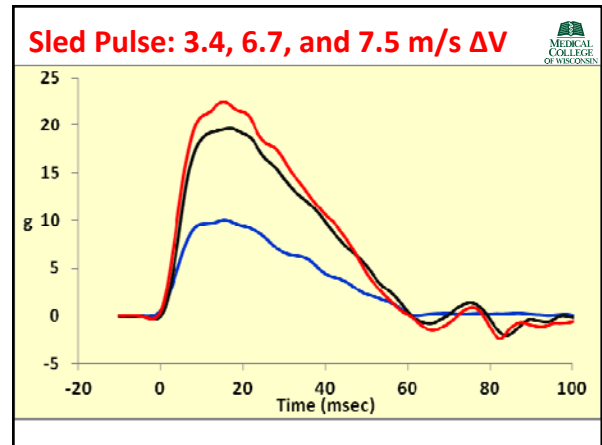


## WorldSID Alignment



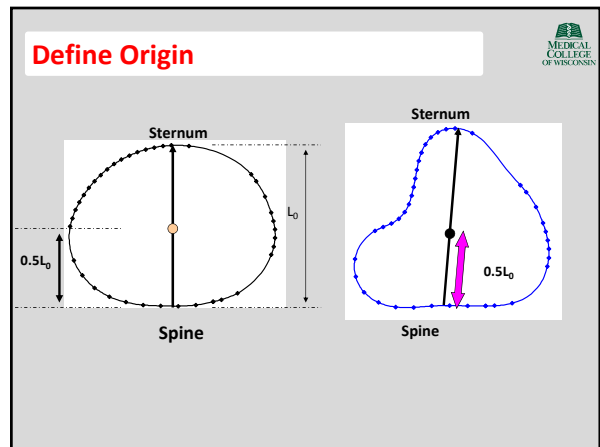
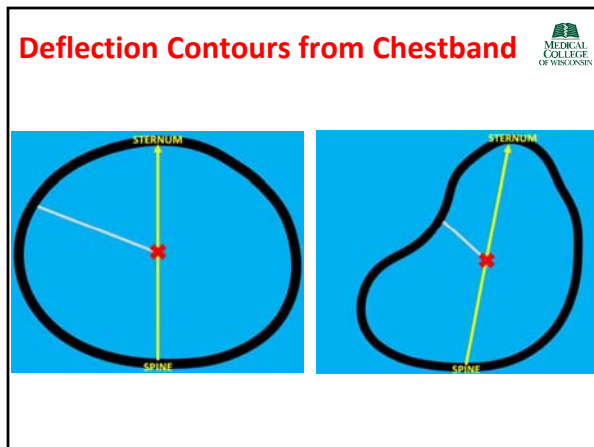
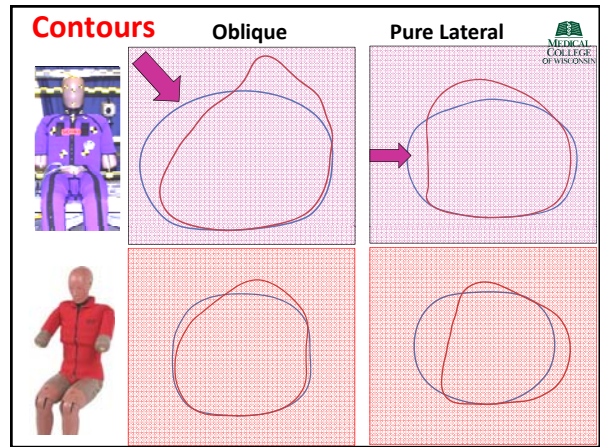
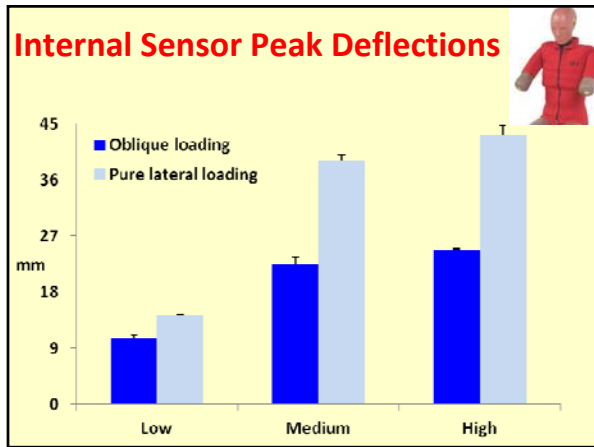
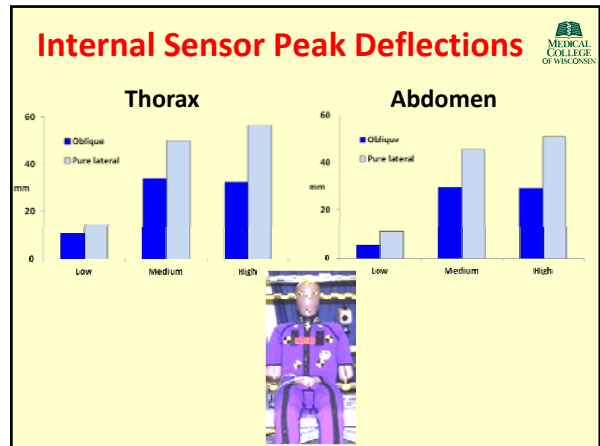
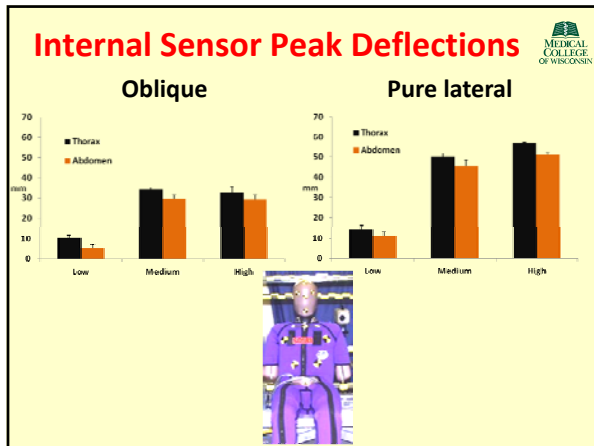


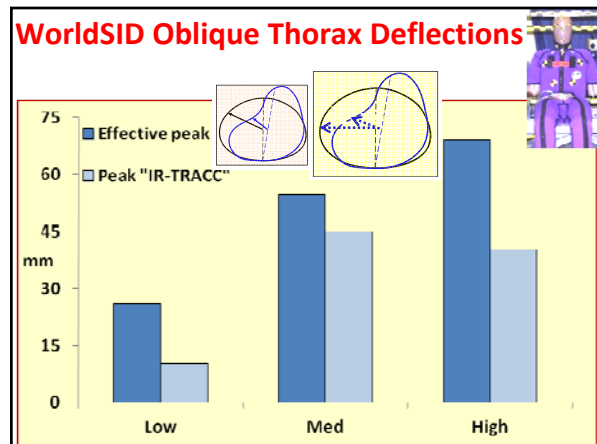
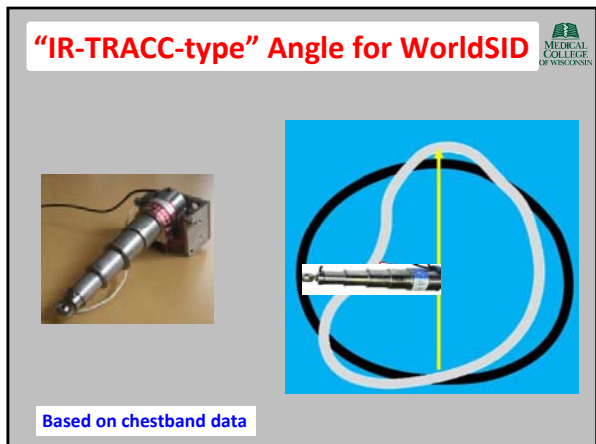
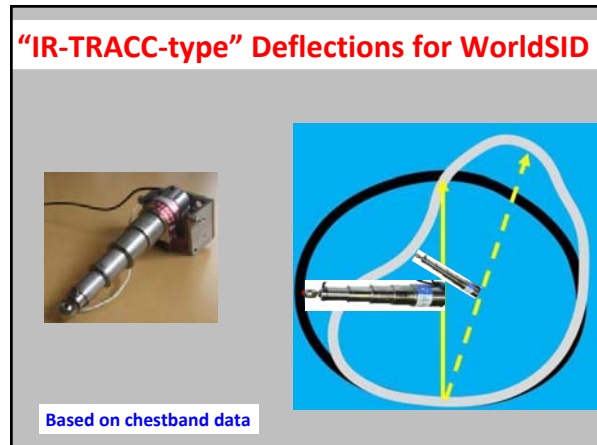
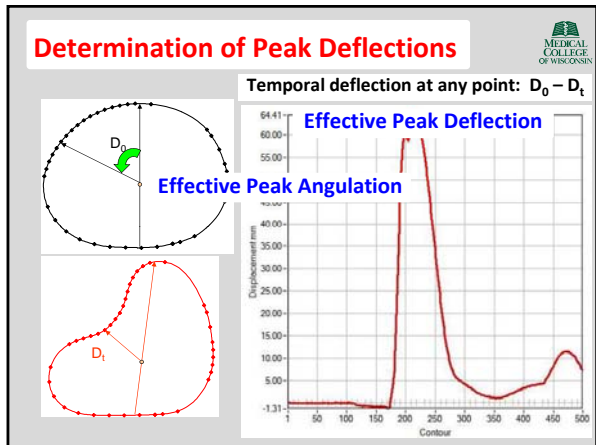
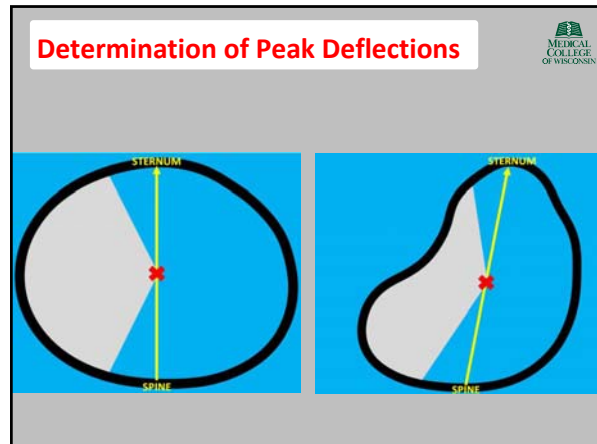
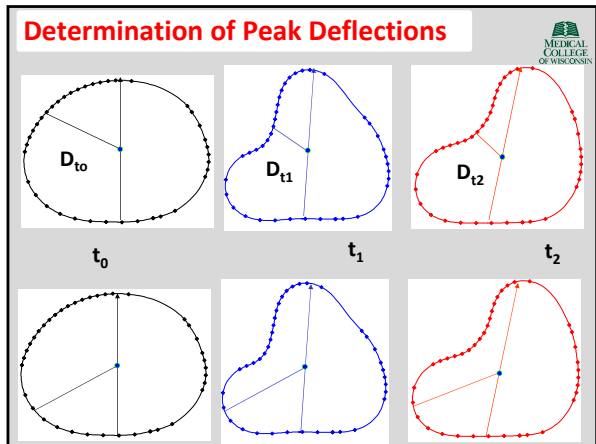
- ### Test Matrix and instrumentation
- Velocities: 3.3, 6.7, and 7.5 m/s
  - WorldSID, ES2-re, & PMHS tests
  - Repeated testing protocol used
  - Triaxial load cells: STAPP plates
  - Thorax & abdomen chestbands
  - Region-specific ATD deflections
  - Oblique and pure lateral output

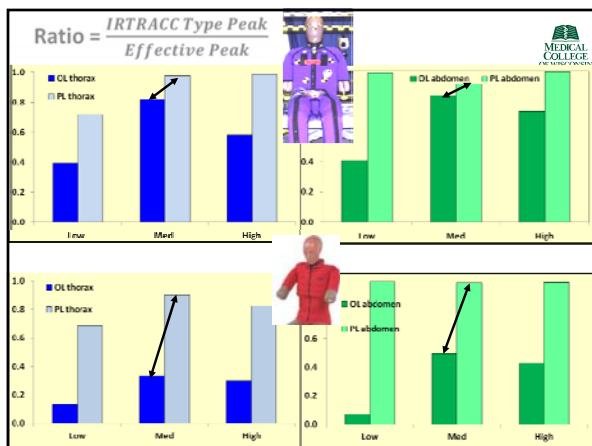
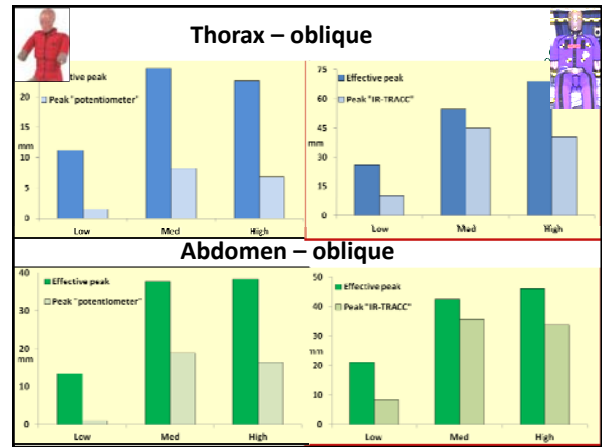
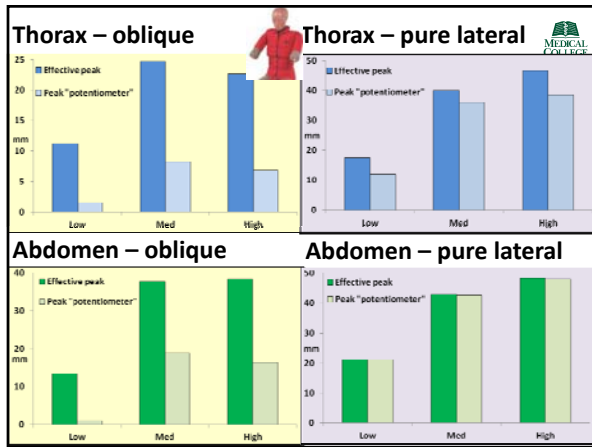
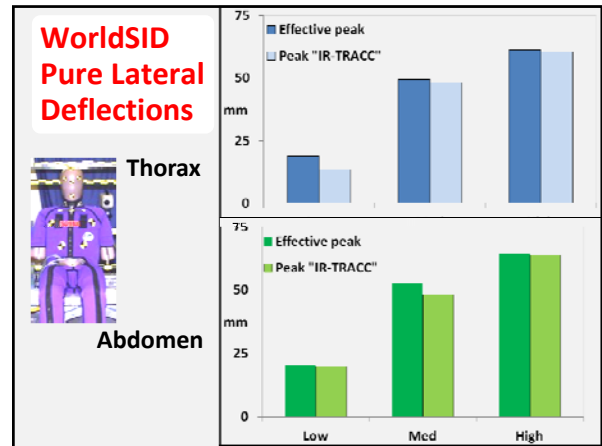
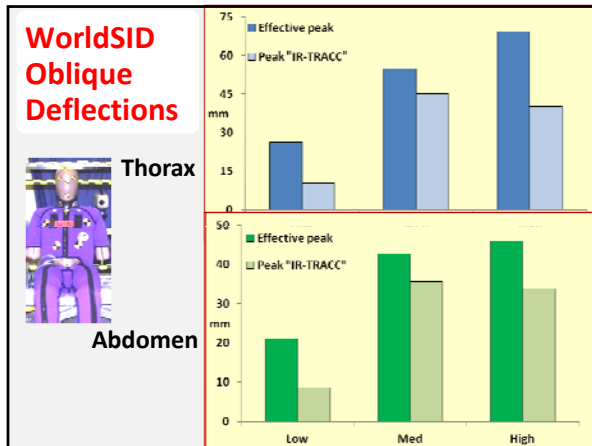


- ### Results: Chestband-based Data
- Effective peak deflections
  - Effective peak angulations
  - “IR-TRACC-type” peak deflections
  - “Potentiometer-type” deflections
  - Thoracic and abdominal regions
- 
- The graph shows chestband-based data for thoracic and abdominal regions. The x-axis represents time in msec, and the y-axis represents deflection. The data shows a series of peaks and troughs, indicating the deflection of the chestbands over time.

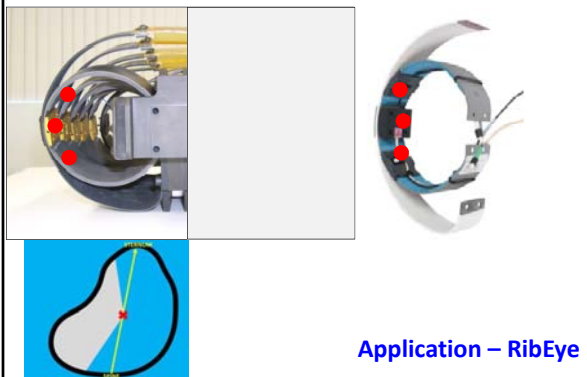
- ### Results: Sensor-based Data
- The thoracic and abdominal regions
  - Peak deflections from five IR-TRACC
  - Peak deflections from potentiometers
- 
- The images show sensor-based data for thoracic and abdominal regions. The left image shows a mannequin with sensors attached to the chest and abdomen. The middle image shows a close-up of a sensor. The right image shows a close-up of a potentiometer.



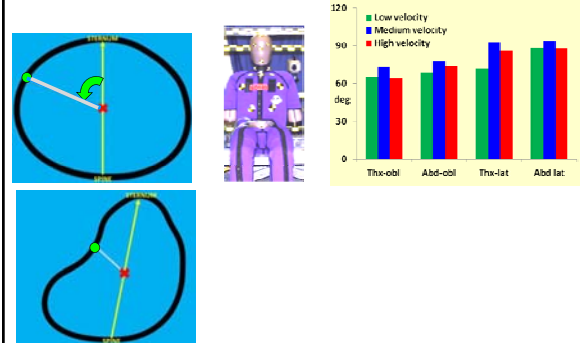




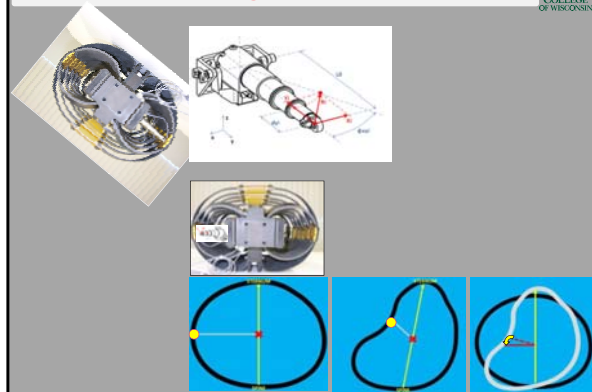
## Multipoint Sensing – Chestband Data



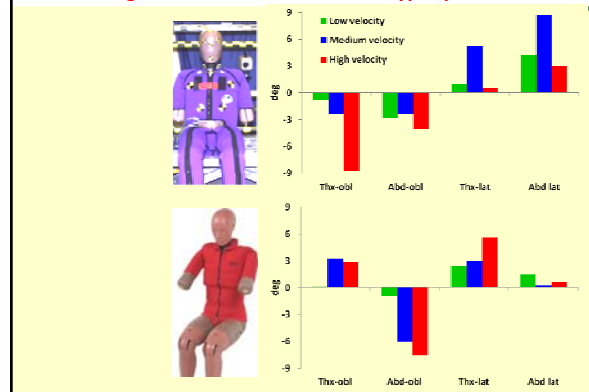
## Effective angulations from effective peak chest deflections



## 2D-IR-TRACC: Angular Measurements



## Effective angulations from "2D-IR-TRACC-type" peak deflections



## Summary



- **Region-specific responses**
  - Both ATD: effective in sensing the pure lateral loads
  - Both ATD: peak deflections in oblique < pure lateral
  - WorldSID better sensed oblique loading than ES2-re
  - WorldSID suitable both oblique/pure lateral impacts
- **Current 1D IR-TRACC sensor location**
  - Replicates pure lateral response well
  - Less than optimal for oblique loading
- **2D IR-TRACC use and implications**
- **Optical sensors may also be used**
- **Injury criteria for oblique loading**

## Thank You



### Acknowledgement

This research was supported in part by  
US DOT NHTSA Cooperative Agreement

DTNH22-07-H-00173