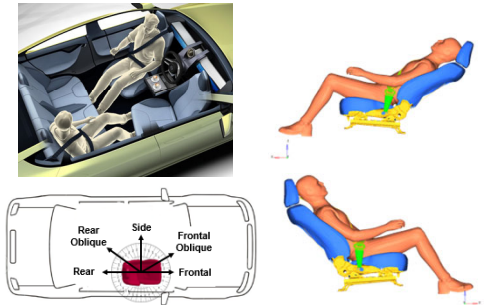


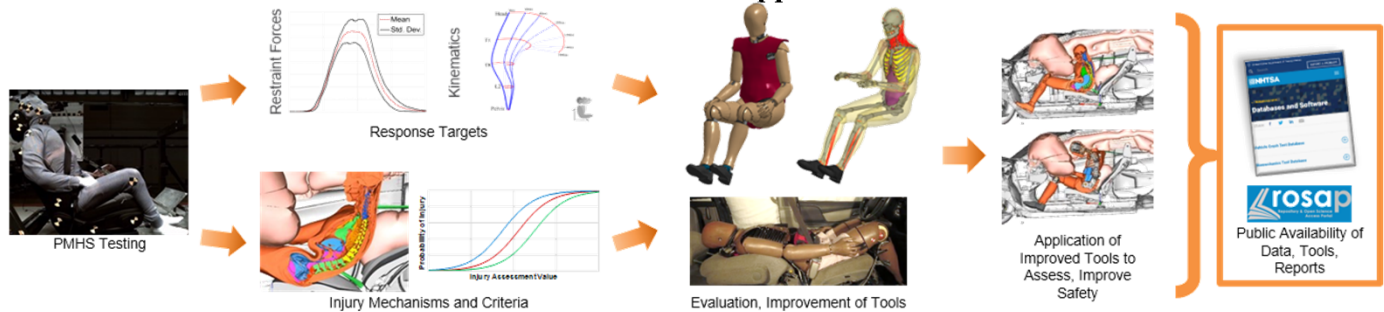
# Crashworthiness of Vehicles with Automated Driving Systems

Crashworthiness tool development/evaluation for non-traditional seating configurations

- NHTSA is investigating existing computational models and crash test dummies in the most likely scenarios: reclined seating for both forward and rear-facing occupants for different impact severities
- Biofidelity of tools to be modified as needed to provide optimal injury risk assessment given new post-mortem human surrogate (PMHS)-based biomechanical data
- NHTSA sponsoring three research projects to generate new biomechanical data:
  - (1) rear-facing, (2) forward-facing, and (3) forward-facing for occupants vulnerable to submarining/abdominal injury.



## NHTSA's Research Approach



### Rear Facing Reclined

#### Test Configuration

- Fixed seatback for repeatability
  - 2018 Honda Odyssey 2nd Row
- Instrumented to measure seat forces
- Adjustable recline angle & PDOF
- Allows for production seats & restraints

#### PMHS, 25° Seatback



#### Test Matrix

- 15 PMHS tests
- Delta V: 24 km/h or 56 km/h
- Seatback Angle: 25° or 45°

#### Key Outputs

- Data from PMHS tests
- Biofidelity corridors
- Injury assessment

#### Matched-pair ATD tests

- THOR-50M
- Hybrid III 50th
- BioRID
- LODC

#### PMHS, 45° Seatback



#### THOR-50M, 45° Seatback



### Forward Facing Reclined

#### Phase I: 50<sup>th</sup> Percentile Male

#### Inclusion Criteria

- Age  $\geq 18$  years
- $170 \leq \text{Height} \leq 181$  cm
- $18.5 \leq \text{BMI} \leq 30$  kg/m<sup>2</sup>

#### Test Configuration

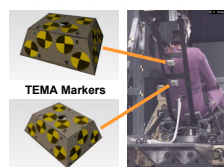
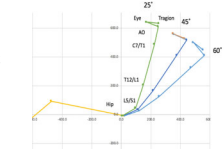
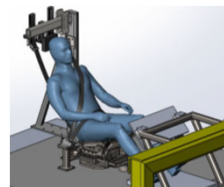
- Adjustable, open seatback
- Adjustable, padded knee bolster
- Spring-controlled seat

#### Test Matrix

- 24 PMHS tests
- Delta V: 32 km/h or 56 km/h
- Seatback Angle: 25° or 45°
- Restraints: force-limited belt with knee bolster out of contact

#### Key Outputs

- Data from PMHS tests
- Data from ATD tests
- Biofidelity corridors
- Injury assessment



### Forward Facing Reclined

#### Phase II: Vulnerable Occupant

#### Inclusion Criteria

- Obese
  - Male or female
  - BMI  $\geq 30$  kg/m<sup>2</sup>
- Small Female
  - $143 \leq \text{Height} \leq 157$  cm
  - $38 \leq \text{Weight} \leq 62$  kg

#### Test Configuration

- Adjustable, open seatback
- Adjustable, padded knee bolster
- Spring-controlled seat

#### Test Matrix

- 24 PMHS tests
  - 12 obese, 12 small female
- Delta V: 15 km/h and 56 km/h
- Seatback Angle: 25° or 45°
- Restraints: force-limited belt with knee bolster out of contact

#### Key Outputs

- Data from PMHS tests
- Data from ATD tests
- Biofidelity corridors
- Injury assessment

