

# COMPARISON OF COMPUTER HUMANOID SIMULATION & PRACTICAL FORENSIC PEDESTRIAN DUMMY TESTING

Alan V Thomas

Director – Research & Consultancy

CAVT Ltd

Loughborough, UK

5<sup>TH</sup> SIMBIO-M

18-19 June 2018, Stratford on Avon





# INTRODUCTION

Two unrelated activities compared

CAE Simulations of Car/Pedestrian Impact

1996-2002

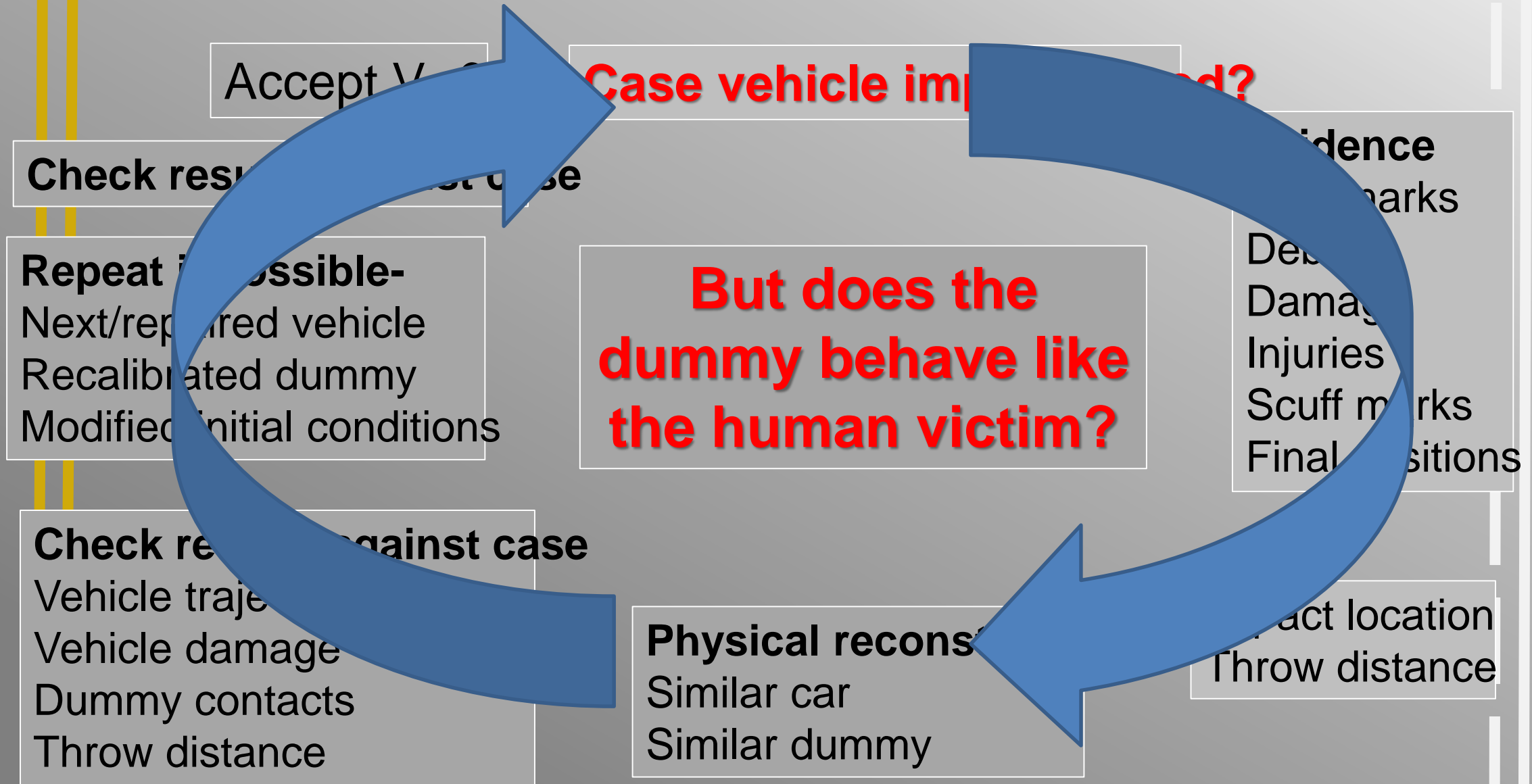
Police Accident Case Reconstruction 2012-3

Dummy Demonstration June 2013

*Just tying up loose ends*



# Underlying Issue – Circular Logic





# Pedestrian ATDs

## IMPACT/ACCELERATION

RAE

Alderson VIP

Sierra Stan

OPAT

APROD

HYBRID II P

GESAC POLAR/2/3

HYBRID III P

RSPD





# Pedestrian ATDs

## SUBSYSTEM

### IMPACTORS

Atkins Leg (GoB'ham &  
Jaguar)  
EVC Impactors  
FlexPLI

## DETECTION

PDI-2

APVRU

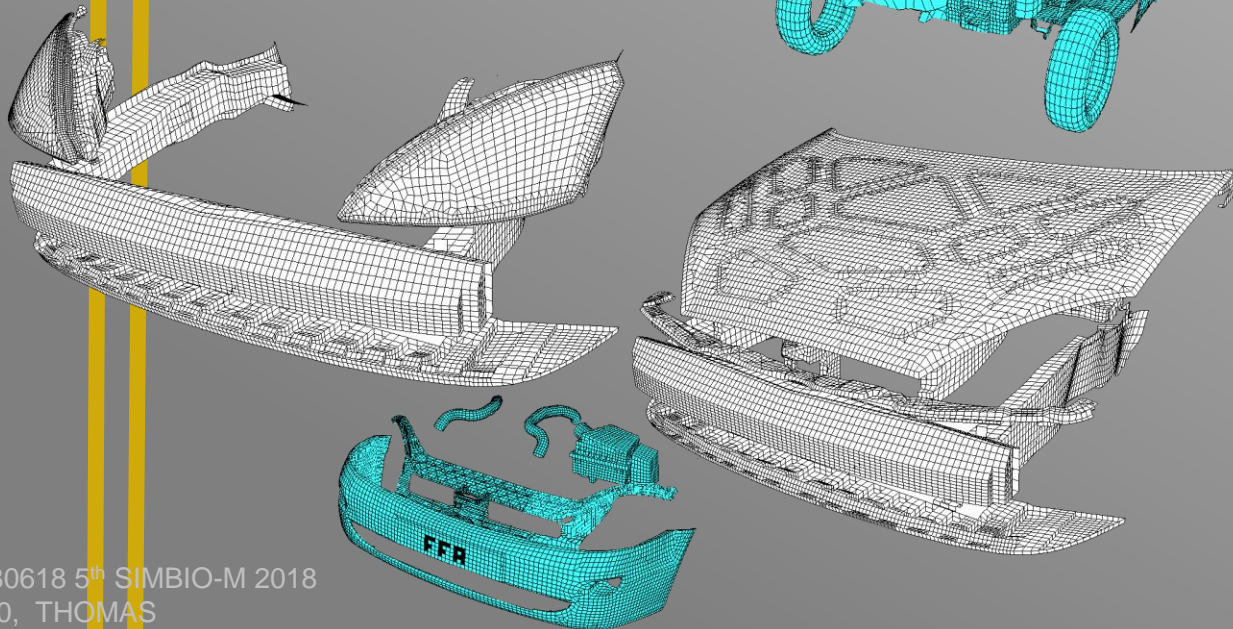
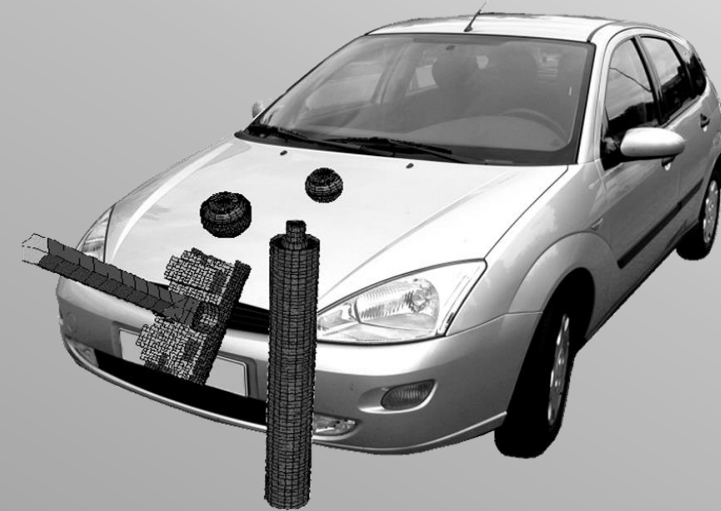
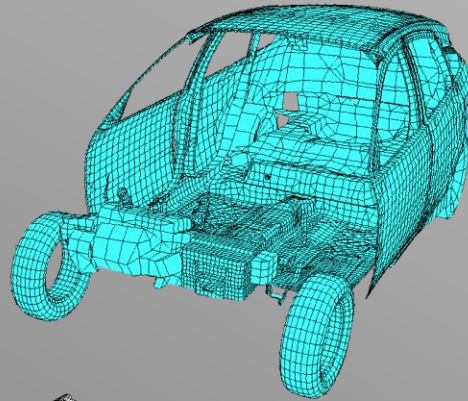
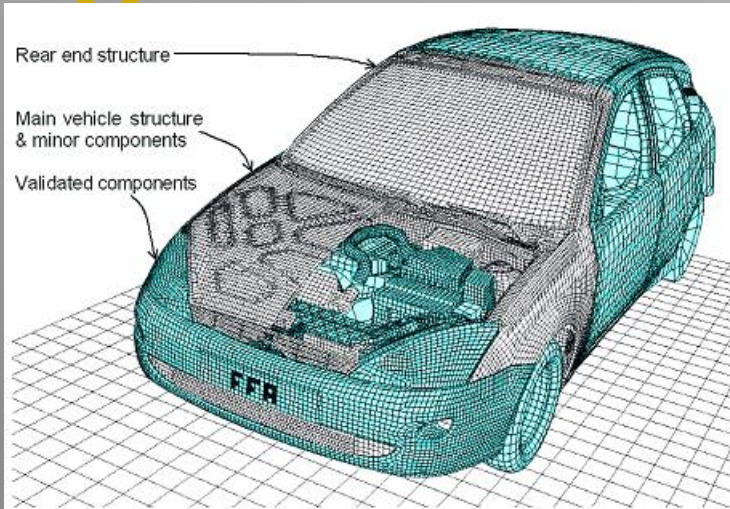
4active

Systems



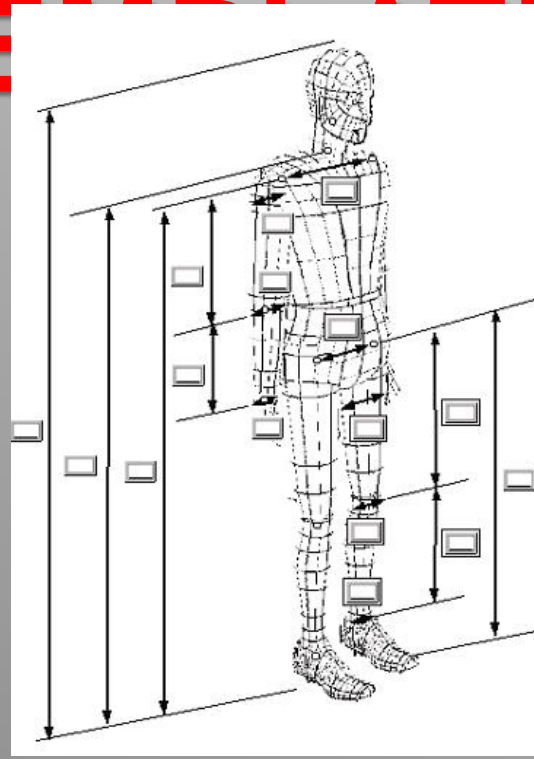
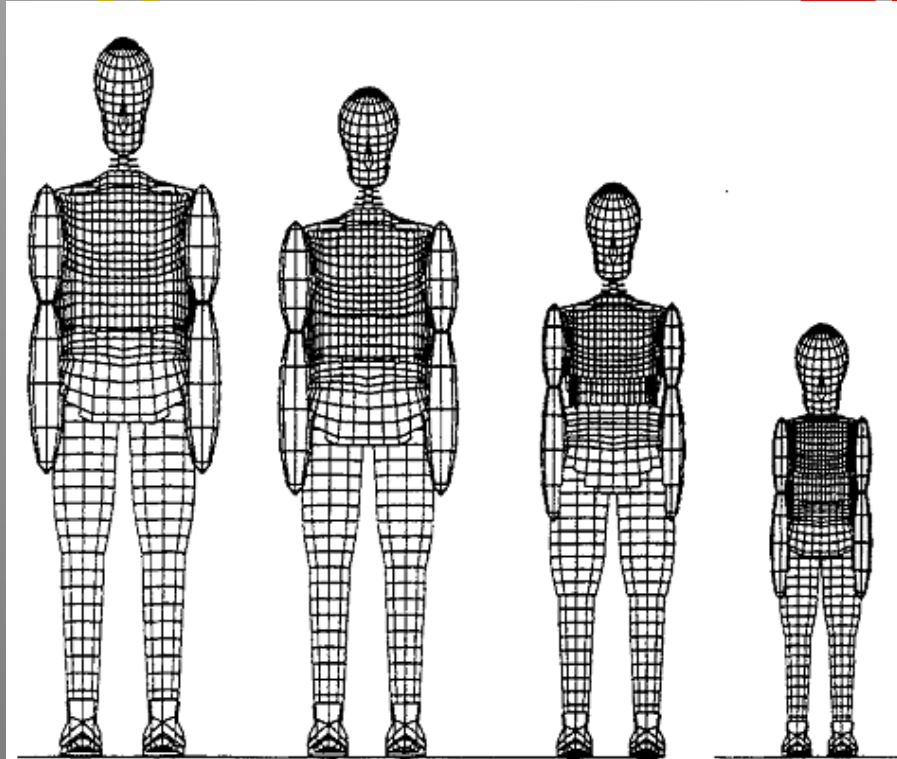


# CAE Simulation & Validation





# HUMANOID FAMILY CAE &

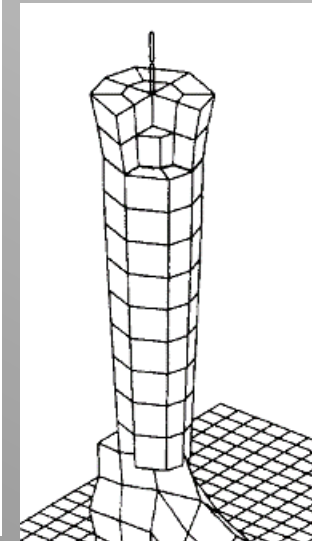
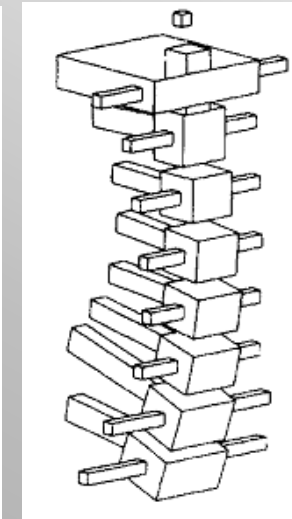
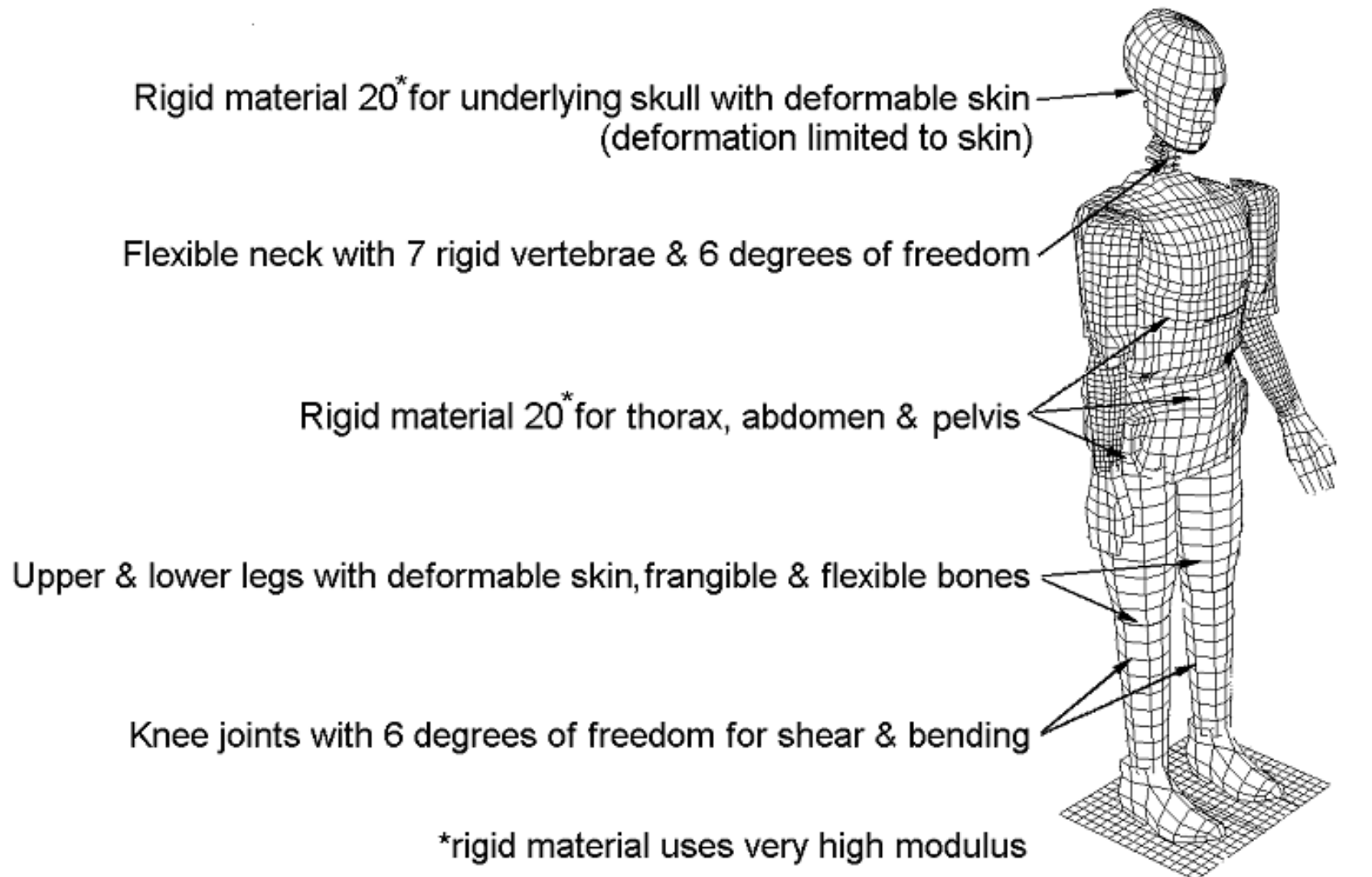


PARAMETER	OPTIONS		
AGE	(actual)		
SEX	Male	Female	
MASS	(actual)		
BUILD	Light	Average	Heavy
CLOTHING	Light	Average	Heavy
HEALTH	details		
PROPORTIONS	details		

Scaled using GEBOD database for stature, ethnic or using case measurement

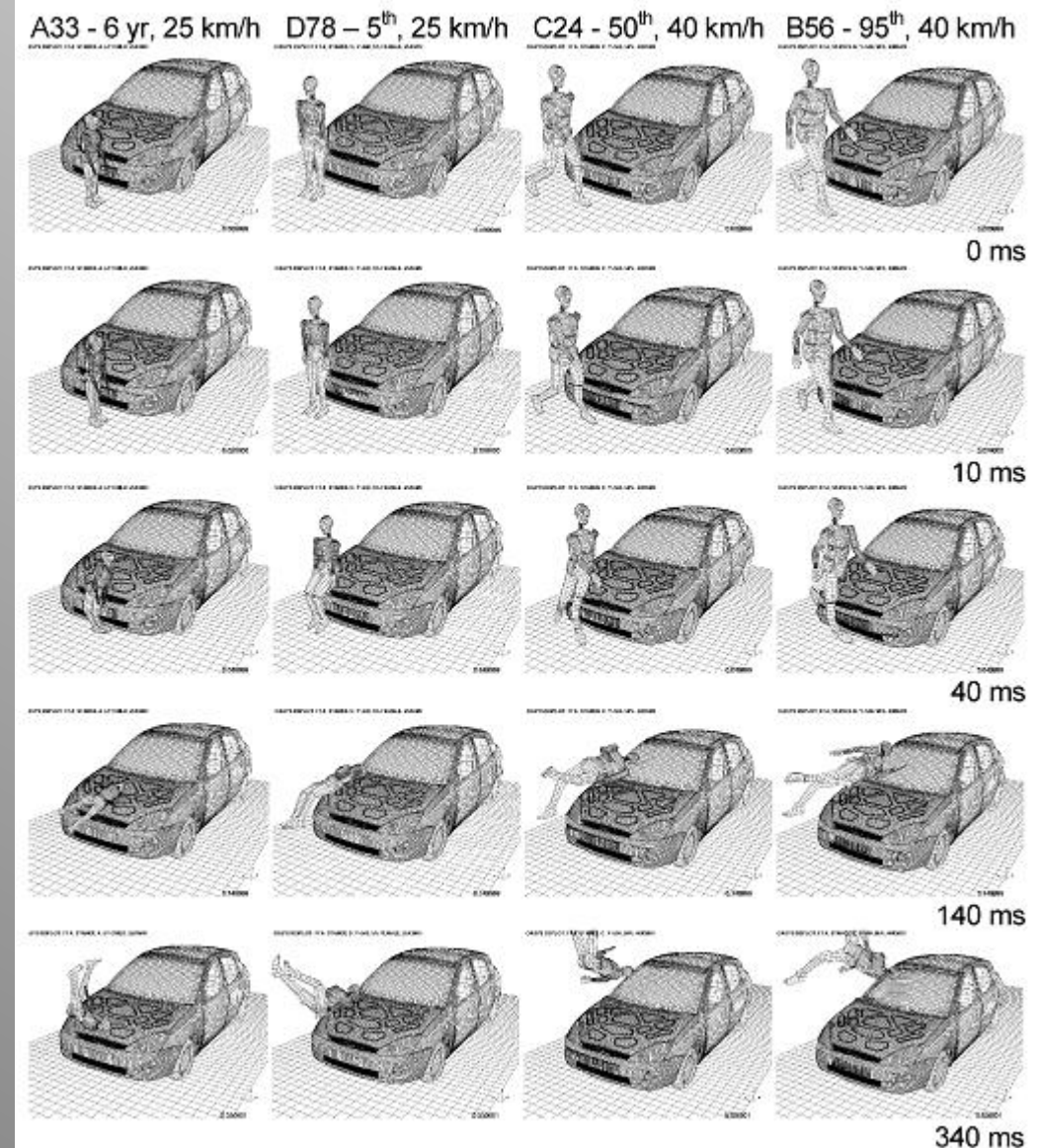
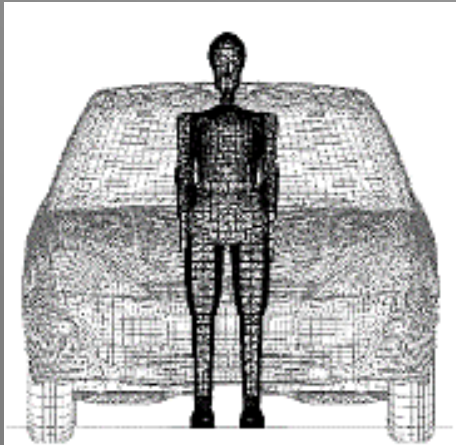
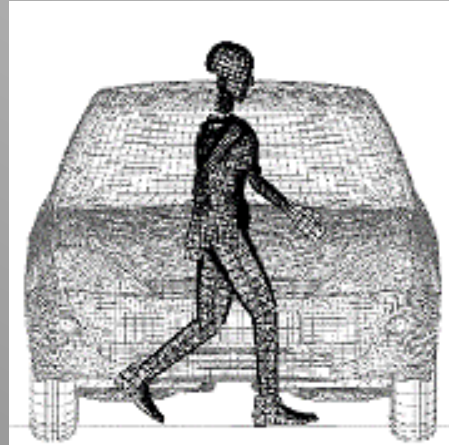
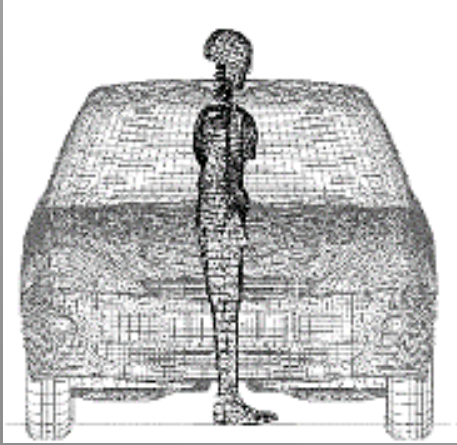


# HUMANOID COMPOSITION



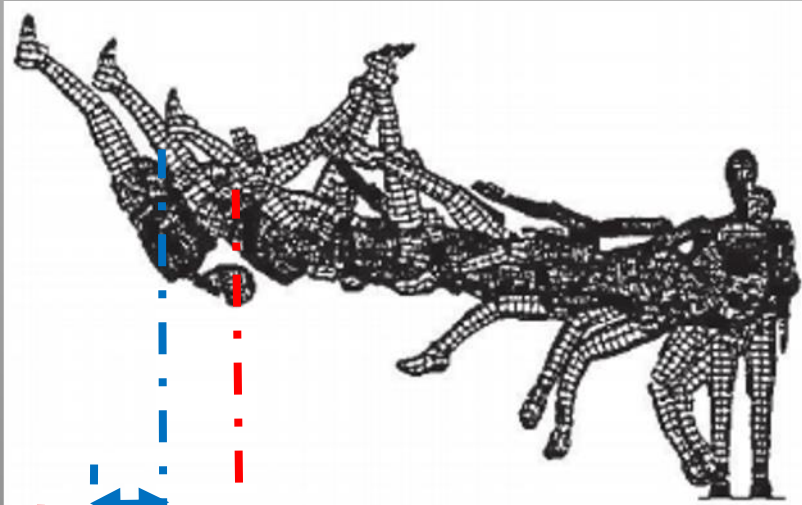


# MULTIPLE CONFIGURATIONS

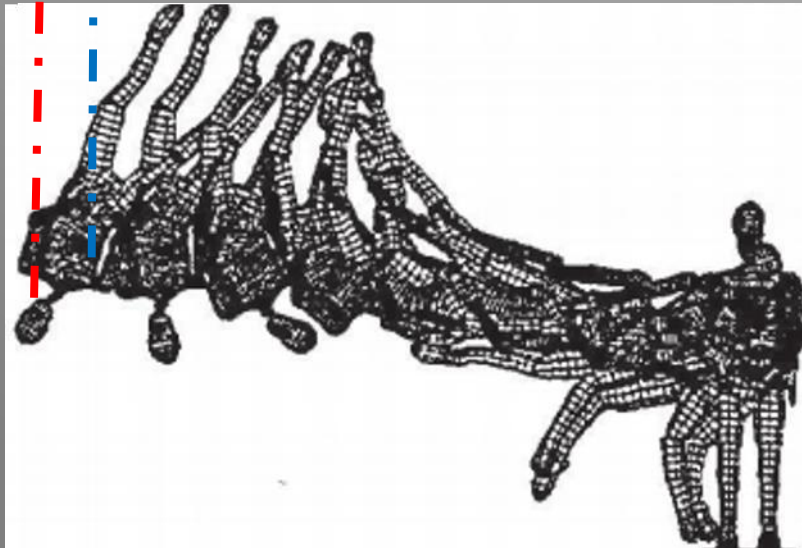




# TYPICAL RESULTS



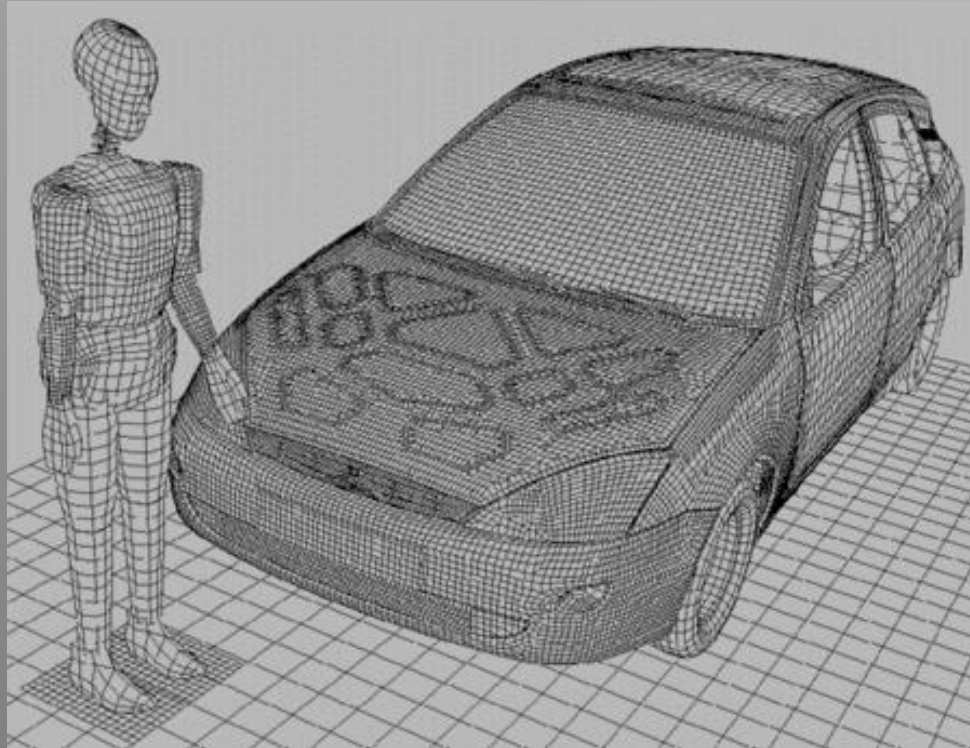
AM50  
40 km/h  
Standing Facing left  
Y-500 offset  
-1.0g braking  
**Zero pitch**



AM50  
40 km/h  
Standing Facing left  
Y-500 offset  
-1.0g braking  
**Braking pitch (-75mm)**



# COMPARISON OF FORENSIC DUMMY and CAE SIMULATION



Ford Research Centre Aachen CAE model of Humanoid Adult Male & Ford Focus Mk I



Ultimate Proof Expendable Forensic Adult Male Dummy & Ford Focus Mk I



# ULTIMATE PROOF DUMMIES





# ULTIMATE PROOF DUMMIES





# Ford Focus Mk 1 – Adult 55





# Ford Focus Mk 1 – Adult 55



CAVT





# ANALYSIS



T=00:00:00:00

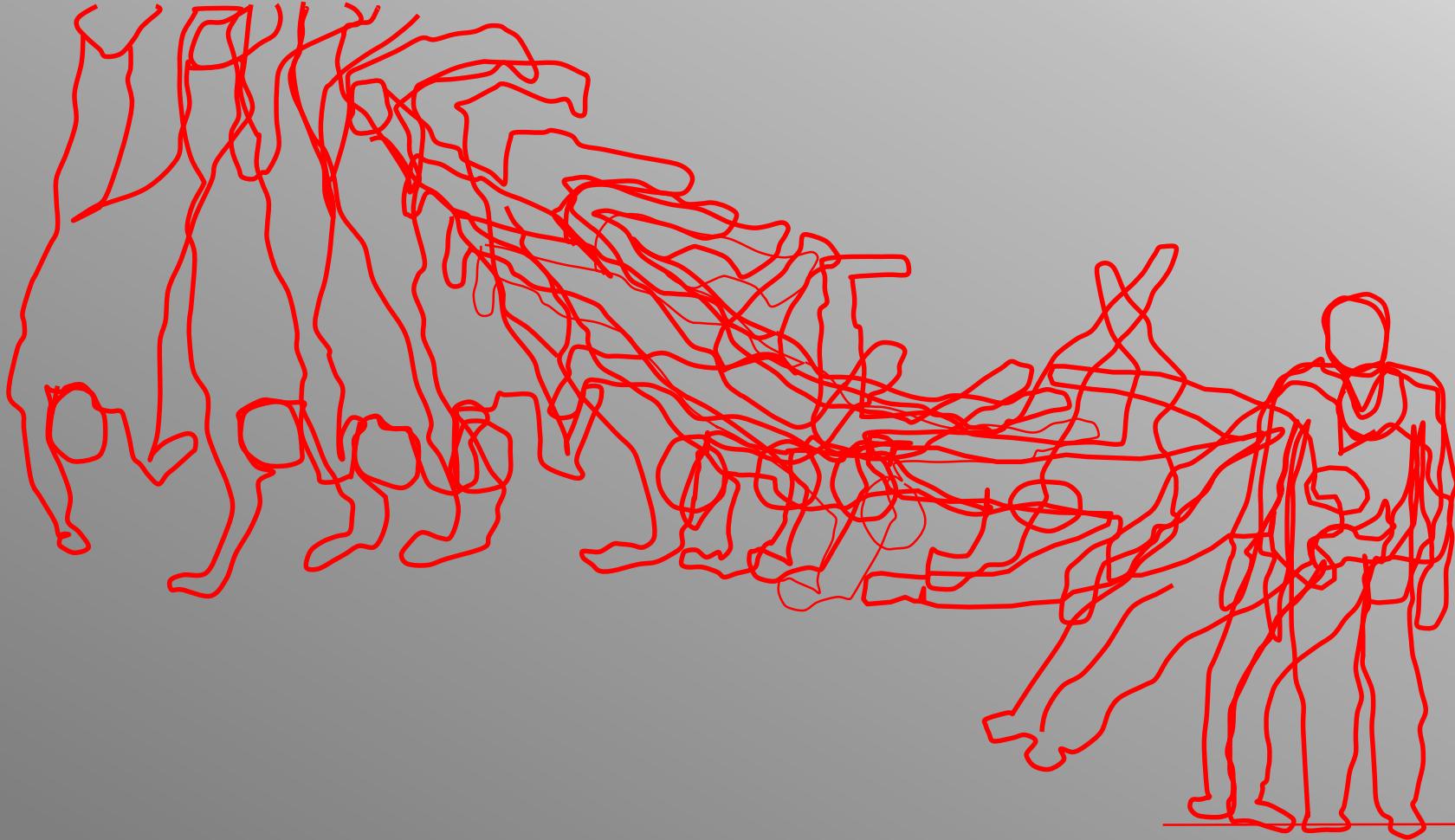


# ANALYSIS



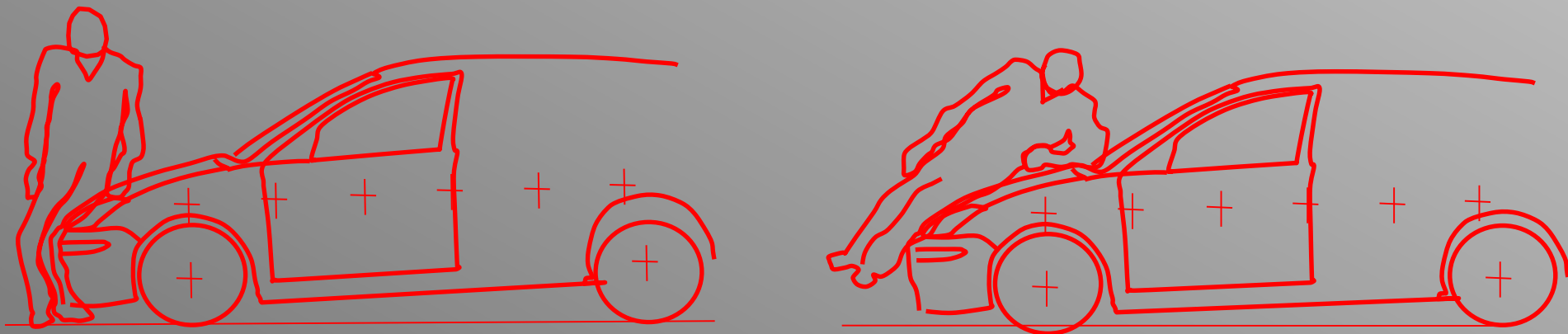
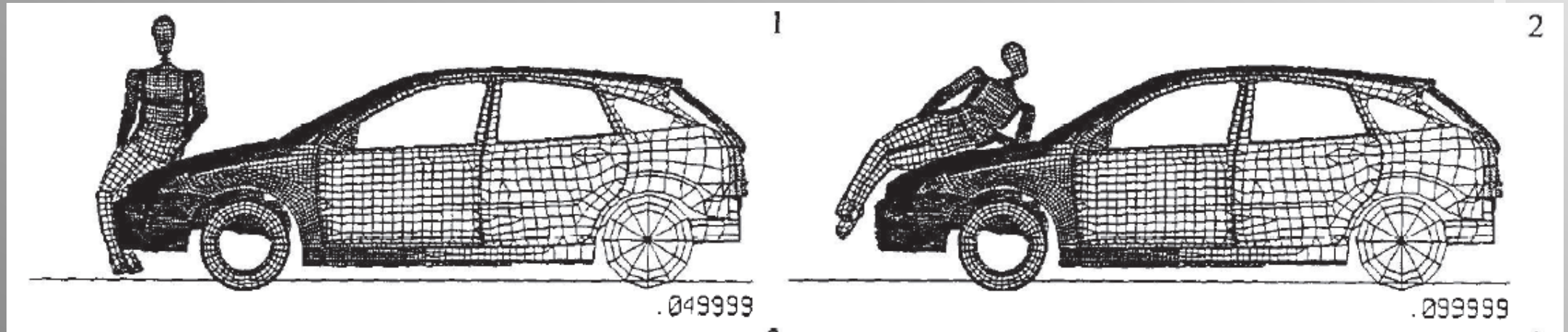


# TRAJECTORY (ground ref)



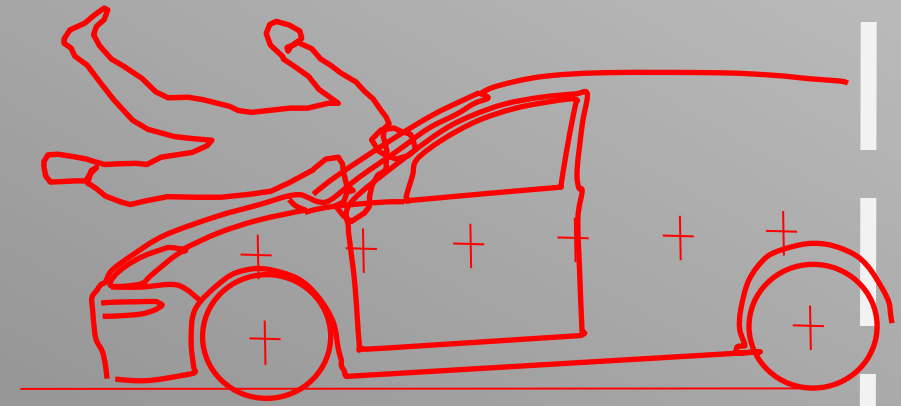
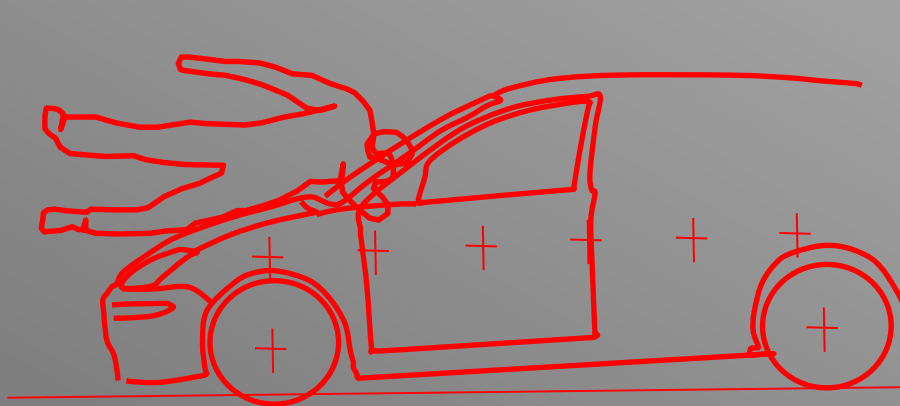
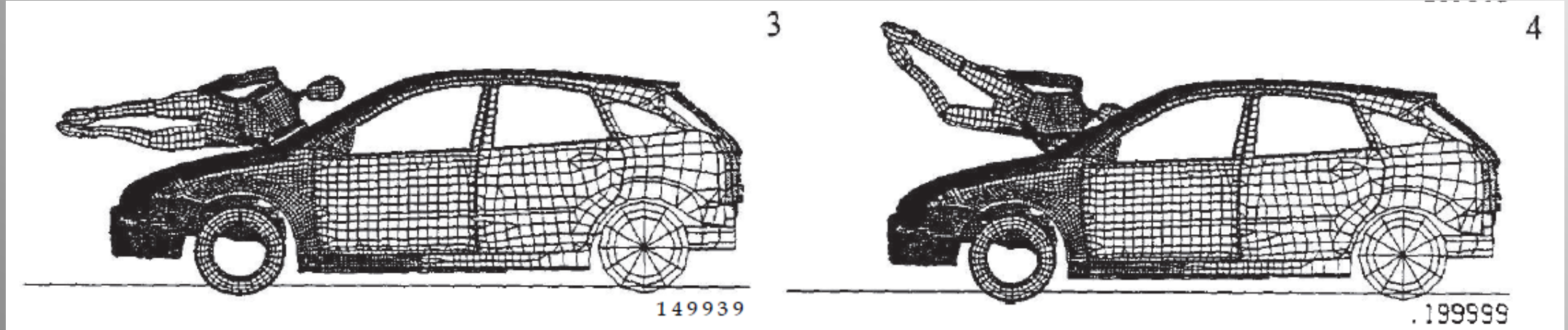


# CAE – TEST COMPARISON - 1





# CAE – TEST COMPARISON - 2





A front-facing photograph of a dark green Ford Focus. The windshield has handwritten text in blue ink: "K-1-C", "P.D.", "5/10/13", "DRIVE3" (circled), and "SCOUTING THE WAY". Two red double-headed arrows are drawn on the front of the car. The top arrow spans the width of the hood and is labeled "Y-678" in red text. The bottom arrow spans the width of the front bumper and is labeled "Y-500" in red text. The car is parked on a light-colored surface with trees in the background.

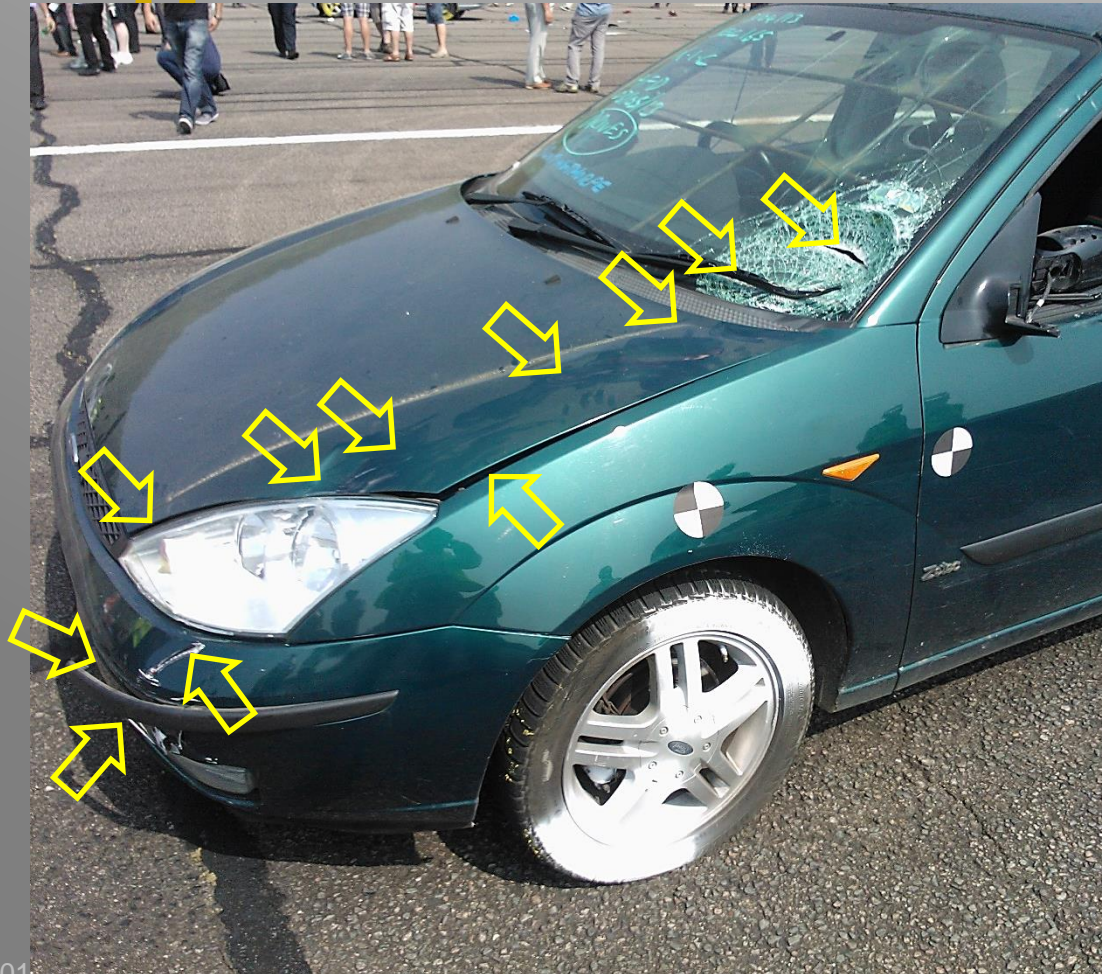
Pre-test reference photo

20180618 5<sup>th</sup> SIMBIO-M 2018  
14:00, THOMAS



# Damage & Marking - 1

AFTER CHILD DUMMY TEST



AFTER CHILD & ADULT DUMMY TEST

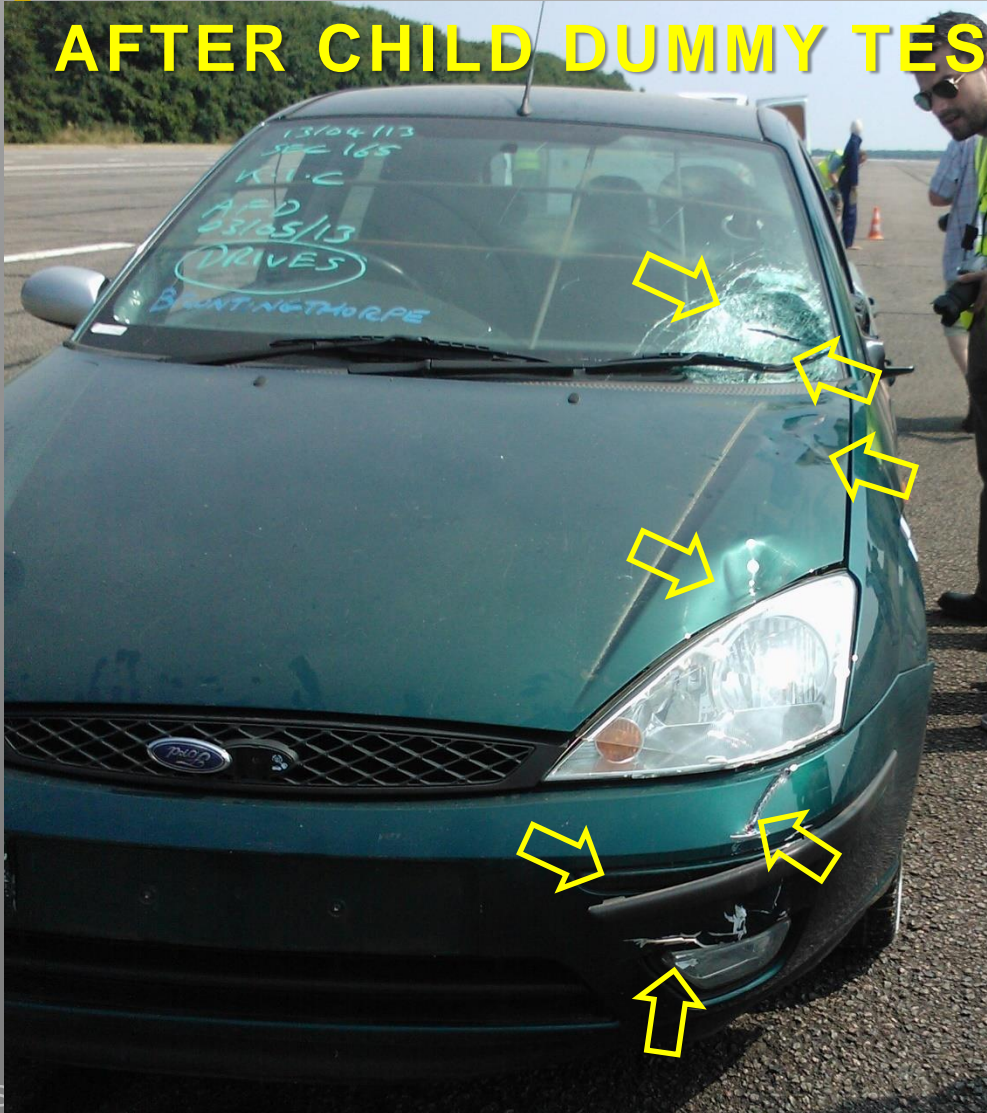




# Damage & Marking - 2



CAVT





# Measuring WAD (Surrogate)





# Measuring WAD (Surrogate

## Vehicle) 1



WAD (mm)	Pitch	WAD
Surrogate	0	2110
CAE	75	2000
Test	81	2020





# DISCUSSION

- Opportunistic: same vehicle, dummy, posture, braking
- Overall motion very similar despite higher  $V_0$  and Y-offset
- Head & elbow impact locations in good agreement
- Little/no evidence of pelvis or torso contact with bonnet
- Deviations mainly in the later stages - leg motion
- Uncertainties due to
  - prior damage from child dummy impact, and possibly before
  - Almost-real-world conditions difficult for video analysis
    - Contrast, reflections, loose clothing



# CONCLUSIONS

- A single test case corresponding to a CAE case is not conclusive
- Influence of impact speed may be less than brake dive, etc. if contact is low enough to rotate legs much more than torso
- A low-cost, disposable dummy may be useful in forensic and research reconstructions, and may refine existing techniques for deducing impact velocity from on-scene measurements



# FOOTNOTES

- Since paper was written, the Ultimate Evidence dummy team are investigating use of Simulaids Rescue dummies as a basis for development with modified skeletal characteristics in standing/walking postures
- CTS BD Dummy launched based on earlier work with replaceable frangible anisotropic skeleton







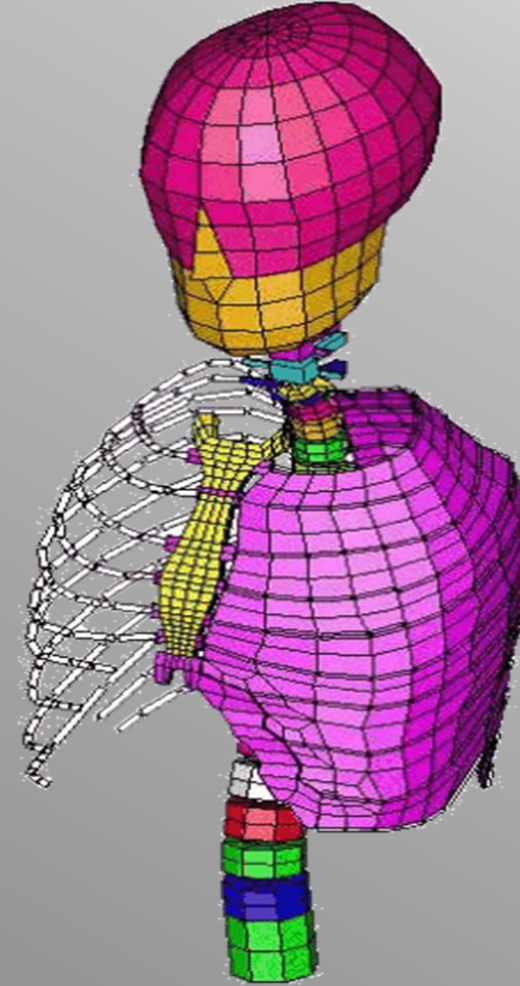
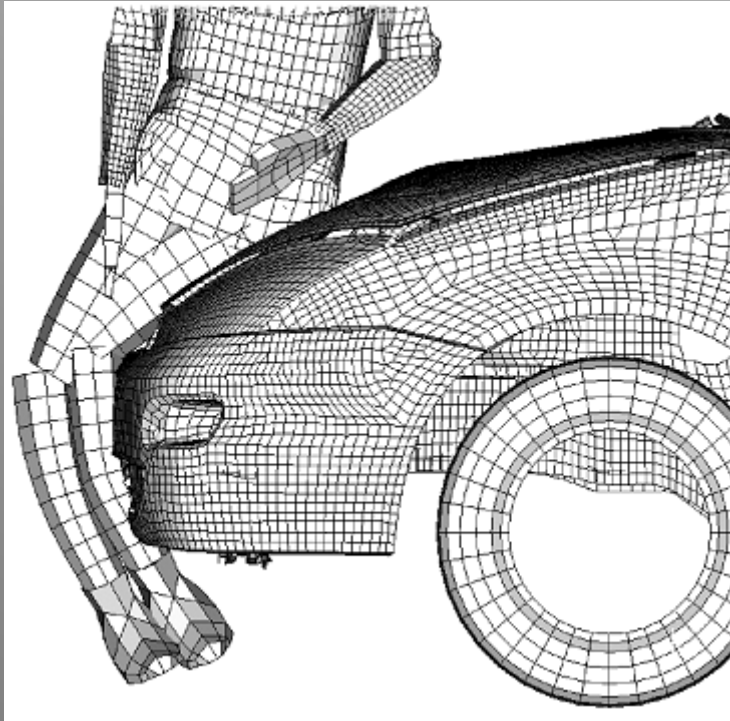
CAVT

# STOP

**Further questions:  
[avthomas@cavt.co.uk](mailto:avthomas@cavt.co.uk)**



# Q & A SLIDES

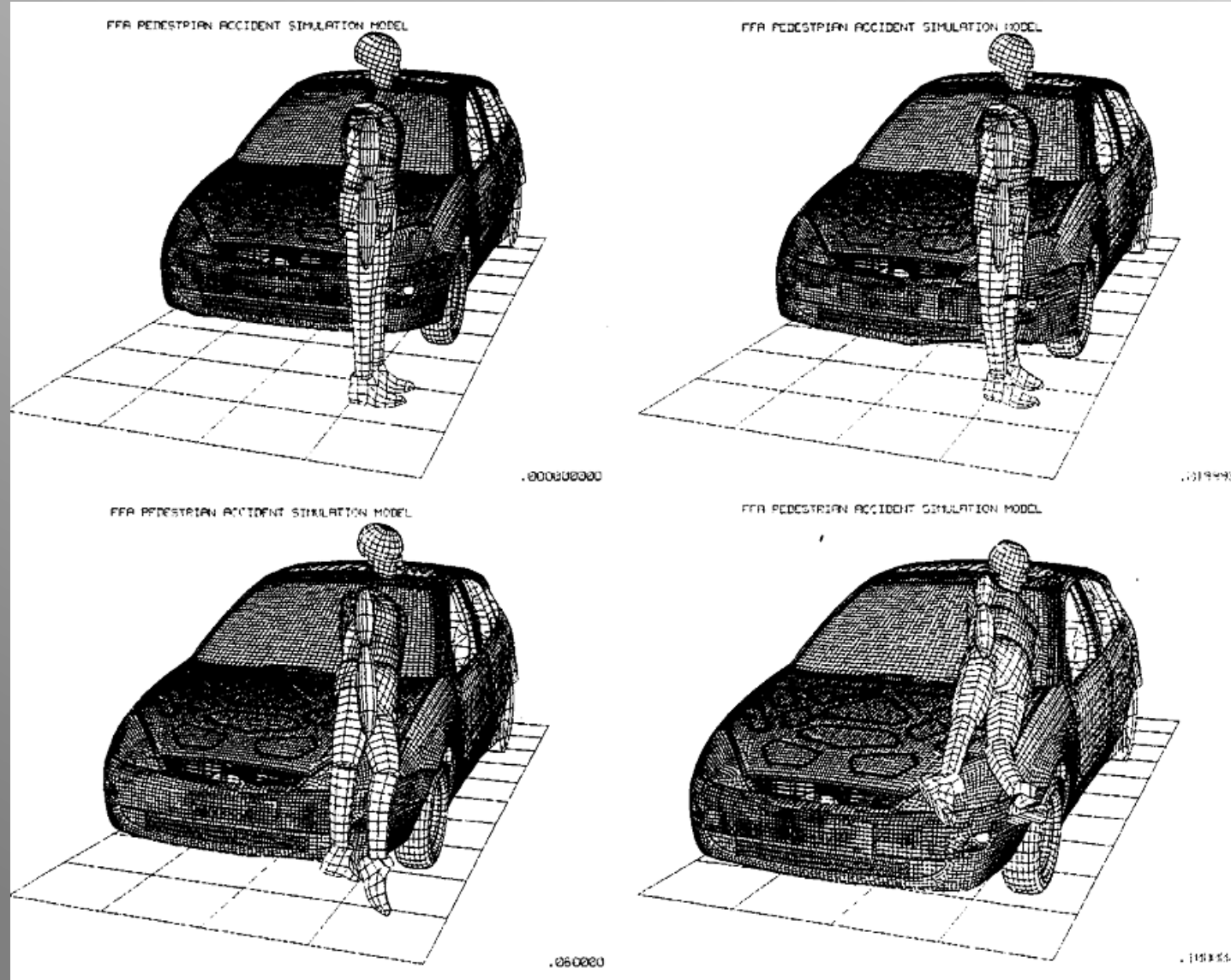




# Q & A SLIDES



CAVT





# Q & A SLIDES

## Child Dummy Test



**Ford Focus- Child Pedestrian 40kg**  
**Speed 47mph Throw/slide 25.5metres**