Characteristics of the Injury Environment in Far-side Crashes

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Va Tech

Outline

- The Joint US/Australian Far-side Research Project
- Progress to Define the Crash Environment

Joint US/Australian Project – Research Objectives

- To obtain a more detailed understanding of far-side crashes, injuries, and injury mechanisms
- To develop suitable test devices, procedures, and injury criteria
- To assess the benefits for a range of generic countermeasures to reduce far-side trauma
- To make all results publicly available

Joint US/Australian Project - Participants

- Monash University (lead agency)
- GW University
- Autoliv, AB
- Holden Australia
- Medical College of Wisconsin
- University of Miami School of Medicine
- Va. Tech & Wake Forrest
- Ford USA
- Wayne State University
- Australian Ministry of Transport

Project Funding & Timing

- Funding from
  - Australian Research Council
  - Ford USA
  - Holden, Australia
  - Autoliv, AB
  - In kind funding from all participants
- Research to be completed during 2007

Present Focus

- Far-side Planar Crashes
- No Rollover or Ejection
- Belted Occupants

- Annual Target US Population
  - With 76% Belt Use –
  - 2,224 MAIS 3+ and Fatal Injuries (MAIS 3+F)

Far-side Rollover – 208 Test Cart

The Target Population

- Target population –
  - Annual number of severe and fatal injuries that might be addressed by a countermeasure
- How well injuries are mitigated will depend on the countermeasure (and the vehicle test requirements)
- Data source – NASS/CDS 1993-2003 - annualzed

Annual MAIS 3+F from NASS in Near-side and Far-side Crashes

Crash Type/ Belt Use	Planar	Roll	Total
Far Belted	2,244	3,499	5,743
Far Unbelted	5,022	6,429	11,451
Far Total	7,265	9,929	17,194
Near Belted	7,620	3,652	11,272
Near Unbelted	7,006	5,695	12,700
Near Total	14,625	9,347	23,972
Near and Far Total	21,891	19,275	41,166
% Due to Far Side	33%	52%	42%

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Far-side Target

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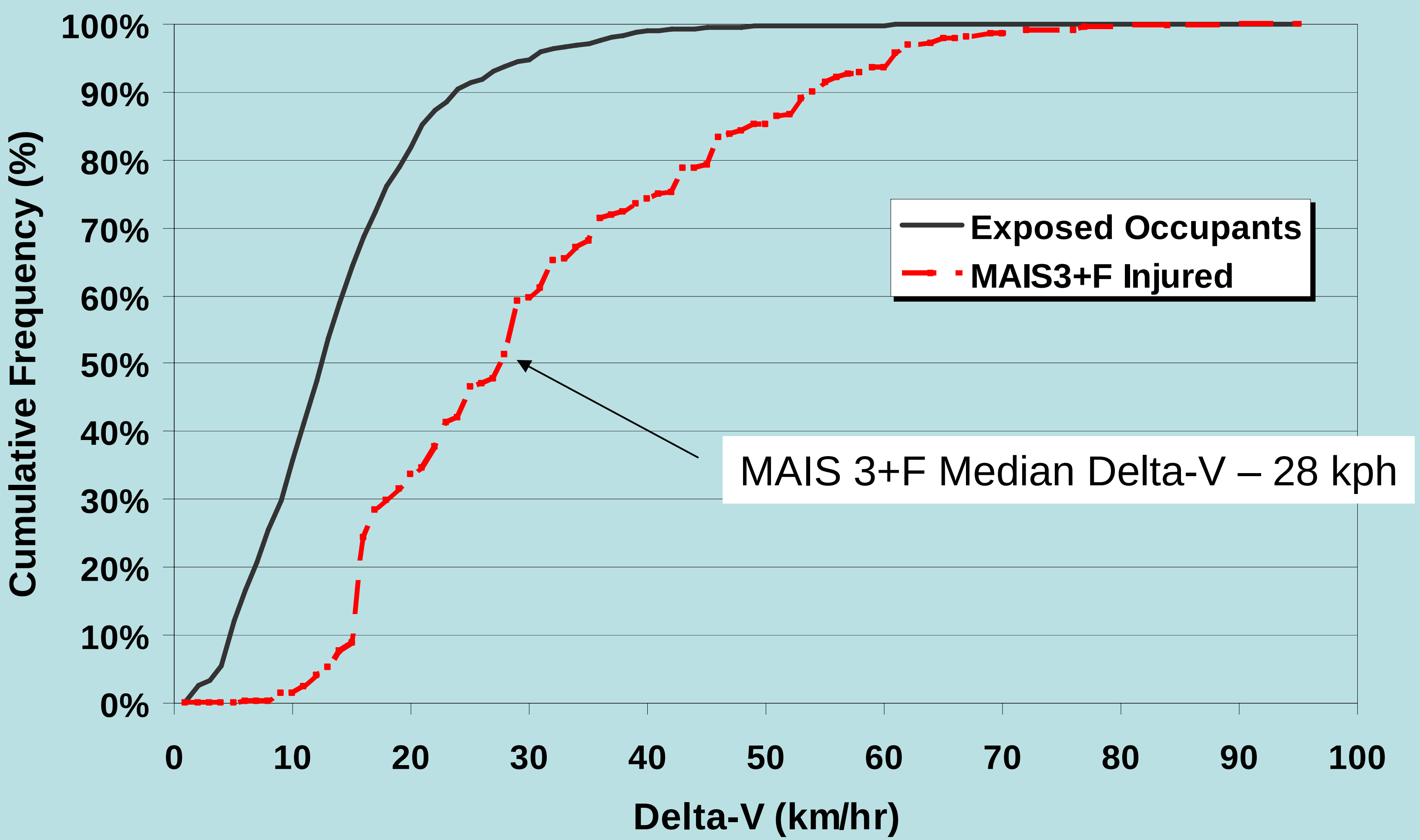
Far-side Target

214 Target

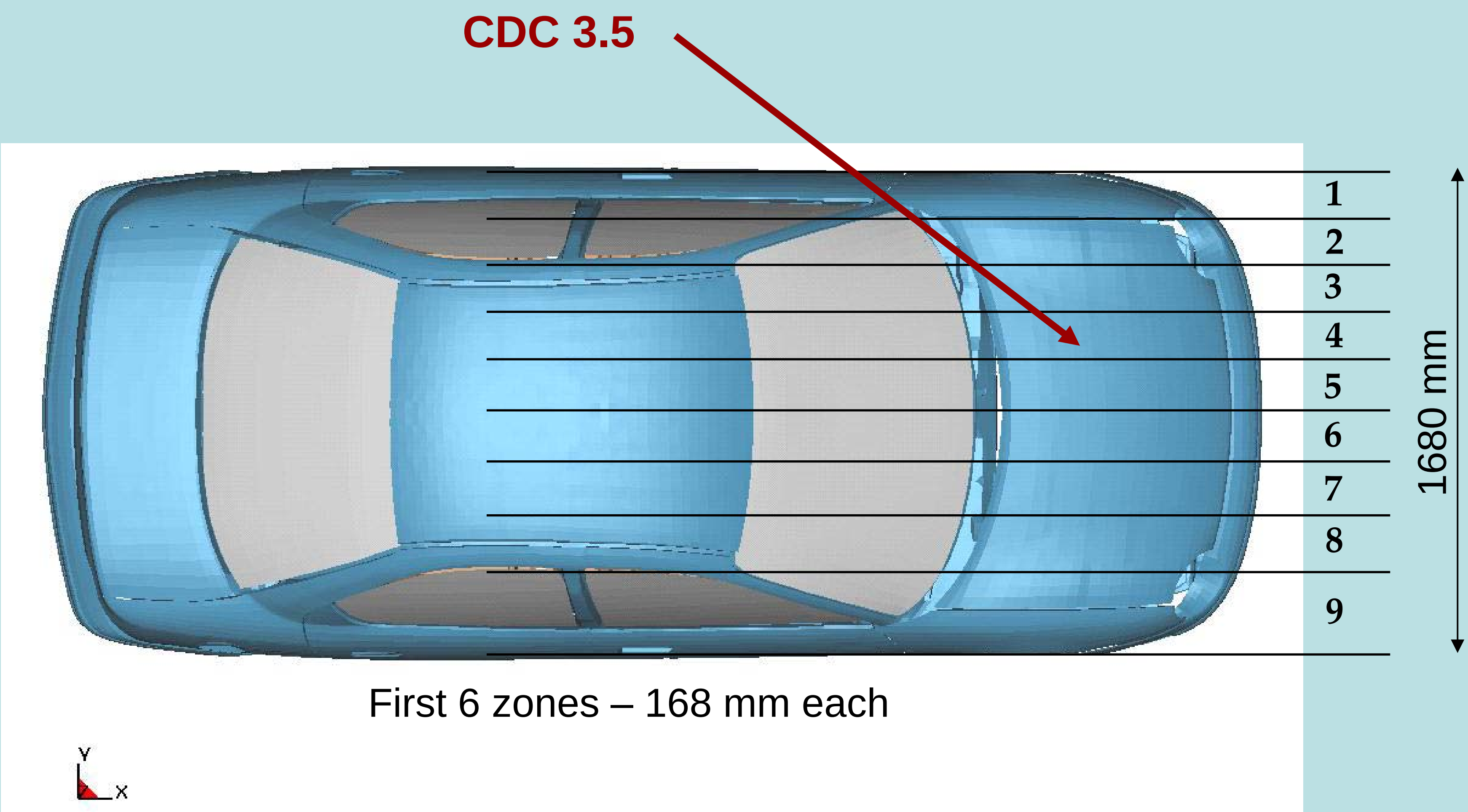
The First Step

- What is the crash environment for far-side belted front seat occupants in planar crashes?
- Harm distrubution published by Gabler SAE 2005-01-0287
- Selected MAIS 3+F distributions to follow

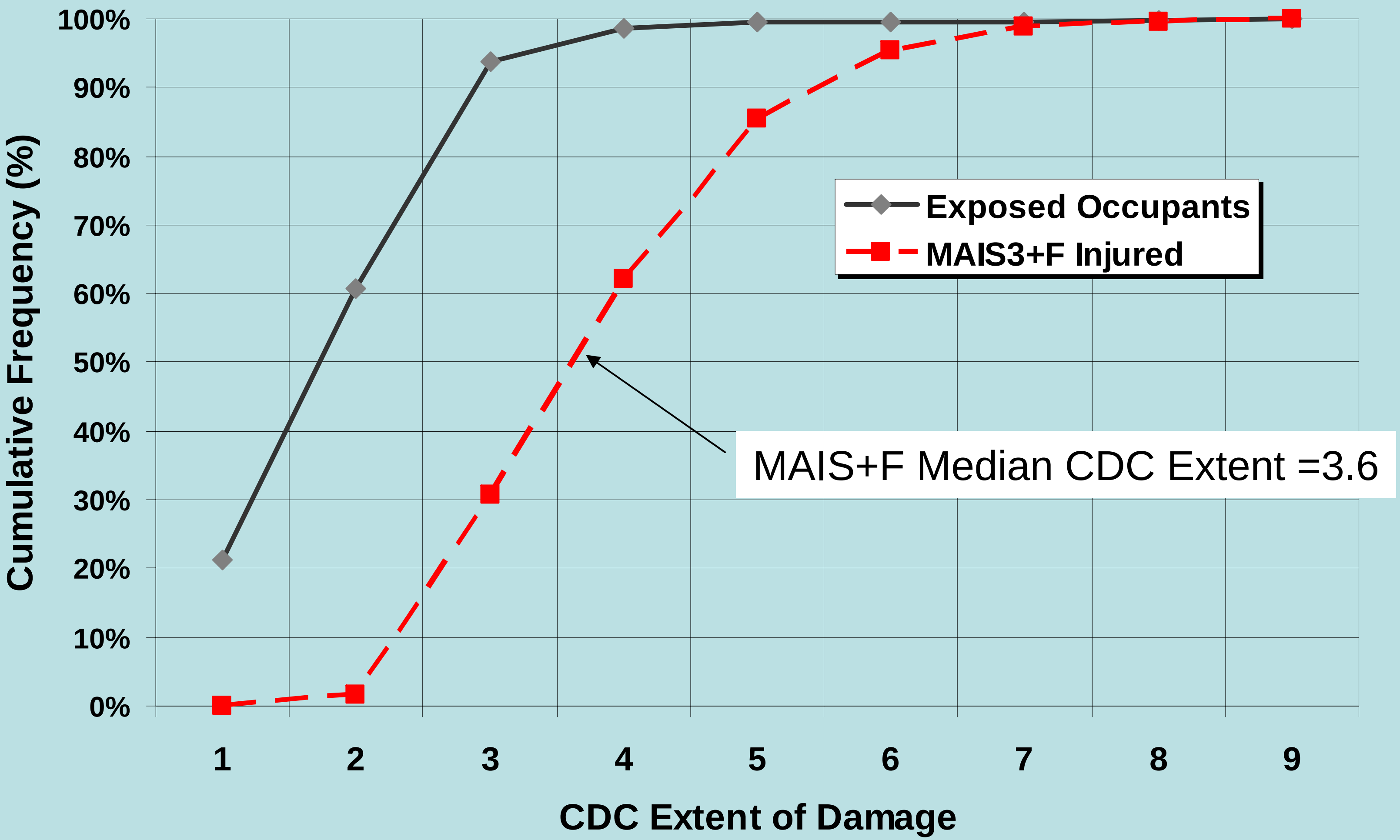
Far-side Crash Severity – Delta-V



CDC Zones for Small Car



Far-side Crash Severity – Damage



Other Crash Factors

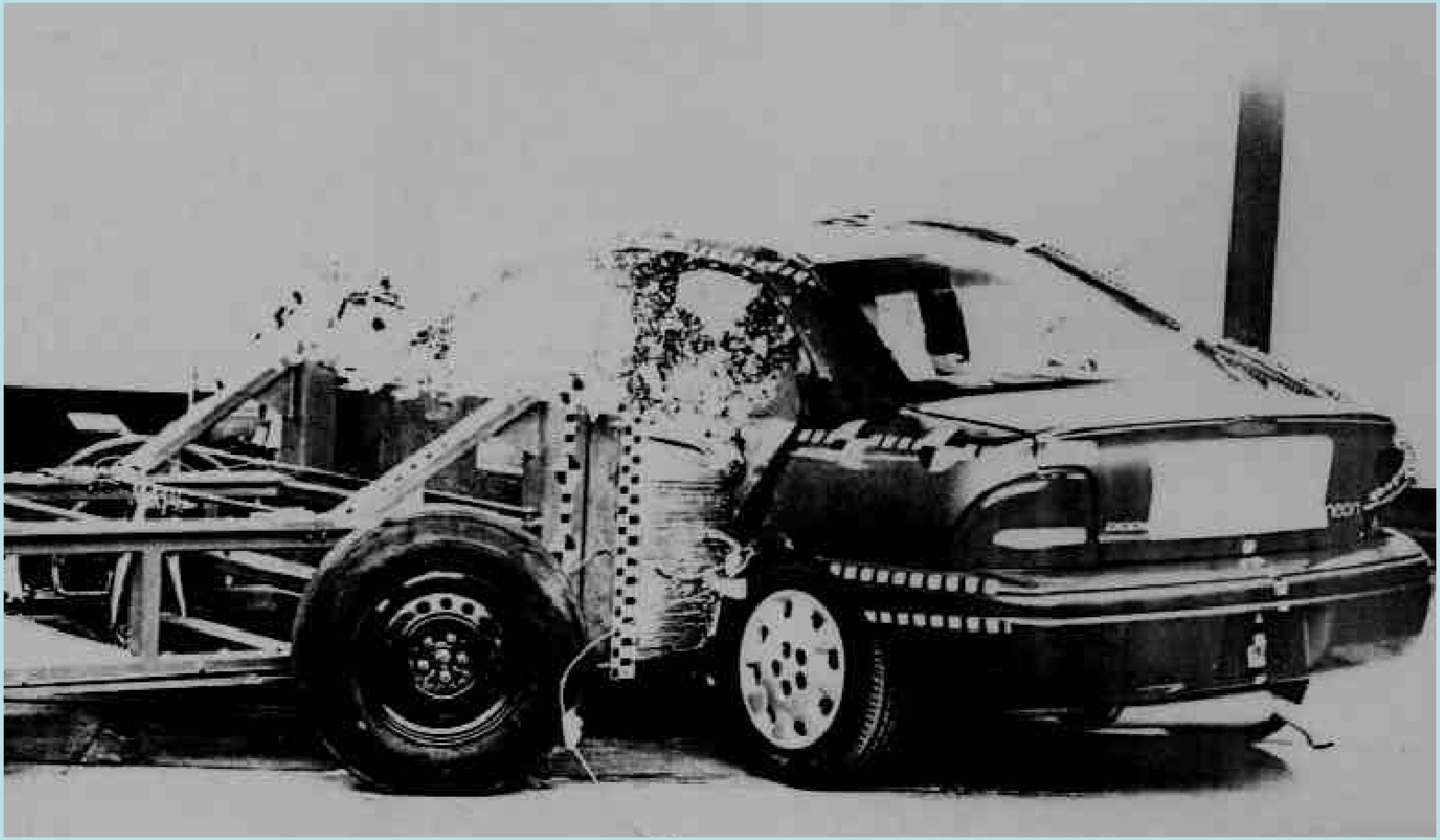
- Crash Direction:
  - 60% of MAIS 3+ at 60 degrees
  - 24% of MAIS 3+ at 90 degrees
- Body Region Injured:
  - 42% of MAIS 3+F Harm is to the **Head**
  - 41% of MAIS 3+F Harm is to the **Trunk**
- CCD Extent of Damage – 3.6
- Delta-V - 28 kph

Research Questions

- Which crash tests represent the far-side injury environment?
- What dummies are suitable for evaluating countermeasures?

- Evaluate available crash tests & apply computer models
  - FEM models of vehicle structure
  - MADYMO models of dummies

NHTSA 214 Barrier Side Test

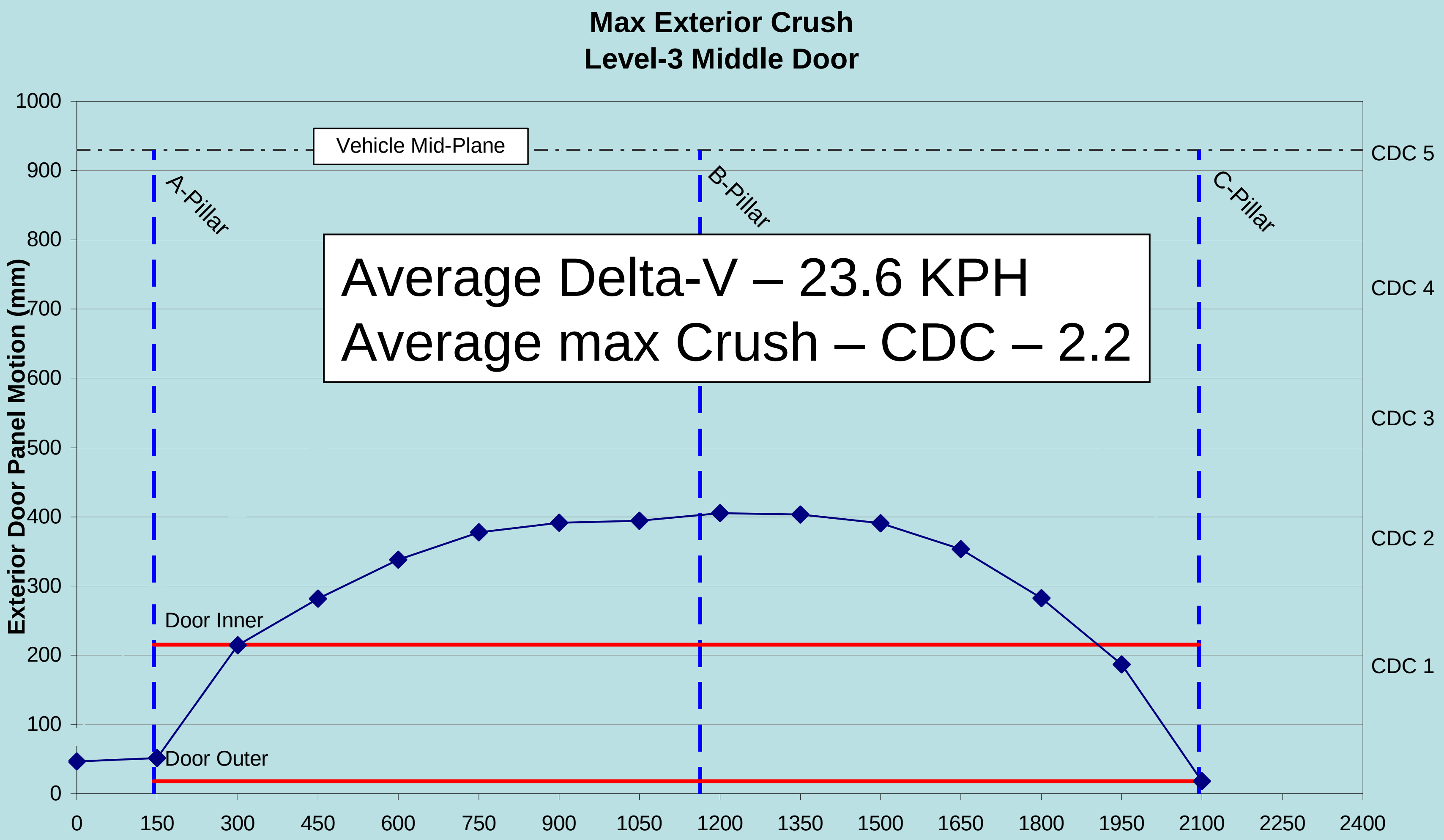


Vehicles Tested in Side Impact by IIHS – with IIHS Barrier

Honda Accord
Nissan Altima
Toyota Camry
Subaru Forester
Mitsubishi Galant
Saturn L series
Chevy Malibu
Mazda 6
Volvo S40
Saab 9-3
Hyundai Sonata
Dodge Stratus

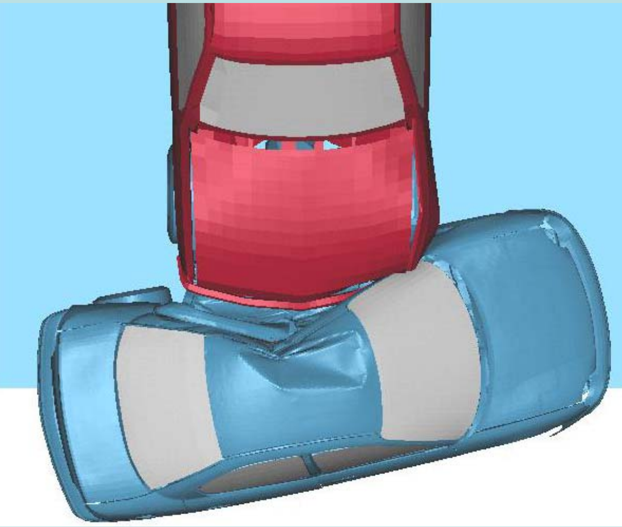
The crash pulse averaged for the 11 cars is displayed in the next slide

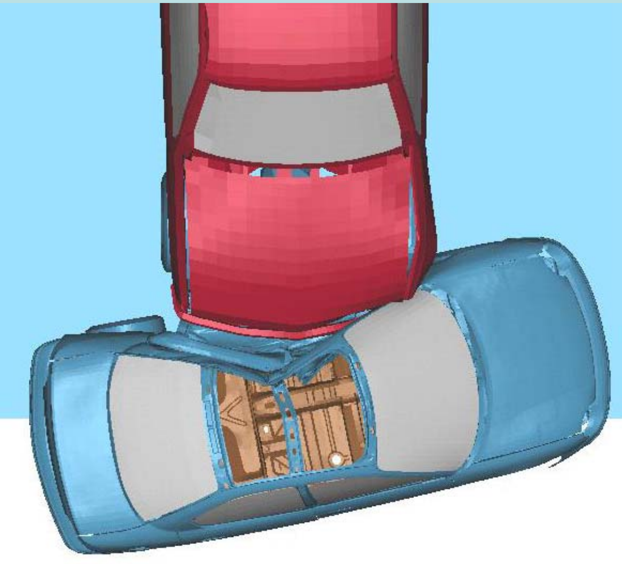
Extent of Damage in IIHS Side Impact Tests



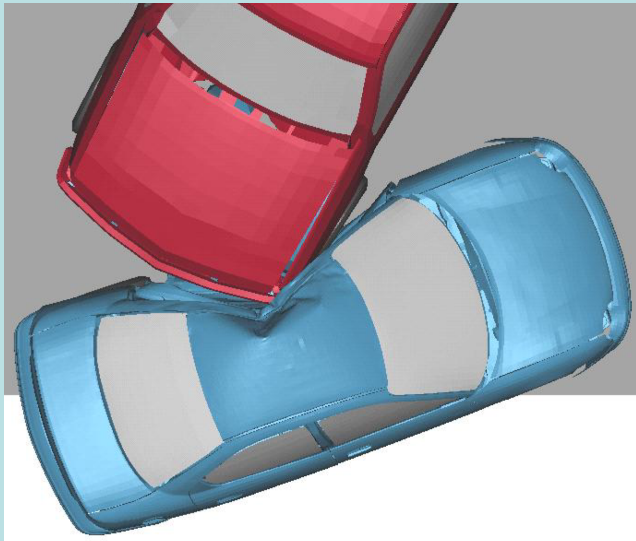
Average of 10 IIHS Tests

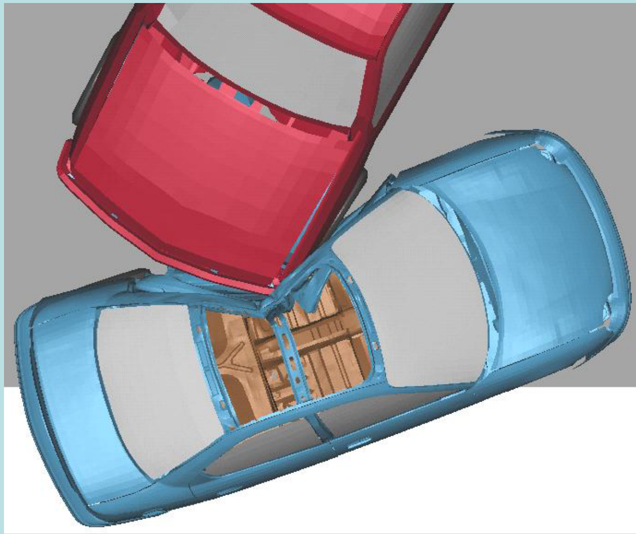
FEM Simulations of 60º & 90º Crashes





1500 Pickup
Into
Taurus

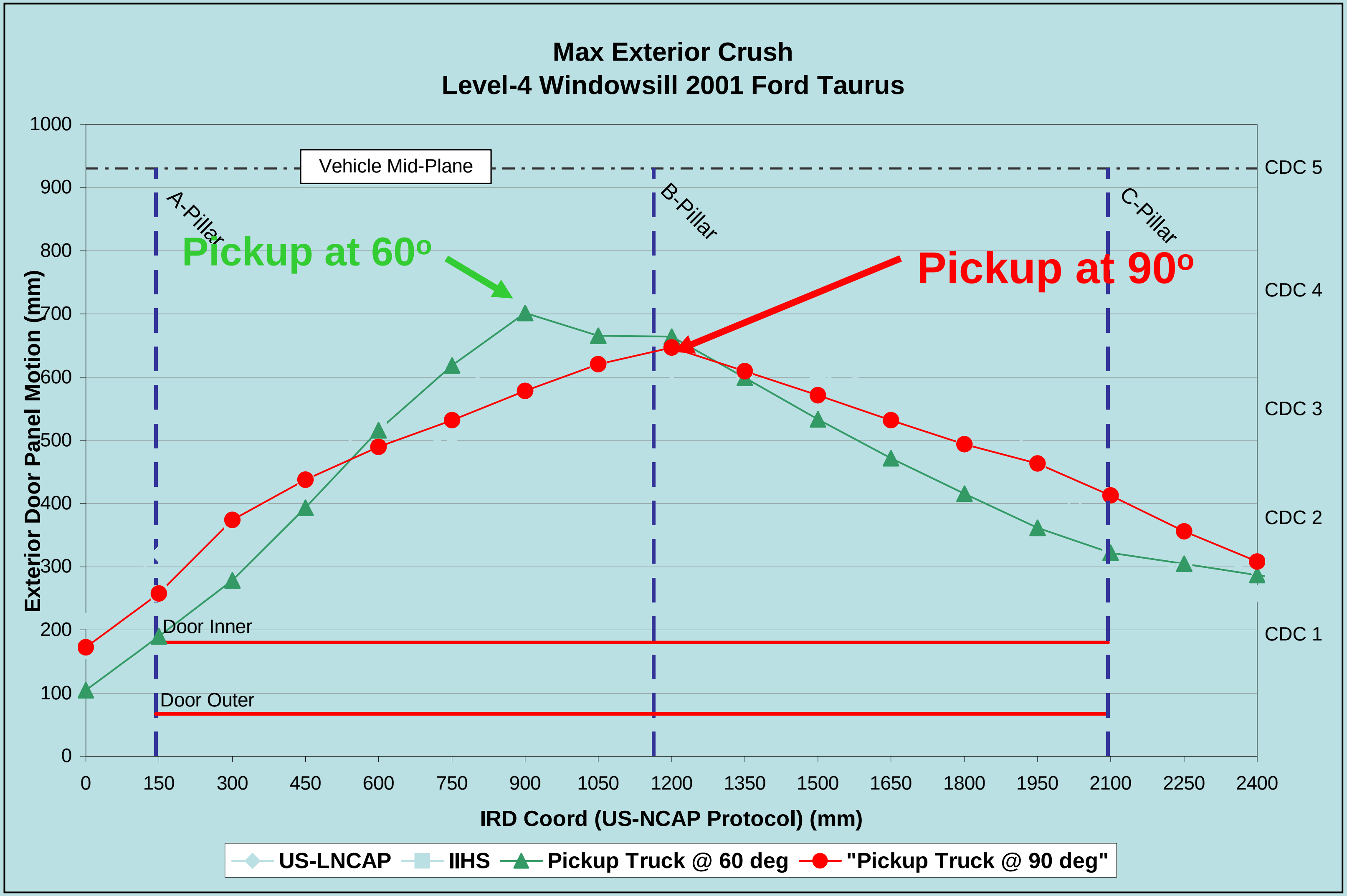




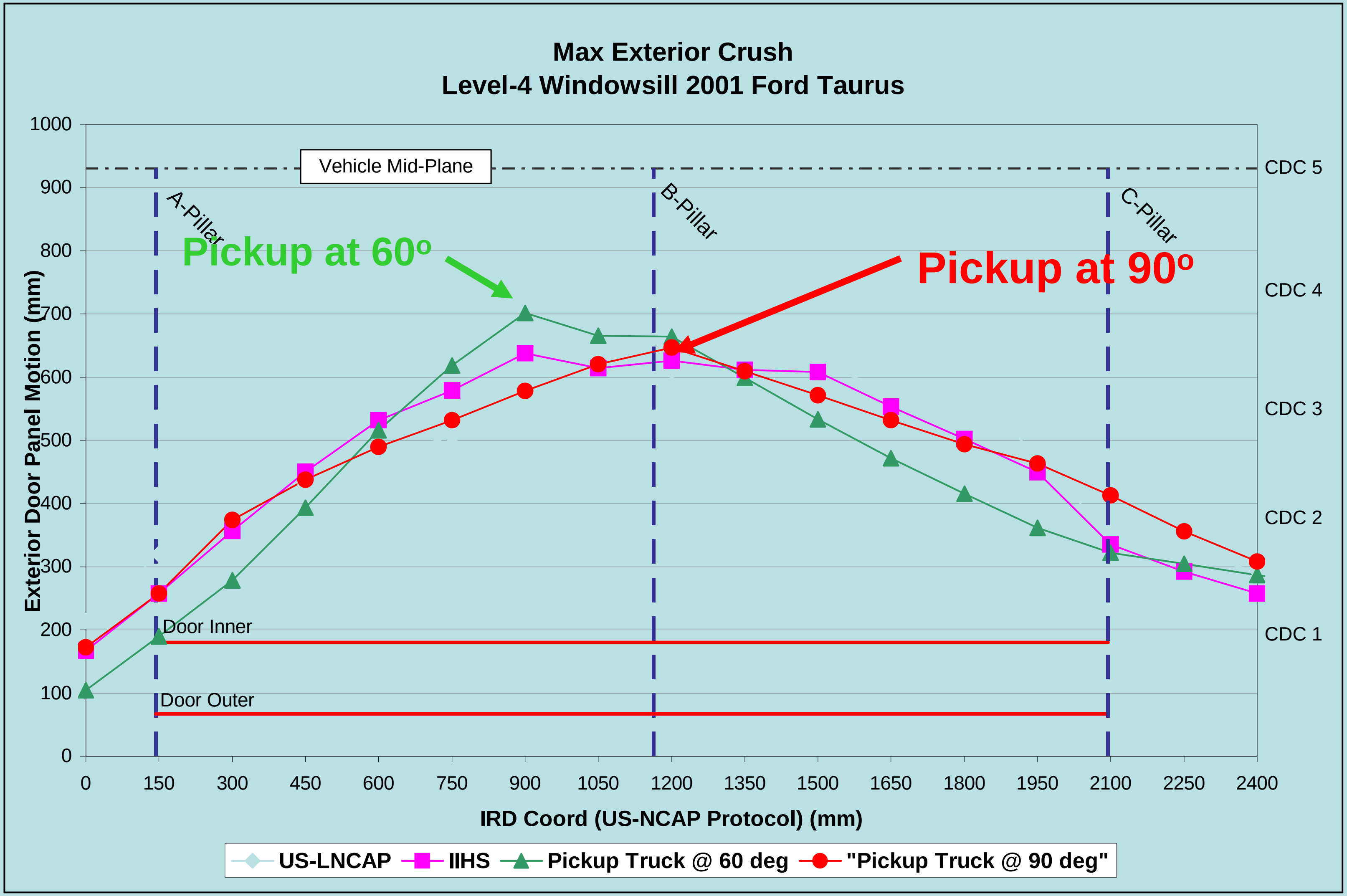
50% risk of MAIS 3+F
Delta-V ~ 28 kph
CDC ~ 3.6

90 deg 60 deg

FEM Simulations Delta-V 28 kph
Crush Profile at Window Sill



FEM Simulations Delta-V 28 kph Crush Profile at Window Sill



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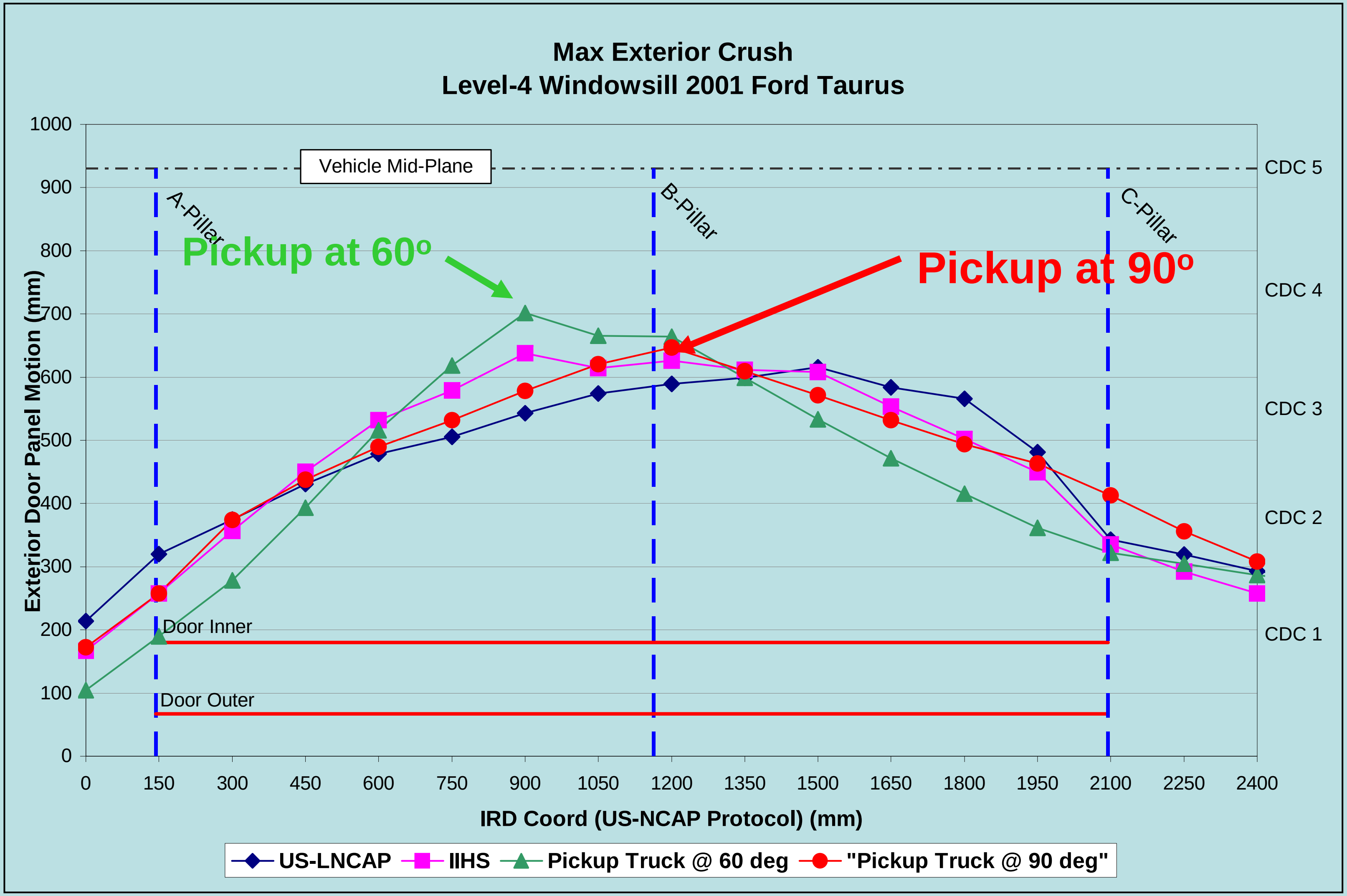


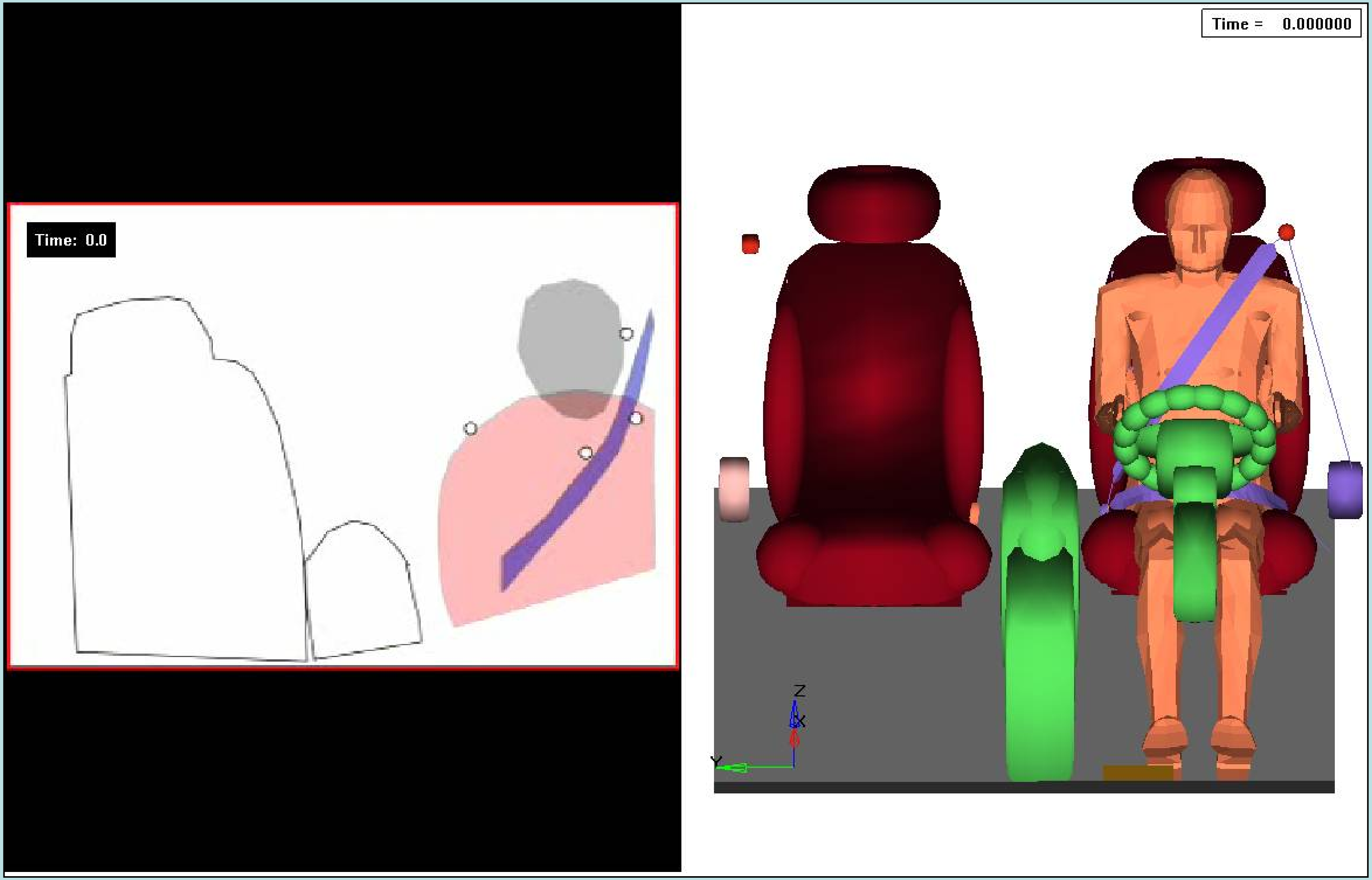
Observations

- Damage pattern produced by IIHS Barrier blends 60º and 90º pickup impacts
- Damage pattern produced by NHTSA barrier produces less front door damage at the same crash severity
- Crash test for far-side crashes should be at higher delta-V than 23.8 kph used by IIHS
- IIHS barrier appears to be the best test device

MADYMO Models of Dummies

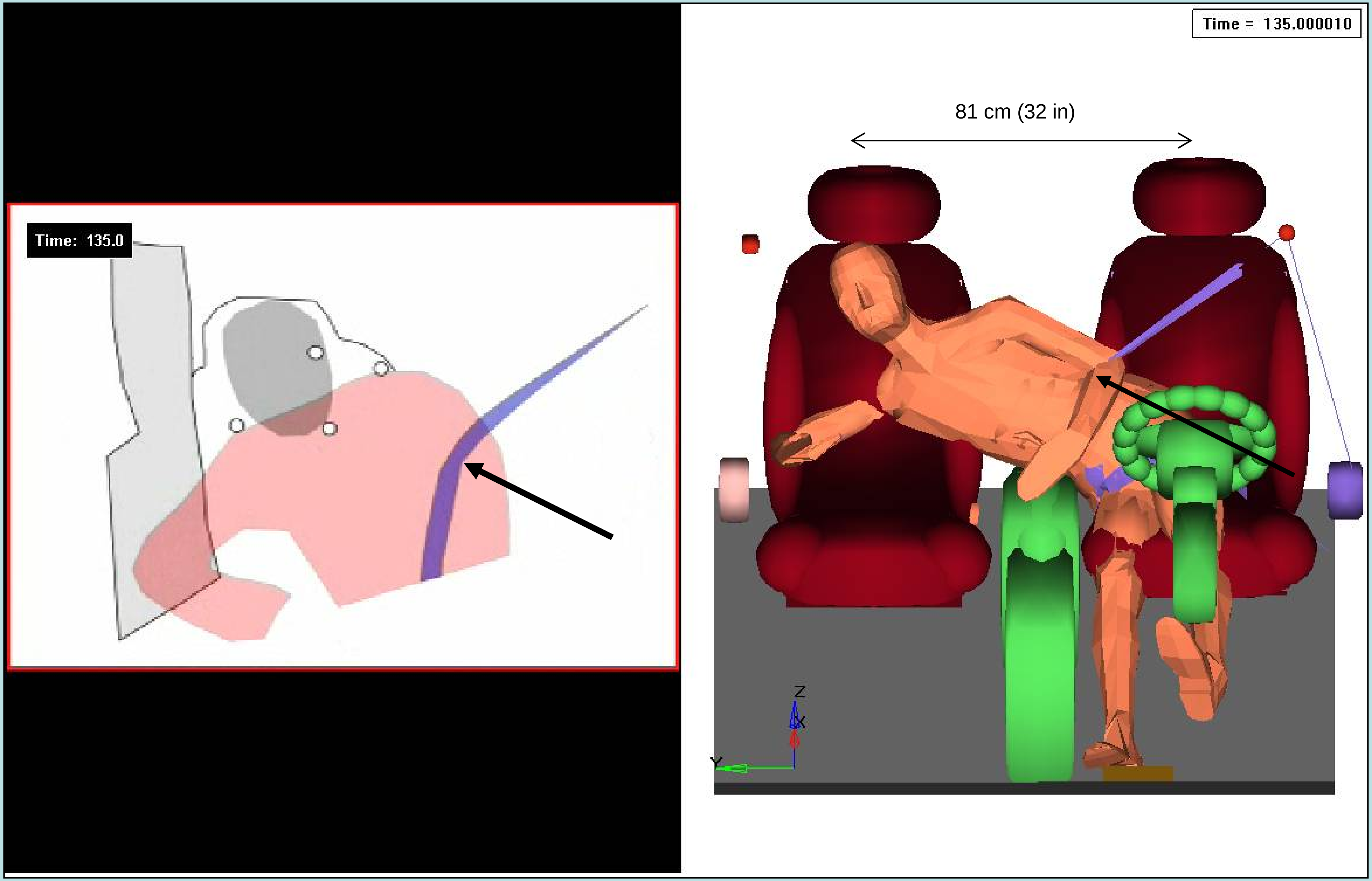
- Select the human facet model as baseline
- Validate human facet against human tests
- Examine performance of MADYMO dummies and compare with human facet model

Cadaver vs. Human MADYMO



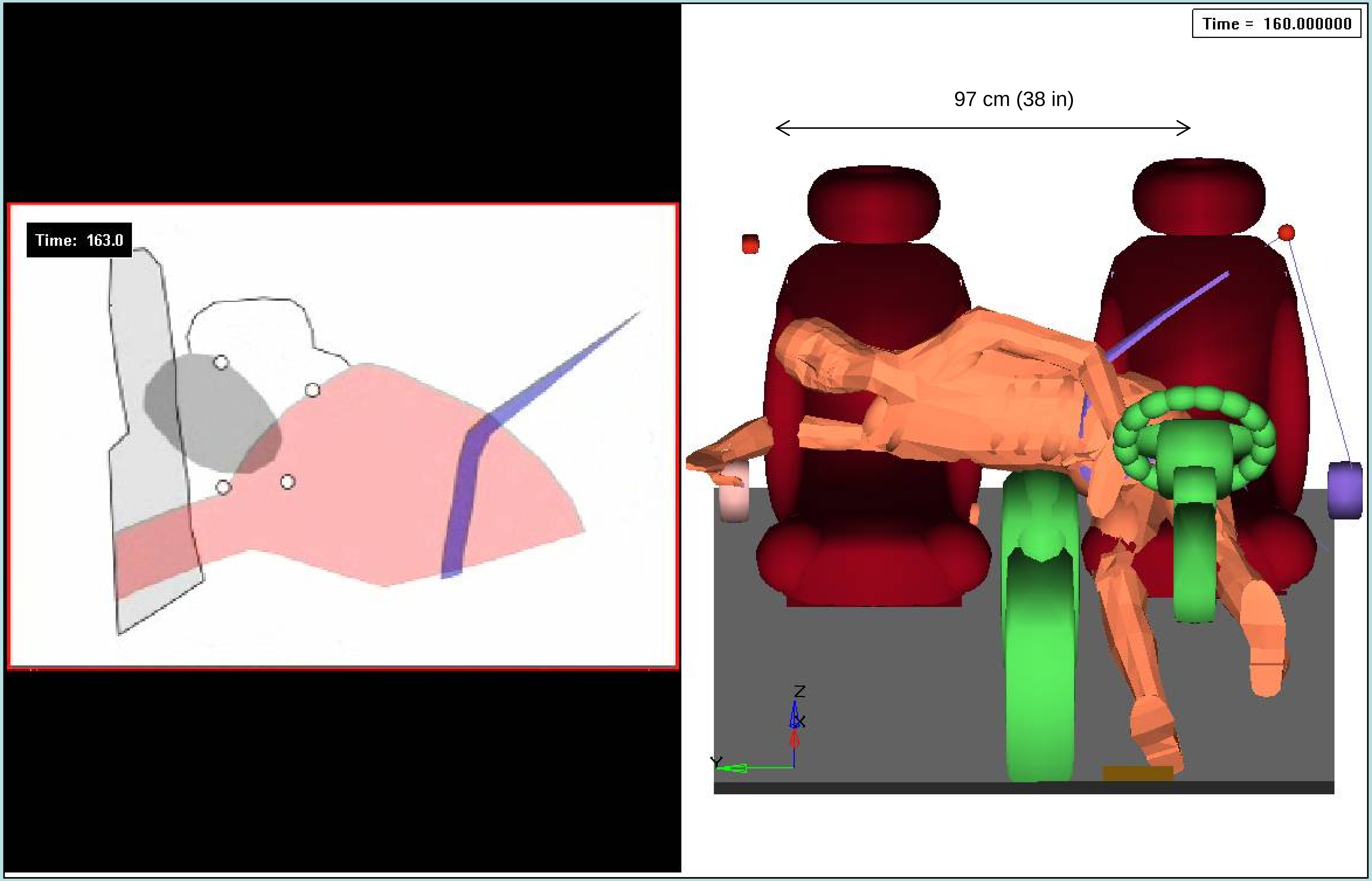
0 ms

Cadaver vs. Human MADYMO



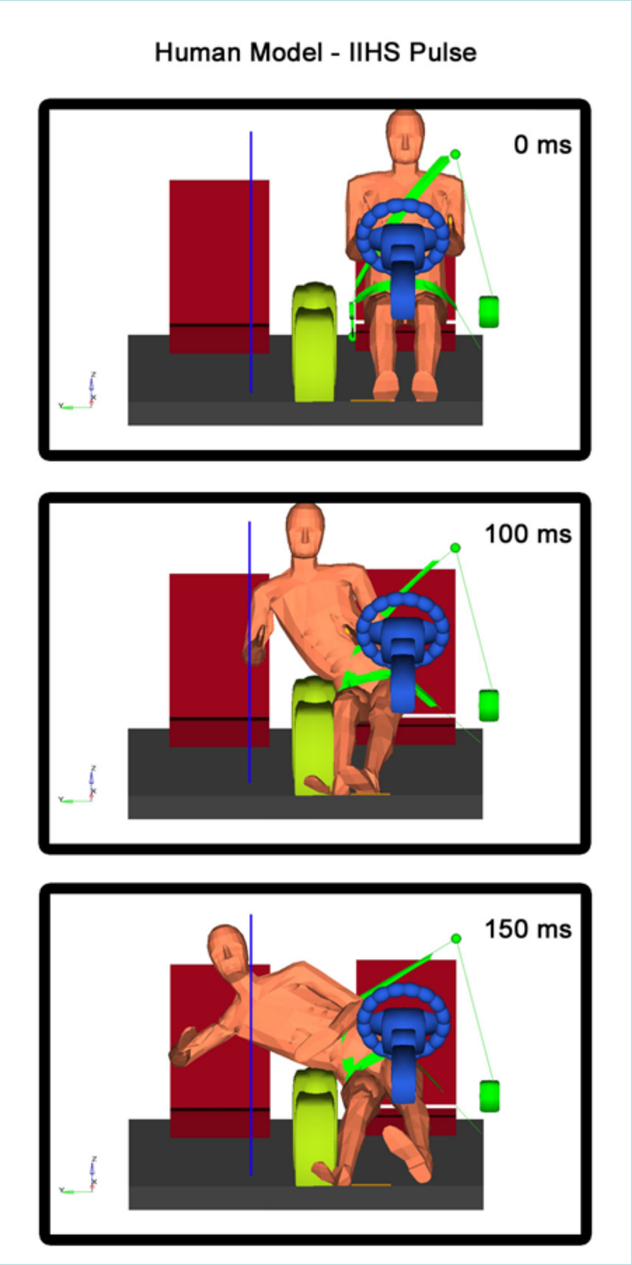
135 ms

Cadaver vs. Human MADYMO



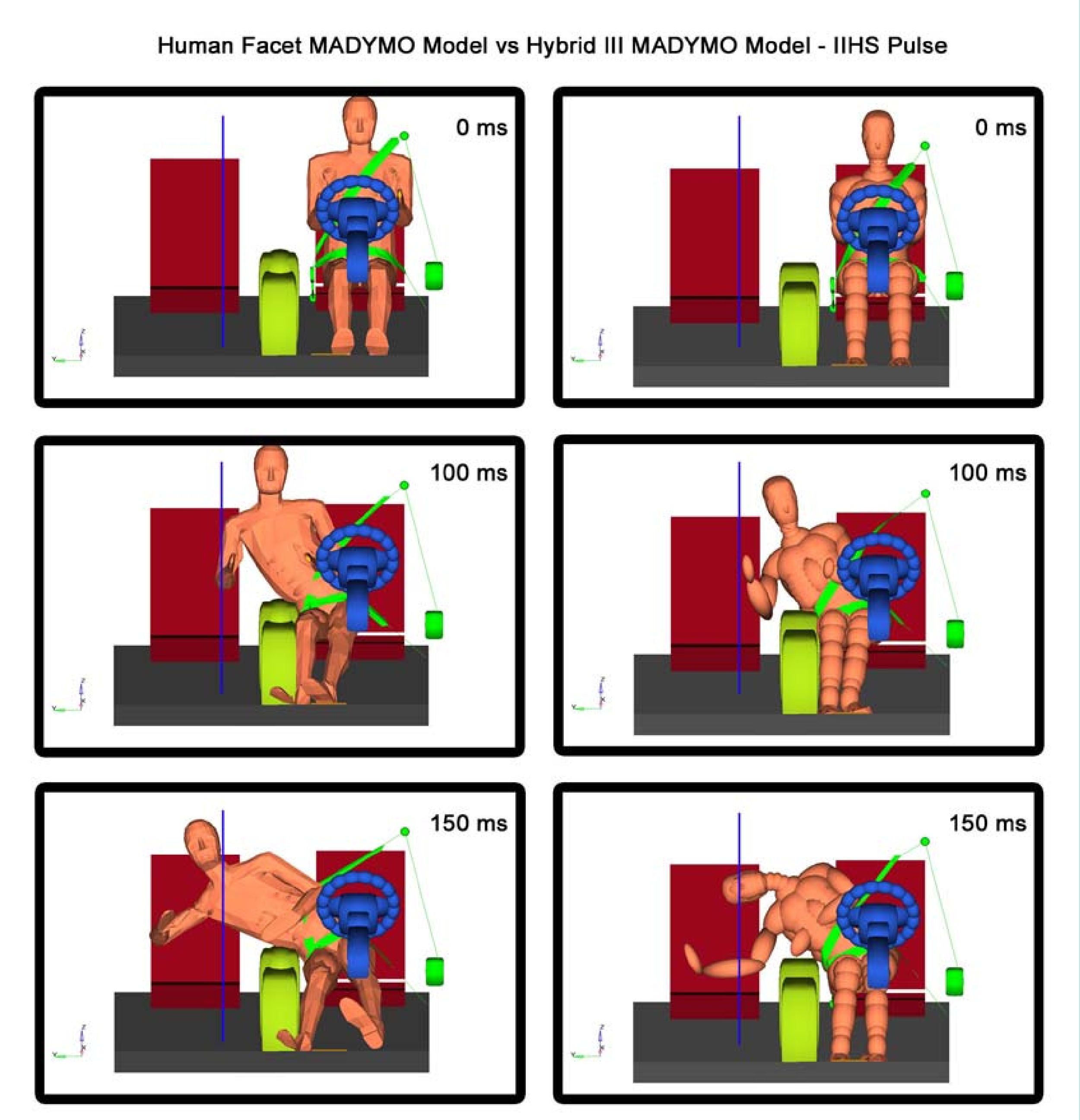
160 ms

MADYMO Human Model with 3.6 CDC Intrusion Displayed



Hybrid III
Dummy
vs
Human
Model

Side impact dummies were no better



Conclusions

Crash configuratrion for 50% far-side MAIS 3+F belted occupants in planar crashes

- Delta-V -28 kph
- Extent of Damage – 3.6 CDC
- Crash direction 60^{o} (60%)

- IIHS barrier at higher delta-V is best available test device
- MADYMO human facet model is good evaluation device
- Improved dummy needed

Conclusions

- Target MAIS 3+F population for far-side belted planar crashes - 2,244
- Target MAIS 3+F population for all far-side crashes - 17,194
- Target MAIS 3+F population for all near-side planar crashes - 14,625

Acknowledgement

The funding is provided in part by the Australian National Research Counsel with cost sharing and support from the other participants. Additional funding for this research has been provided by private parties, who have selected Dr. Kennerly Digges [and the FHWA/NHTSA National Crash Analysis Center at the George Washington University] to be an independent solicitor of and funder for research in motor vehicle safety, and to be one of the peer reviewers for the research projects and reports. Neither of the private parties have determined the allocation of funds or had any influence on the content.

Thanks to Colleagues

Dr. Brian Fildes of Monash University, Leader

- A. Linder, C. Douglas, T. Gibson; Monash U.
- B. Alonso, P. Mohan, R. Morgan; GWU
- F. Pintar, and N. Yoganandan; MCWisconsin
- S. Duma, and J. Stitzel; Va. Tech/Wake Forest
- C. Gabler; Va.Tech
- J. Augenstein; Miami Medical College
- O. Bostrom; Autoliv
- L. Sparke and S. Smith; Holden,
- C. Newland; DoT, Australia
- K. Yang; WSU
- S. Rohana; Ford

Questions