Development of Dummy-Based Rotational Brain Injury Criterion
Brain Injury Research

- Data Driven Research
  - CIREN, NASS
- The SIMon Process
- Dummy-Based Procedure
Data Driven Research: NASS

Risk of AIS 3+ Injury (%)

- Head
- Face
- Neck
- Thorax
- Abdomen
- Spine
- UE
- LE
- Unspec

Rollover, Frontal, Side, Rear

CIREN Case Example of Brain Injury

- Case vehicle DV = 20 mph (32 kmph)
- Max crush = 39 cm.
- Max intrusion = 7.9 in. (20 cm.) at right roof rail
- PDOF = 20 degrees
- Adult Male Right Front Passenger
Clinical Evidence

- Brain injury expands from initial contact
  - Diffuse hemorrhage and axonal injury
    - Intracerebral
    - Corpus collosum
    - Brainstem
The SIMon Process

- NHTSA has been working on a brain injury prediction tool for several years called SIMon
  - Published at 2003 and 2008 Stapp Car Crash Conferences
- SIMon stands for Simulated Injury Monitor
- It takes as an input head kinematic measurements from a test dummy or a simulation (linear and angular accelerations or velocities) and calculates/outputs potential for most common brain injuries
- It utilizes finite element modeling technology to carry out the calculations
New SIMon FE Head Model (coarse version): NDT data (Hardy et. al, 2002)
New SIMon FE Head Model (coarse version): NDT validation

![Displacement vs Time Graph](Figure B3. 383-T1-A6x)
Most Common TBI in MVC - Biomechanical Equivalents

- Cumulative Strain Damage Measure (CDSM) for DAI
- Dilatational Damage measure (DDM) for Focal injuries/Contusions
- Relative Motion Damage Measure for ASDH
- Maximum Principal Stress and Strain, Product of strain and strain rate, etc.

Takhounts et al., 2003
Correlation to Injuries from Animal Studies (CSDM)

CSDM (0.25) = 0.54
Side Impact Tests Evaluation - HIC

HIC15 = 668

HIC15 = 225