tass
delivering transport safety solutions

Accurate and efficient dummy models for occupant safety design

6th European LS-DYNA Users' Conference

Gothenburg May 29-30, 2007

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Summary

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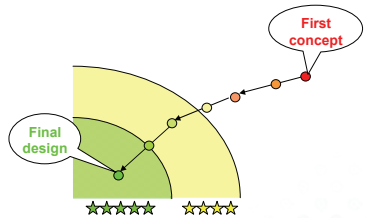
- Market Observations
- MADYMO Quality Rating
- Dummy Models
- Coupling
- Future Outlook

Market Observations

- Consumers increasingly safety conscious
  - OEMs use safety for product differentiation & image building
- Legislation & NCAP requirements increasing in number & stringency
  - safety design ever more challenging
- Cost reductions by platform sharing
  - safety design needs to meet global requirements for multiple platforms
- Legislation & NCAP accelerate penetration of new safety features
  - new features rapidly transfer to commodities
  - manufacturers need to continuously develop features to offer product differentiation

Our Approach

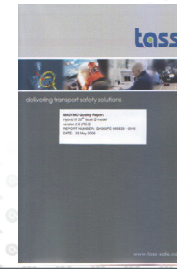
- TASS believes these requirements can be met through an extensive use of virtual testing, in particular
  - by using fast and accurate simulations
  - combined with advanced optimisation techniques
  - to balance system performance with development costs
  - while meeting safety requirements at a global level



MADYMO Rated Quality

- MADYMO is investing significantly in next generation dummy models to continue to meet our customers (increasing) demands in terms of
  - Speed
  - Accuracy
  - Reliabilty
  - Ease of use

All new MADYMO Models are delivered with the unique MADYMO Quality report



MADYMO Rated Quality

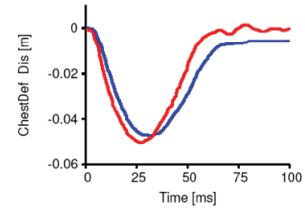
- Describe model quality compared to reference signals using numerical values in an automated process
- Depending of model: 100 – 350 pages
- Compares previous model with latest version, Contains:
  - Details validation set
  - Objective rating results
  - Evaluation
  - Signal curves

Goals:

- Easy judgement of model quality
- Easy comparison of models
- Setting objective requirements and a systematical approach for model improvement

MADYMO Rated Quality

- Objective rating
  - Peak criterion
  - Peak timing criterion
  - Shape/trend criterion (wifac)



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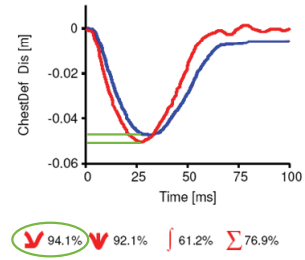

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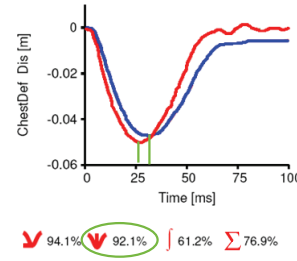

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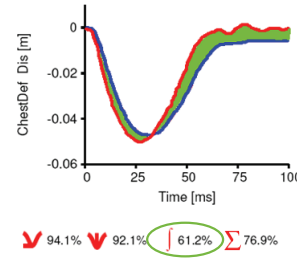

Examples of Quality Rated Models

Quality Rated Models
- Hybrid III 50th percentile
- WorldSID 50th percentile
- EuroSID 2 (re)
- BioRID 2

In Progress
- Hybrid III 5th percent
- SID-IIs
- …

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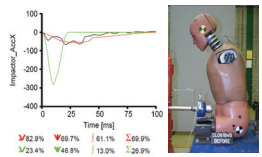
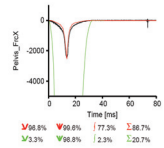
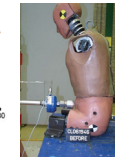
Hybrid III Facet Q v3.0 Correlation

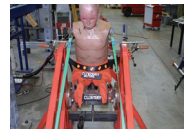
v3.0: 81.1% v2.0: 21.0%

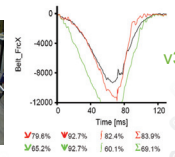






V2.0 v3.0
experiment





v3.0: 81.4% v2.0: 67.8%

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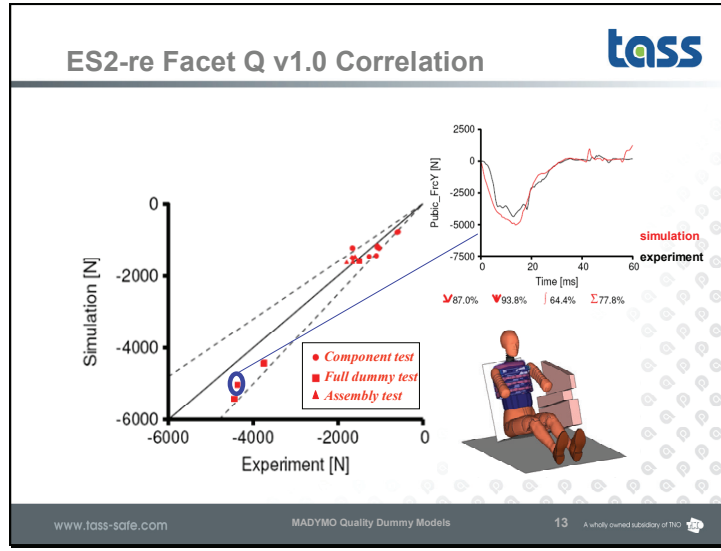
ES2-re Facet Q v1.0 Correlation
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Simulation [N]
Experiment [N]
0
-2000
-4000
-6000
Component test
Full dummy test
Assembly test
Pubic_FrcY [N]
2500
0
-2500
-5000
-7500
Time [ms]
simulation
experiment
87.0%
93.8%
64.4%
77.8%
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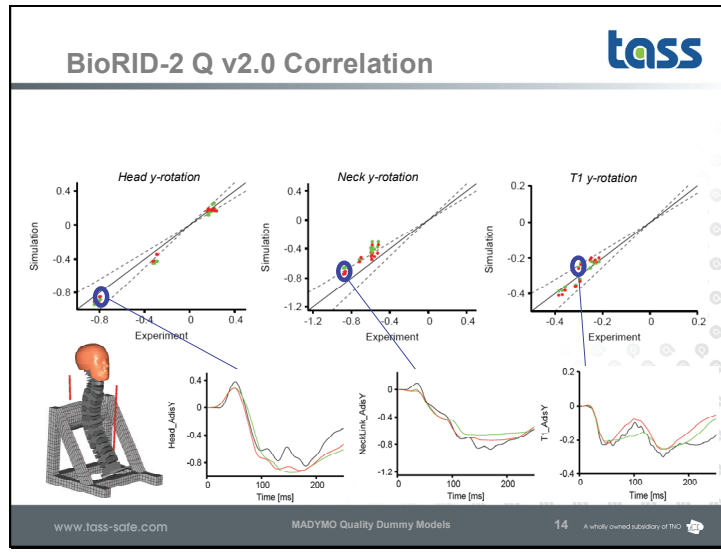
BioRID-2 Q v2.0 Correlation
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Head y-rotation
Neck y-rotation
T1 y-rotation
Simulation
Experiment
Head_AdisY
NeckUpIn_AdisY
T1_AdisY
Time [ms]
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Combining the best of both worlds

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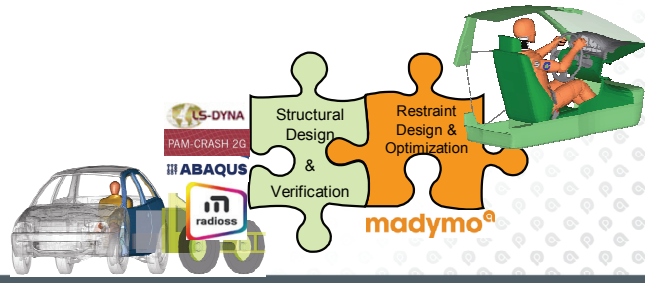
- Seamless integration of dedicated occupant restraint analysis design with structural design process



Mix and Match

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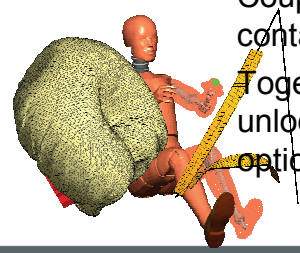
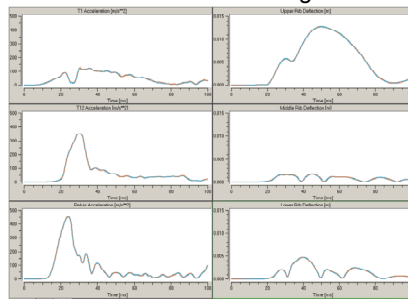
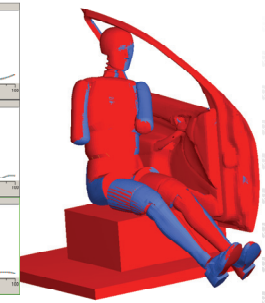
- Coupling allows for arbitrary mix of Dyna/MADYMO components
- Coupled components may contain FE and/or MB
- Together these components unlock powerfull analysis options



Rating in Coupling environment

Performance of MADYMO Quality Rated Dummy models is a constant factor regardless of code of execution

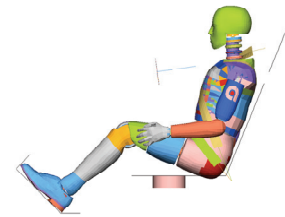




MADYMO ES2re Facet Q Dummy model in MADYMO environment (blue) vs MADYMO ES2re Facet Q Dummy model in LS-DYNA coupling (red)

Coupling Application Example

- Coupled sled test;
  - NCAP severity pulse
  - Dyna restraints
  - MADYMO occupant model



Coupling Application example

- Runtime < 1 hour for 150 ms

Signal	Peak value	Peak timing	Wifac	Total
Femur force Left	74	95,8	62,8	77,5
Femur force Right	82,6	90,4	66,1	79,7
Chest deflection	94,3	95,2	81,4	90,3
Head acceleration x	67,9	96,8	61,6	75,4
Chest acceleration x	97,2	86	74,7	86,0
Pelvis acceleration x	94,4	88,7	63,8	82,3
Neck force fx	69,4	95,9	56,9	74,1
Neck force fz	87,4	94,7	73,2	85,1
Neck moment My	51	97,3	52	66,8

Madpost Quickrating

Future Outlook

- Continued investments in highest quality models for ATD's and Human models
- Continued investments in world-class solutions for restraint modeling, such as Gasflow
- Introduction of second generation stochastic models
- Dedicated pre/post solutions for coupled analysis