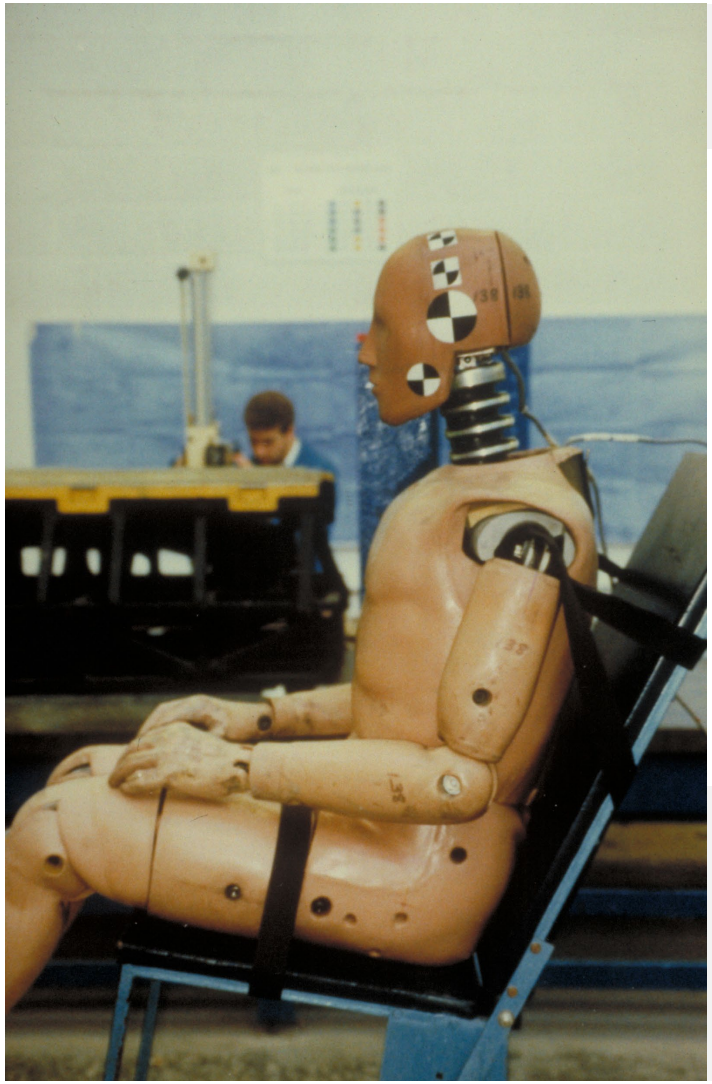
Virtual Testing Protocols and LS-DYNA — Pre and Post Processing Solutions in the Oasys LS-DYNA Environment

Alasdair Parkes and **Rory Bradshaw**

17th German LS-DYNA Forum, 2024

What is Virtual Testing?

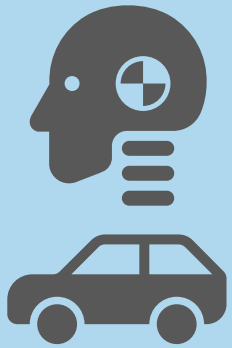


Validation

Virtual Loadcases

A Paradigm Shift

Paper



Virtual Testing

Protocol Requirements

Industry Challenges

Oasys

LS-DYNA ENVIRONMENT

Solutions

✓

Protocol Requirements

Euro NCAP and C-NCAP

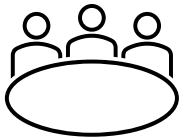
Protocol Requirements

- Quality ..... Hourglass energy, mass scaling, duration
- Correlation ..... ISO/TS 18571:2024
- Injury Assessment ..... Validation Criterion 2, Correction Factor A
- Data Submission ..... ISO-MME, videos

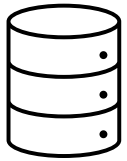
Industry Challenges

Challenges

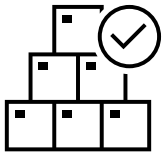
1. Good correlation has become mandatory



2. Collaboration between CAE and Vehicle Safety teams



3. Quantity of LS-DYNA analysis



4. Format and quality of data

Solutions

Solutions

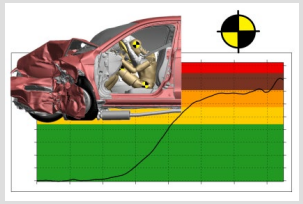
Oasys

LS-DYNA ENVIRONMENT

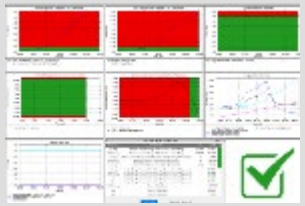
PRIMER	D3PLOT	T/HIS	REPORTER
Prepare	Visualise	Process	Report

SHELL	JavaScript Python		
Analyse	Automate	Communicate	

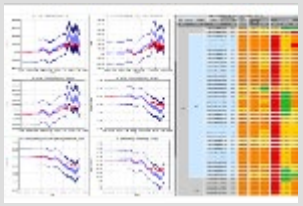
Virtual Testing Workflows



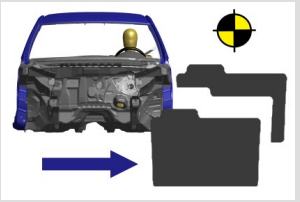
Automotive Assessments



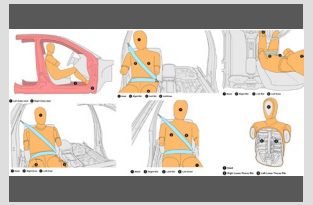
VTC Quality Criteria



Sim VT



LS-DYNA to ISO-MME

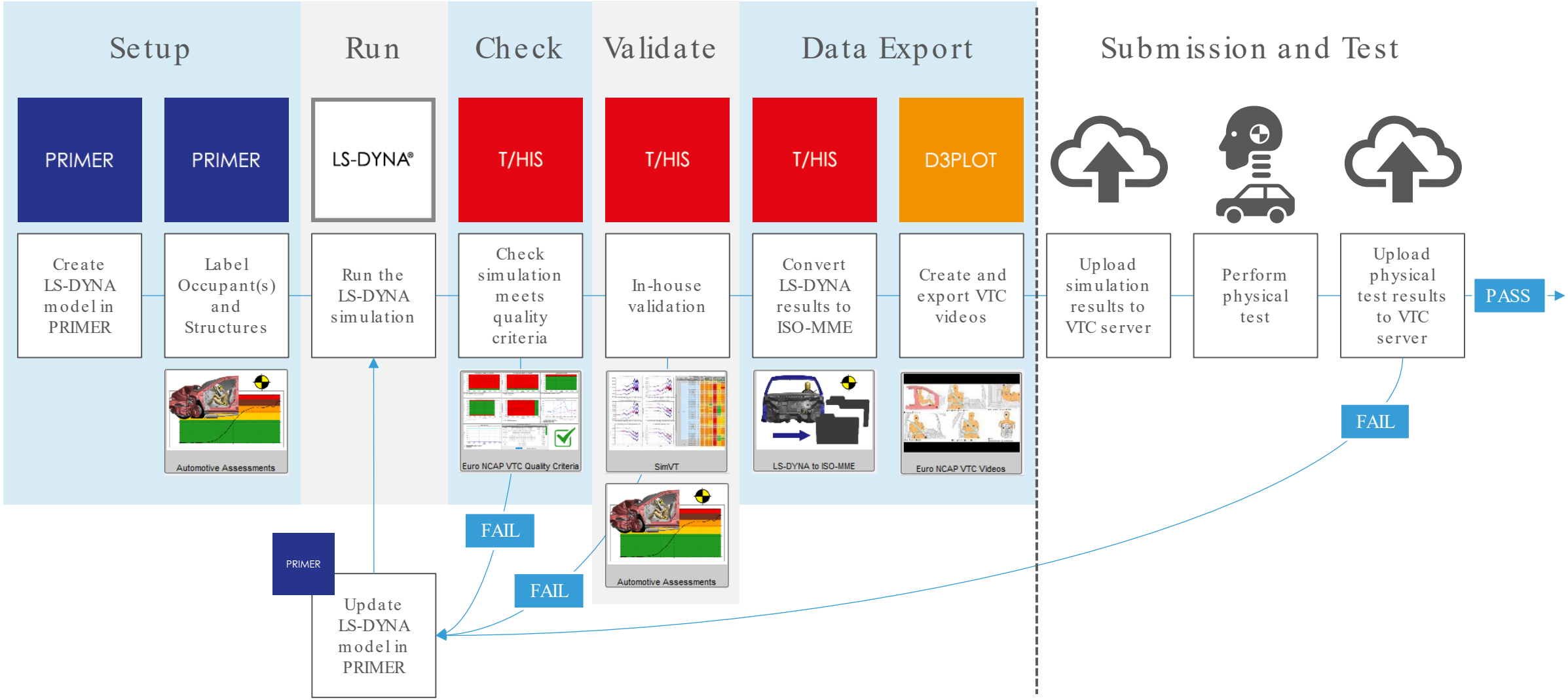


VTC Videos

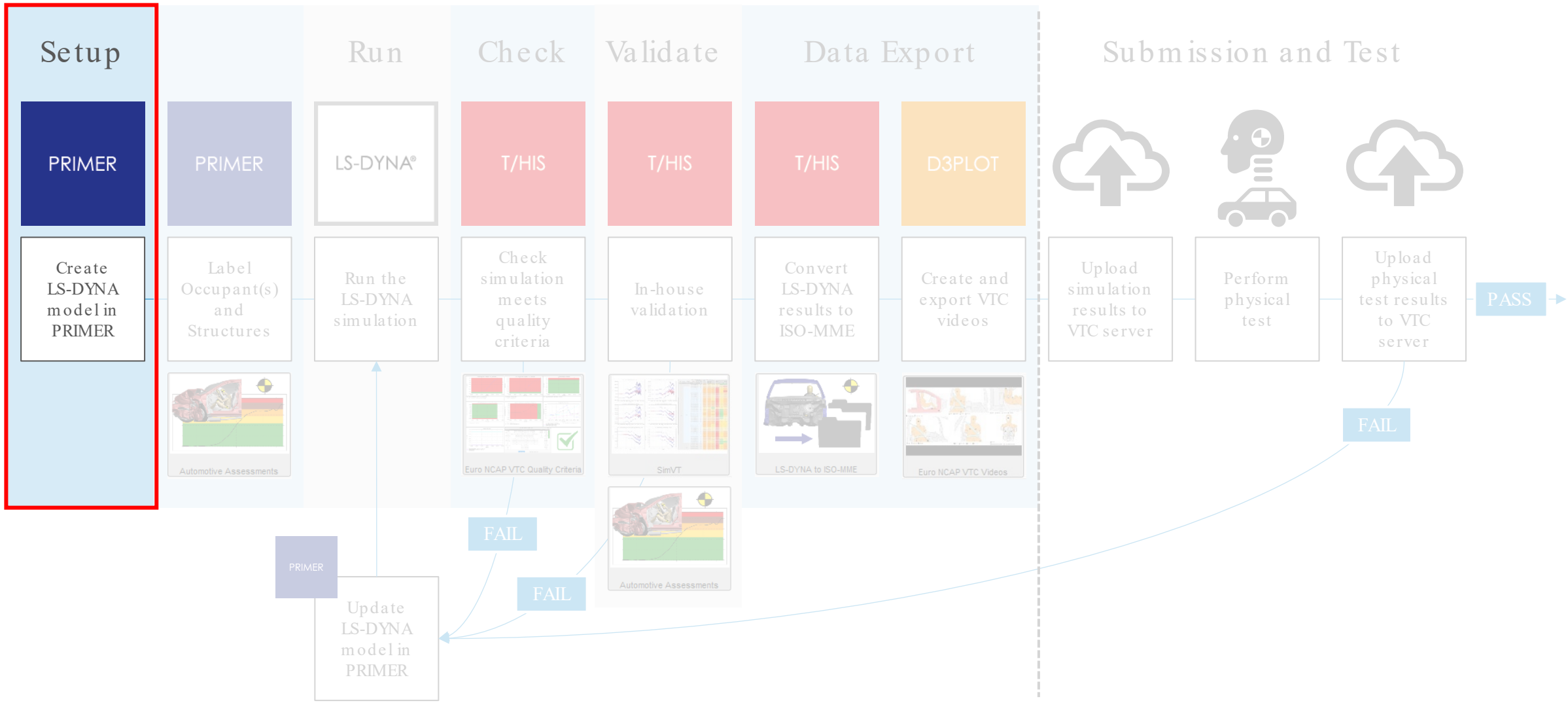
Euro NCAP, C-NCAP, and future protocols

★ ★ ★ ★ ★

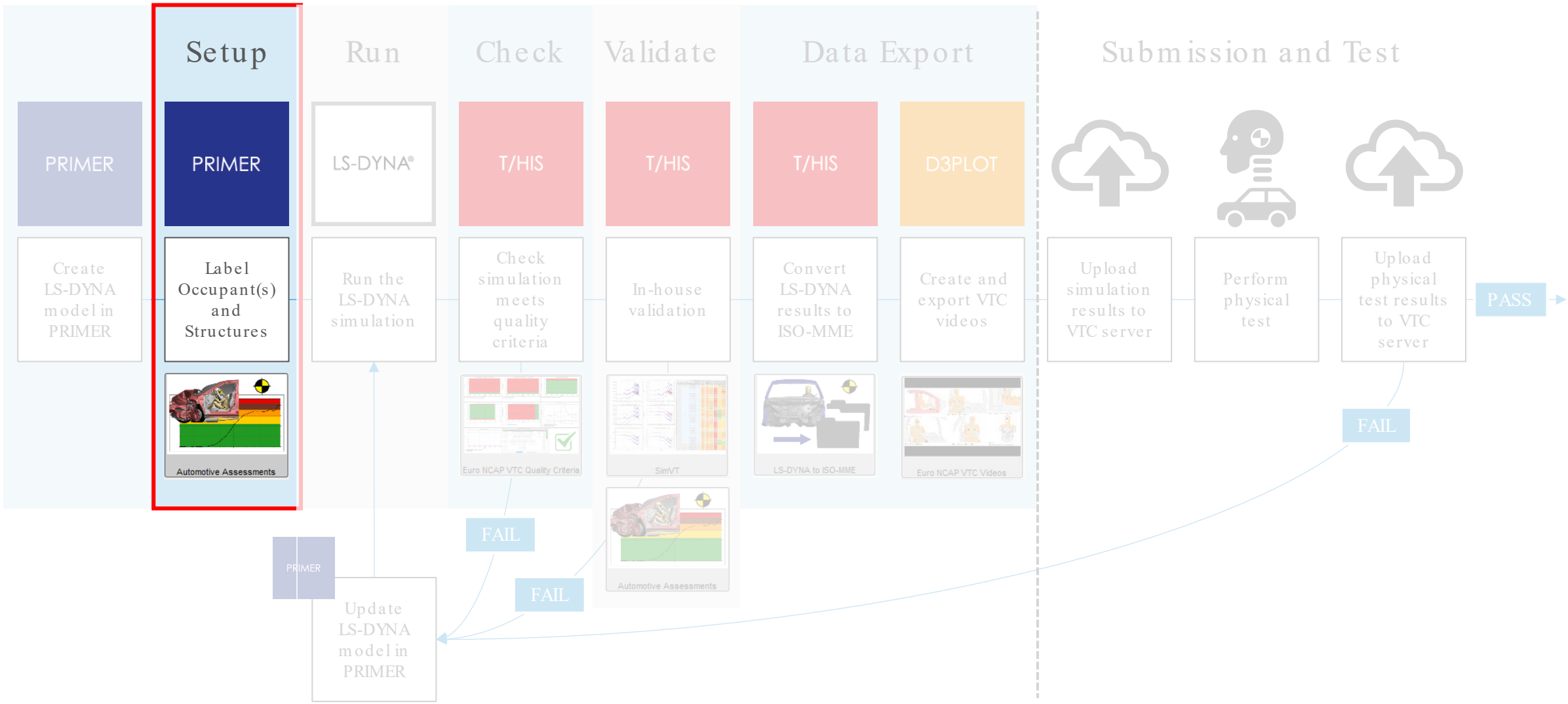
The Virtual Testing Workflow



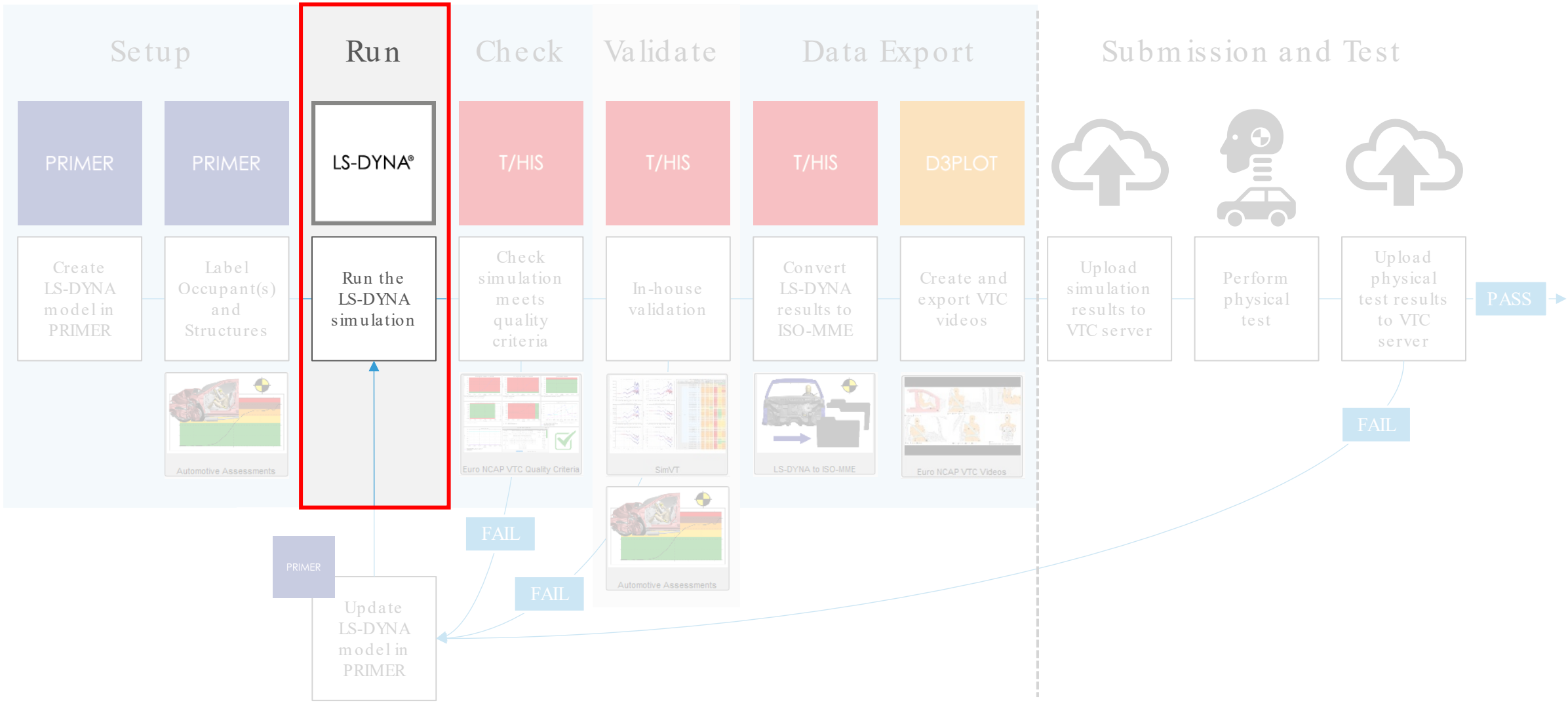
The Virtual Testing Workflow



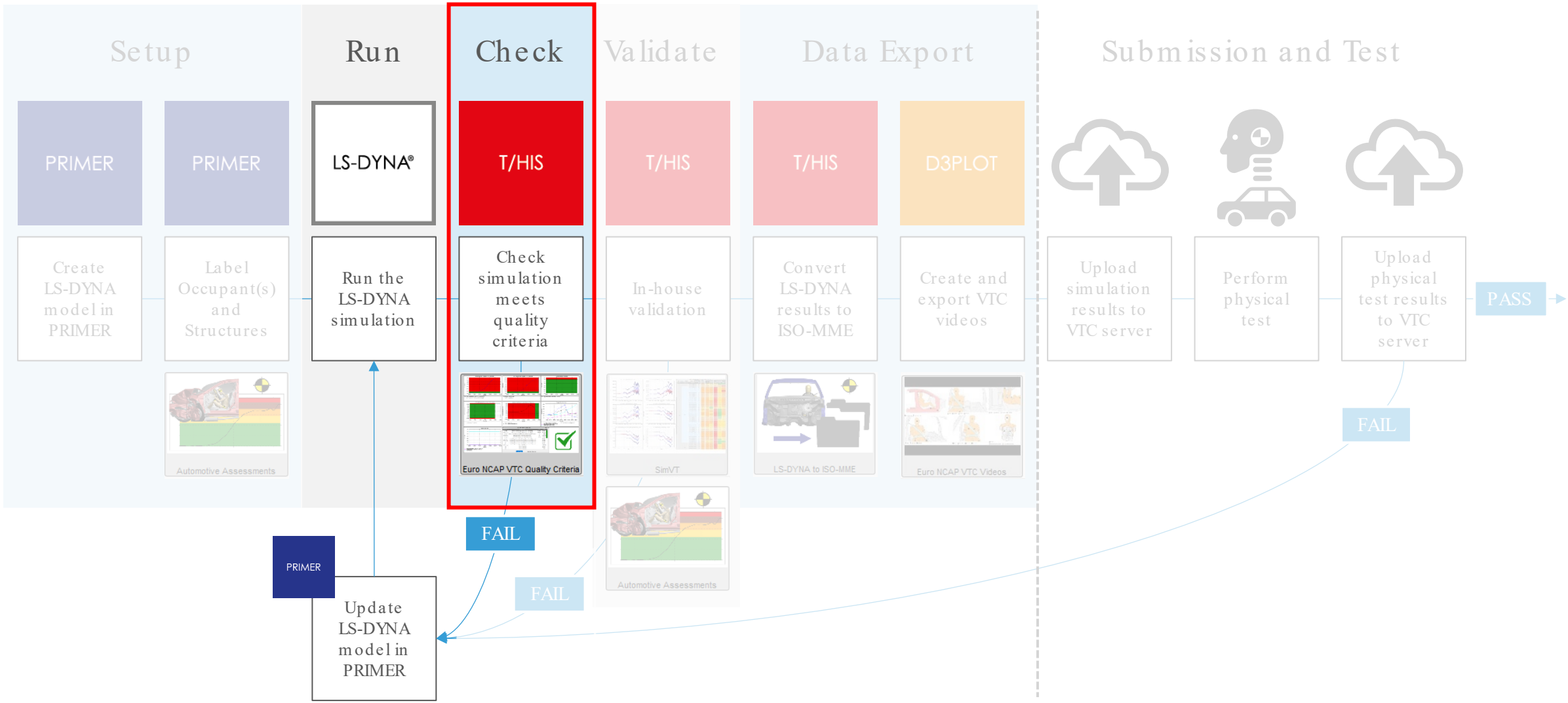
The Virtual Testing Workflow



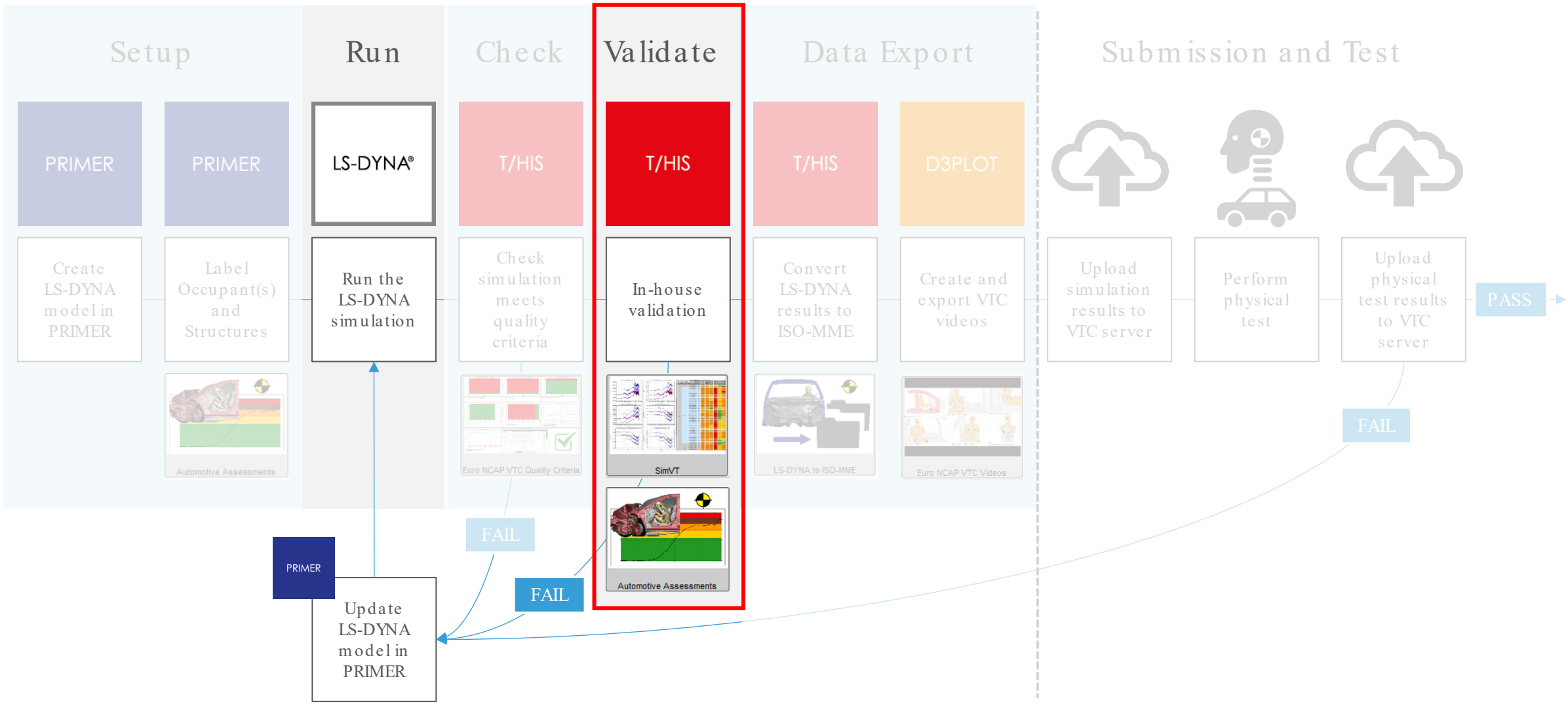
The Virtual Testing Workflow



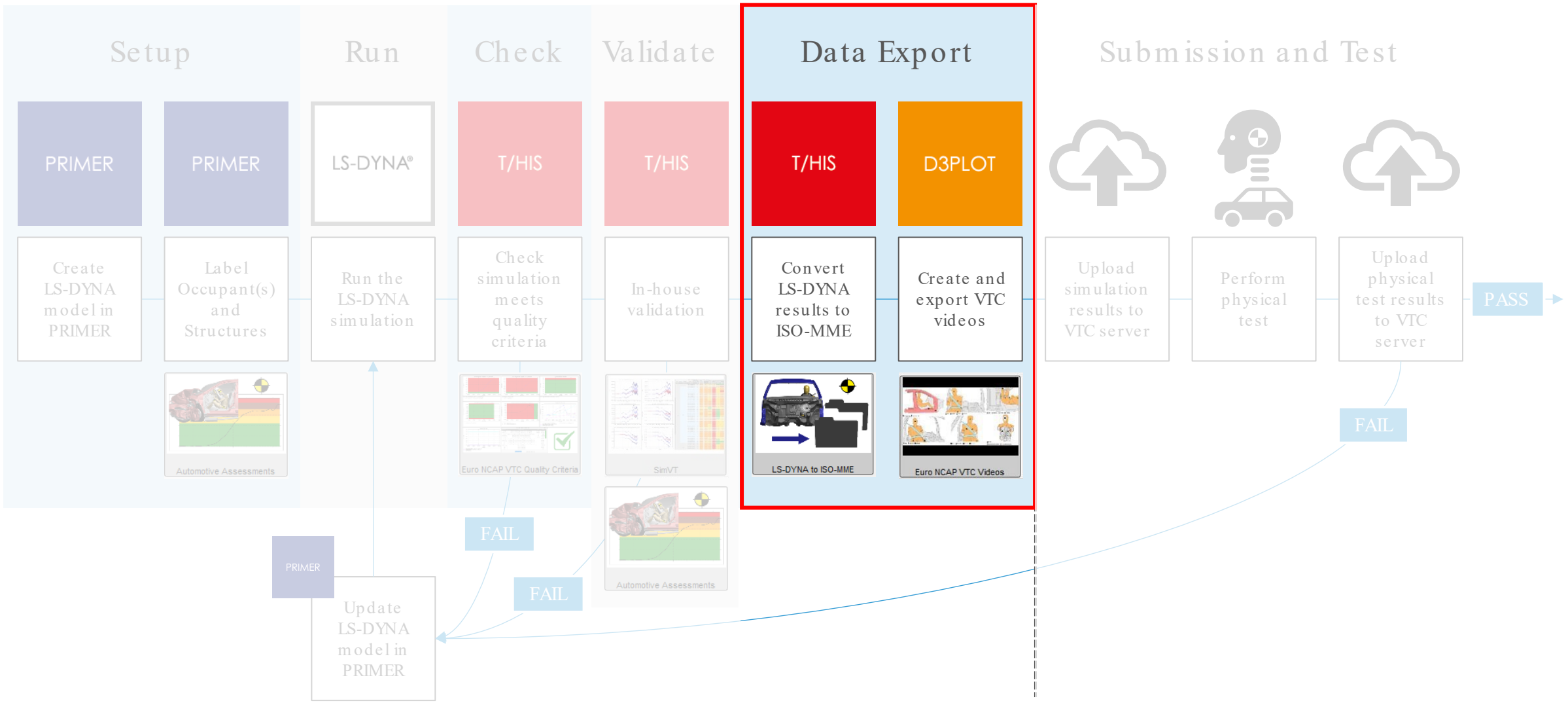
The Virtual Testing Workflow



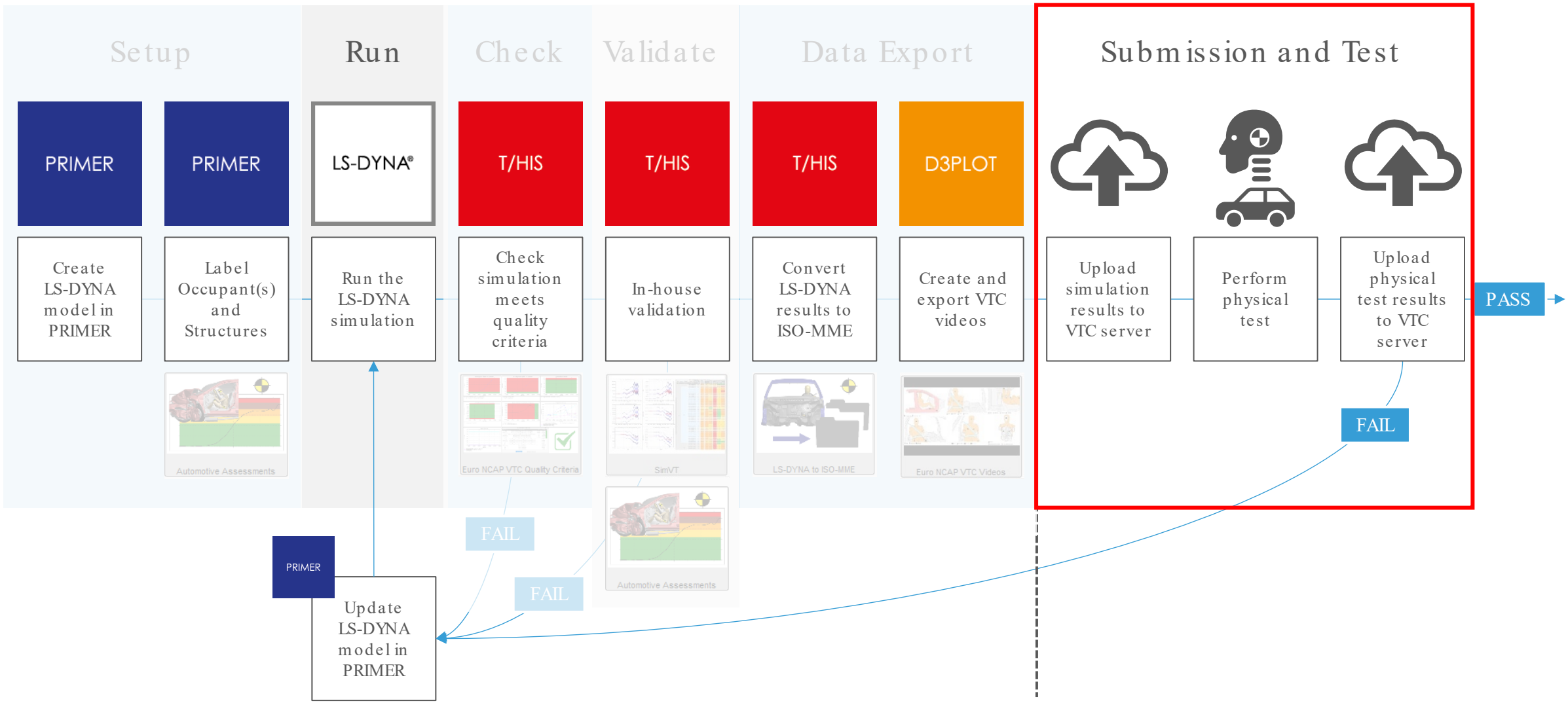
The Virtual Testing Workflow



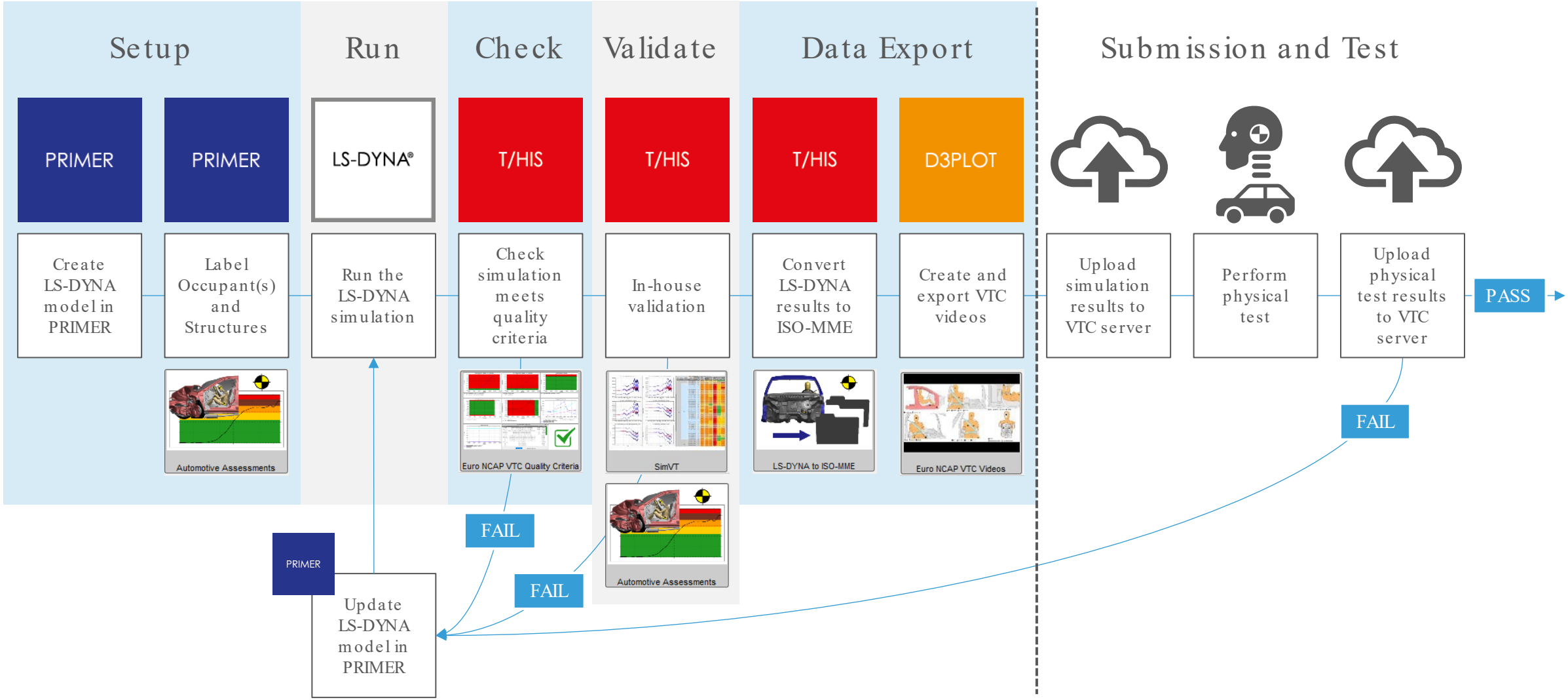
The Virtual Testing Workflow

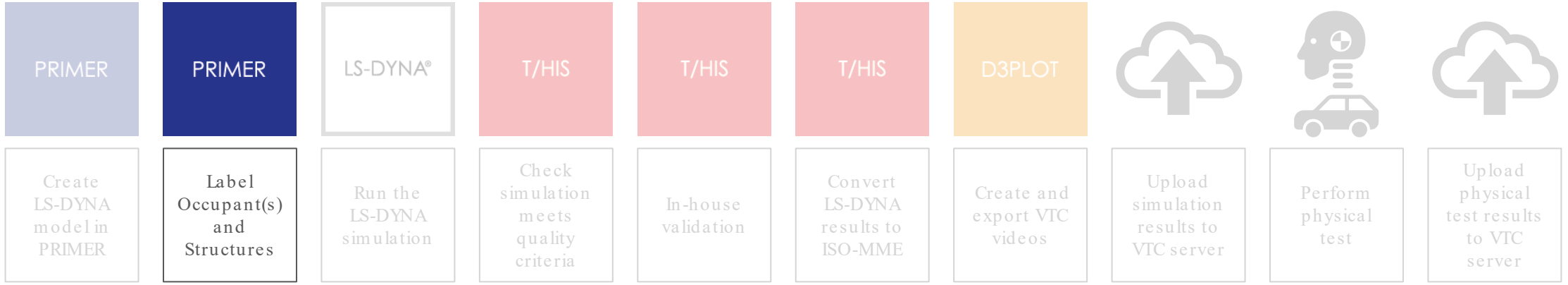


The Virtual Testing Workflow



The Virtual Testing Workflow





Automotive Assessments

Setup in Oasys PRIMER

PRIMER 21.1 - 64 bit (build 35746), Licensed to : Arup_UK

File Keywords Tools Display Images Viewing Options Help Blank PART (any type) Key in: <Search> Undo

PRIMER: M1: FS_AEMDB_75_x-ref_z-ref_50M_Sim_1

Automotive Assessments

Crash Test	Occupants	Structures
Far Side + VTC	LHD / RHD; Flip occupants; Delete all	<Airbag>
Regulation: EuroNCAP	WSID-50M; WSID-50M; Edit Delete	B-Pillar (non-struck side)
Version: 2024	not required <empty> Add	<Centre Console>
Model Units: U2 (mm, t, s)	not required <empty> Add	<Contact Dummy-Airbag>
	not required <empty> Add	<Contact Dummy-Centre Console>
	not required <empty> Add	<Contact Dummy-Seat>
		<Contact Dummy-Seatbelt>
		<Driver Seat>
		<Dummy>
		Lap Belt (B6)
		<< < 1/2 > >>

Save To File | Save To Model

Z Y X

%%% WARNING %%%
Part ID name and number fields are empty for part seed elements in model LSTC MPDB Shell Model

Tools | Mesh tools | Post

Assign ms | Composite | JavaScript | Other
Attached | Connection | Load Path | Remove
Batteries | Cut Section | Macro | Rigidify
Blanking | Find | Mass Prop | Safety
BOM | Groups | Measure | Text Edit
Check | ICFD Setup | Mechanism | Units
Clipboard | Implicit | Node Import | Workflows
Coat | Include | Orient | Xrefs

Volumes I & II | Volume III

AIRBAG | DAMPING | INCLUDE | RAIL
ALE | DATABS | INITIAL | RIGIDWALL
BOUND | DEFINE | INTEGRN | RVE
CASE | DEF_2_RG | INTRFCE | SECTION
COMMENT | ELEMENT | LOAD | SENSOR
CONSTR | EOS | MAT | SET
CONTACT | FATIGUE | NODE | TERMIN
CONTROL | FREQ | PARAM | UNIT
CONTROLLE | HOURGL | PART
COSIM | IGA | PERTURB

Model | Part tree

M1:Main file

Model functions

Create | Copy | Delete | List | Modified?
Read | Merge | Build | Compare | Renumber
Write | Submit | Check | Contents | Utilities

Apply | Inc declash | Scan all | Quick scan

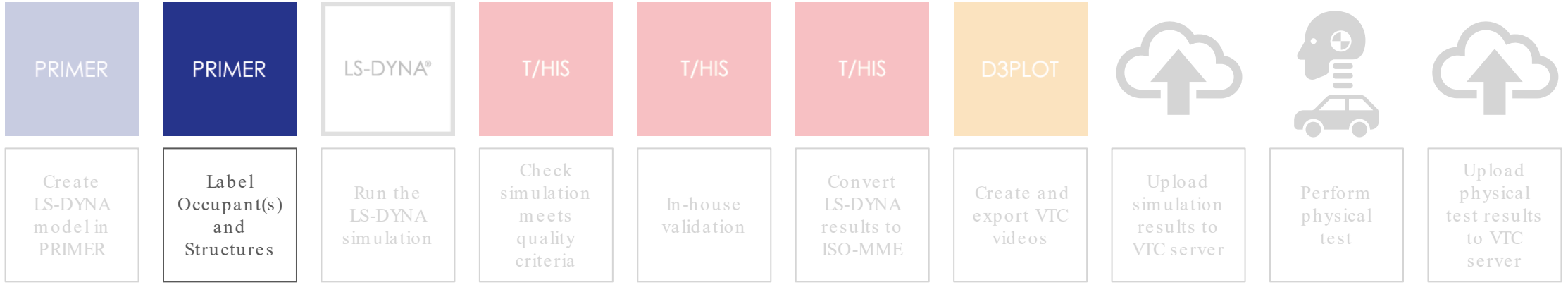
LS-DYNA
NASTRAN
RADIOSS
ABAQUS
IGES
STEP
JT
More...

file read log
24 Lines
0 Warnings
0 Errors
View log | Database... | Options | Advice

Keyword
Read any *INCLUDE files

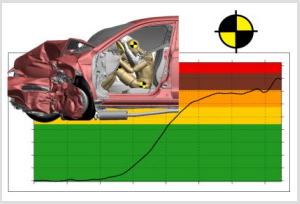
File: DB_75_x-ref_z-ref_50M_Sim_1.key
Model No: 2 (First free)

Manual | CT | SI | Node plot | Li | Hi | Sh | Save P | Lock
Stop | Timestep | Init Vels (Tr) | AC | Zoom | CN | All
Tidy | +XY | +YZ | +XZ | +ISO | Views | Rev
? | -XY | -YZ | -XZ | -ISO | Ent

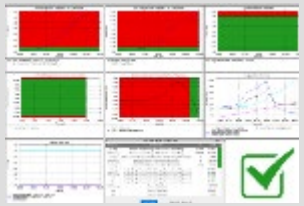


Workflow User Data

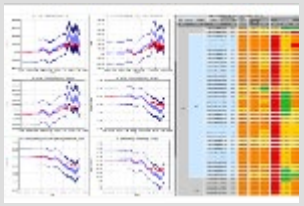
Virtual Testing Workflows – Shared user data



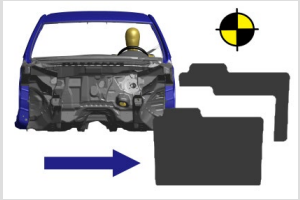
Automotive Assessments



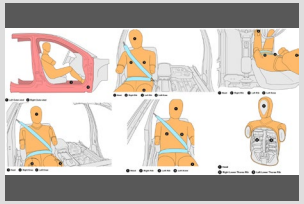
VTC Quality Criteria



Sim VT

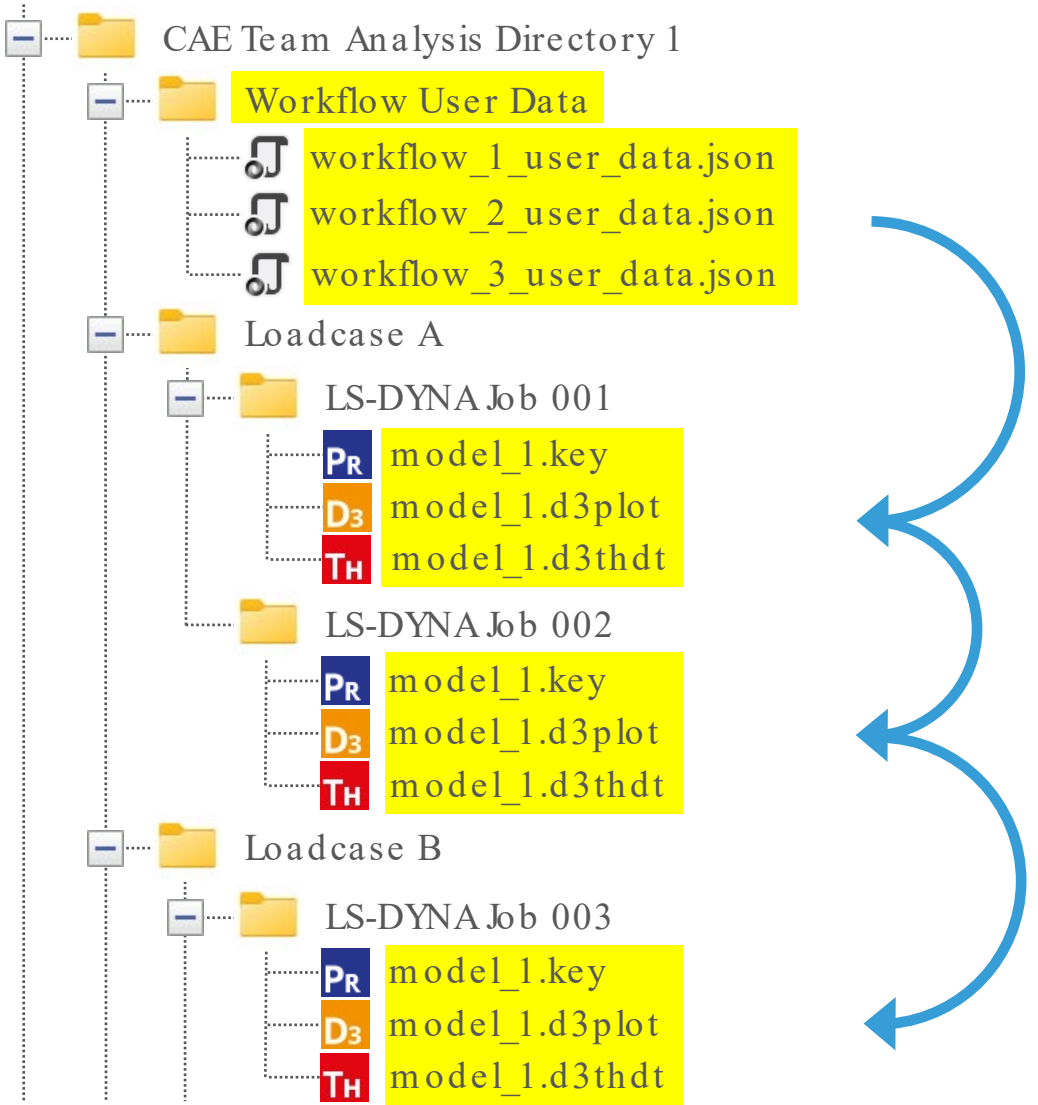


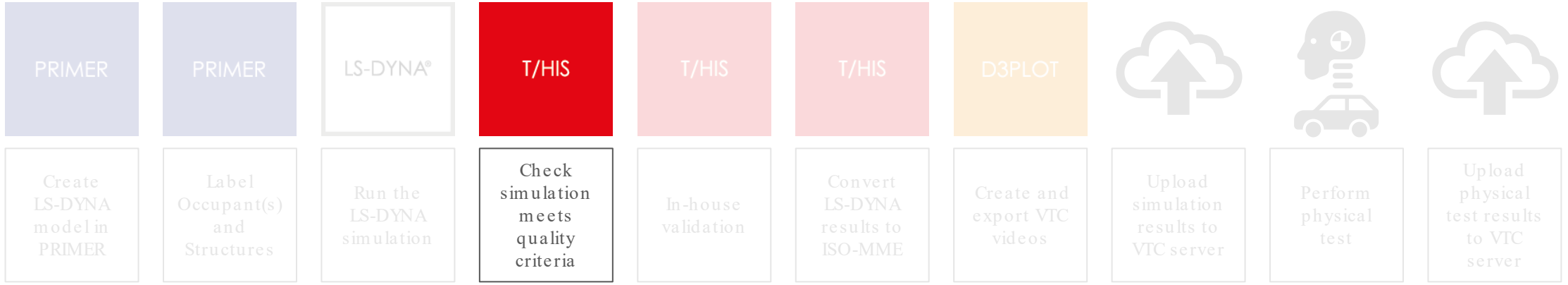
LS-DYNA to ISO-MME



VTC Videos

Workflow User Data JSON Files





VTC Quality Criteria

VTC Quality Criteria

REPORTER

Euro NCAP VTC Quality Criteria

2024 (Version 1.0)

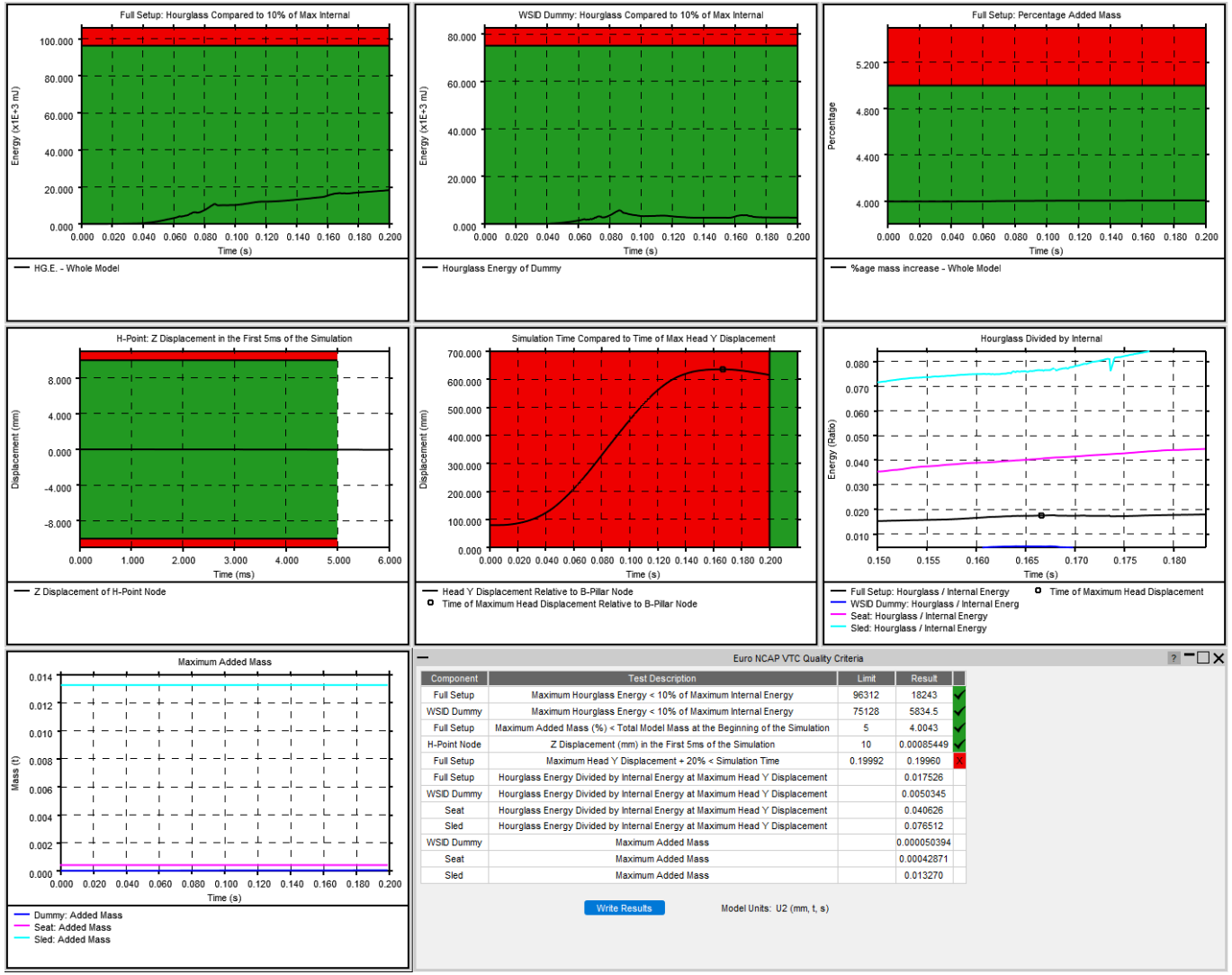
Summary

Component	Test Description	Value	Limit	Result
Full Setup	Maximum Hourglass Energy < 10% of Maximum Internal Energy	18243	96312	PASS
WSID Dummy	Maximum Hourglass Energy < 10% of Maximum Internal Energy	5834.5	75128	PASS
Full Setup	Maximum Added Mass (%) < Total Model Mass at the beginning of the simulation	4.0043	5	PASS
H-Point Node	Z Displacement (mm) in the first 5 ms of the simulation	0.00085449	10	PASS
Full Setup	(Time of Maximum Head Y Displacement) + 20% < Simulation Time	0.1996	0.19992	FAIL
Full Setup	Hourglass Energy divided by Internal Energy at Time of Maximum Head Y Displacement	0.017526	[monitored]	[monitored]
WSID Dummy	Hourglass Energy divided by Internal Energy at Time of Maximum Head Y Displacement	0.0050345	[monitored]	[monitored]
Seat	Hourglass Energy divided by Internal Energy at Time of Maximum Head Y Displacement	0.040626	[monitored]	[monitored]
Sled	Hourglass Energy divided by Internal Energy at Time of Maximum Head Y Displacement	0.076512	[monitored]	[monitored]
Dummy	Maximum Added Mass	5.0394e-5	[monitored]	[monitored]
Seat	Maximum Added Mass	0.00042871	[monitored]	[monitored]
Sled	Maximum Added Mass	0.01327	[monitored]	[monitored]

Model | Z:/example/model/08_FS_AEMDB_75_x-ref_z-ref_50M_Sim_1.key

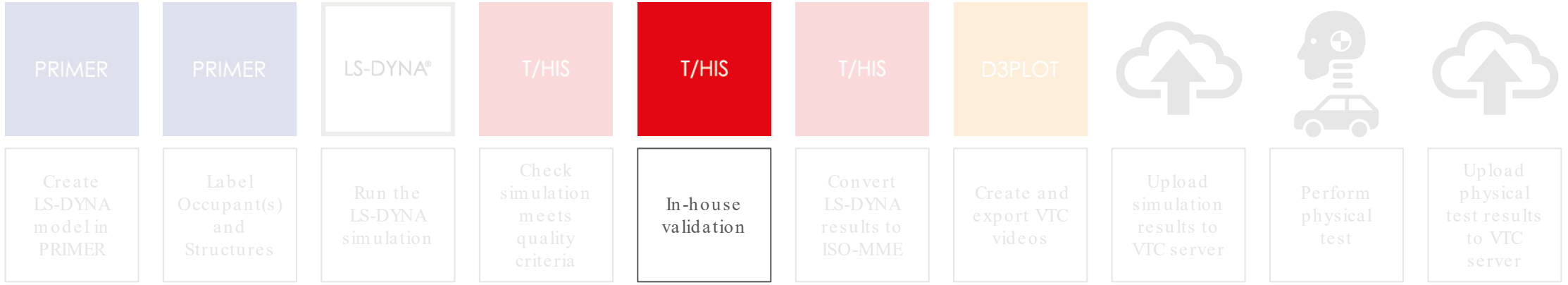
VTC Quality Criteria

T/HIS

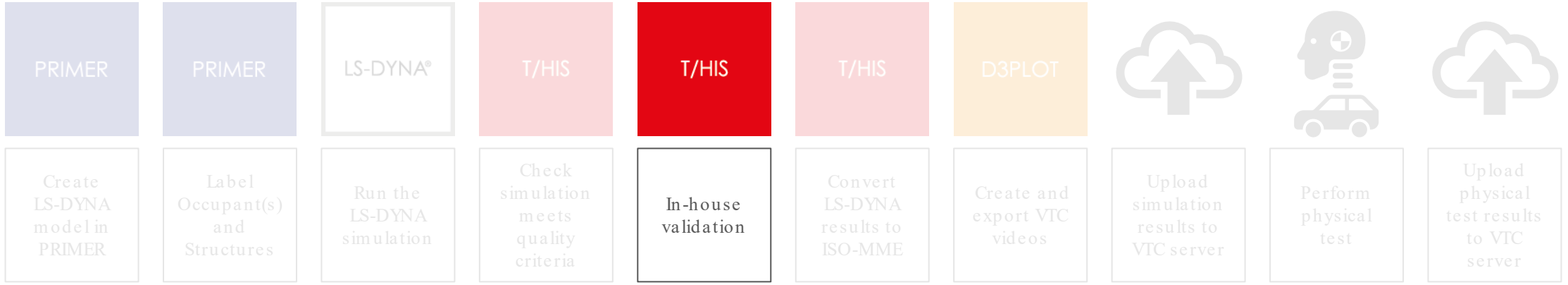


Component	Test Description	Limit	Result
Full Setup	Maximum Hourglass Energy < 10% of Maximum Internal Energy	96312	18243
WSID Dummy	Maximum Hourglass Energy < 10% of Maximum Internal Energy	75128	5834.5
Full Setup	Maximum Added Mass (%) < Total Model Mass at the Beginning of the Simulation	5	4.0043
H-Point Node	Z Displacement (mm) in the First 5ms of the Simulation	10	0.00085449
Full Setup	Maximum Head Y Displacement + 20% < Simulation Time	0.19992	0.19960
Full Setup	Hourglass Energy Divided by Internal Energy at Maximum Head Y Displacement		0.017526
WSID Dummy	Hourglass Energy Divided by Internal Energy at Maximum Head Y Displacement		0.0050345
Seat	Hourglass Energy Divided by Internal Energy at Maximum Head Y Displacement		0.040626
Sled	Hourglass Energy Divided by Internal Energy at Maximum Head Y Displacement		0.076512
WSID Dummy	Maximum Added Mass		0.000050394
Seat	Maximum Added Mass		0.00042871
Sled	Maximum Added Mass		0.013270

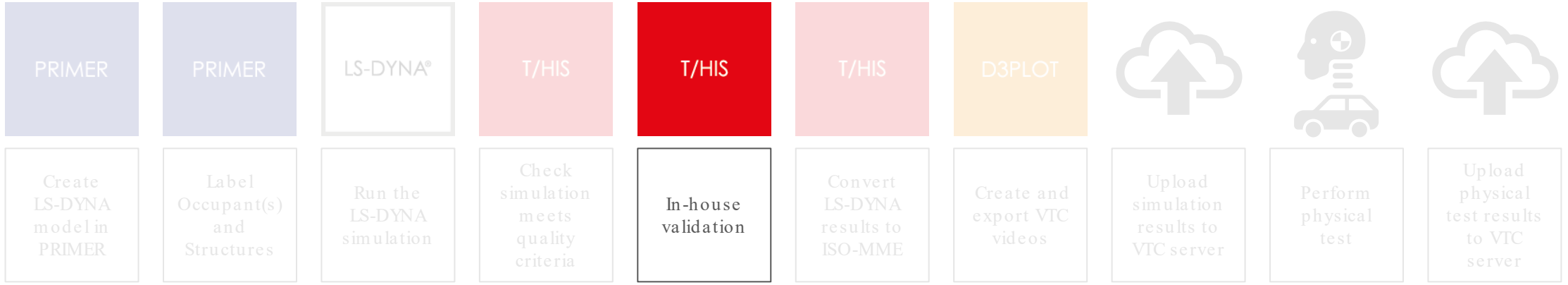
Oasys


PRIMER
PRIMER
LS-DYNA®
T/HIS
T/HIS
T/HIS
D3PLOT
Create LS-DYNA model in PRIMER
Label Occupant(s) and Structures
Run the LS-DYNA simulation
Check simulation meets quality criteria
In-house validation
Convert LS-DYNA results to ISO-MME
Create and export VTC videos
Upload simulation results to VTC server
Perform physical test
Upload physical test results to VTC server

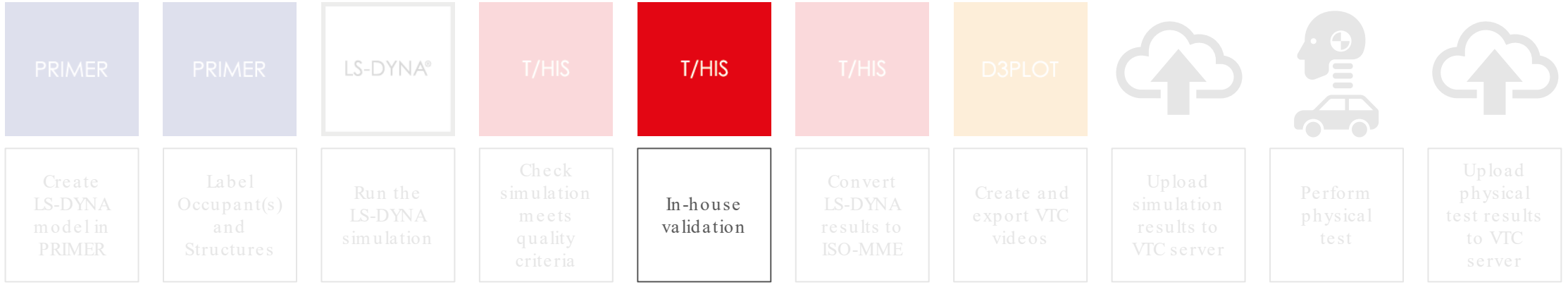
Sim VT


PRIMER
PRIMER
LS-DYNA®
T/HIS
T/HIS
T/HIS
D3PLOT
Create LS-DYNA model in PRIMER
Label Occupant(s) and Structures
Run the LS-DYNA simulation
Check simulation meets quality criteria
In-house validation
Convert LS-DYNA results to ISO-MME
Create and export VTC videos
Upload simulation results to VTC server
Perform physical test
Upload physical test results to VTC server

Sim VT

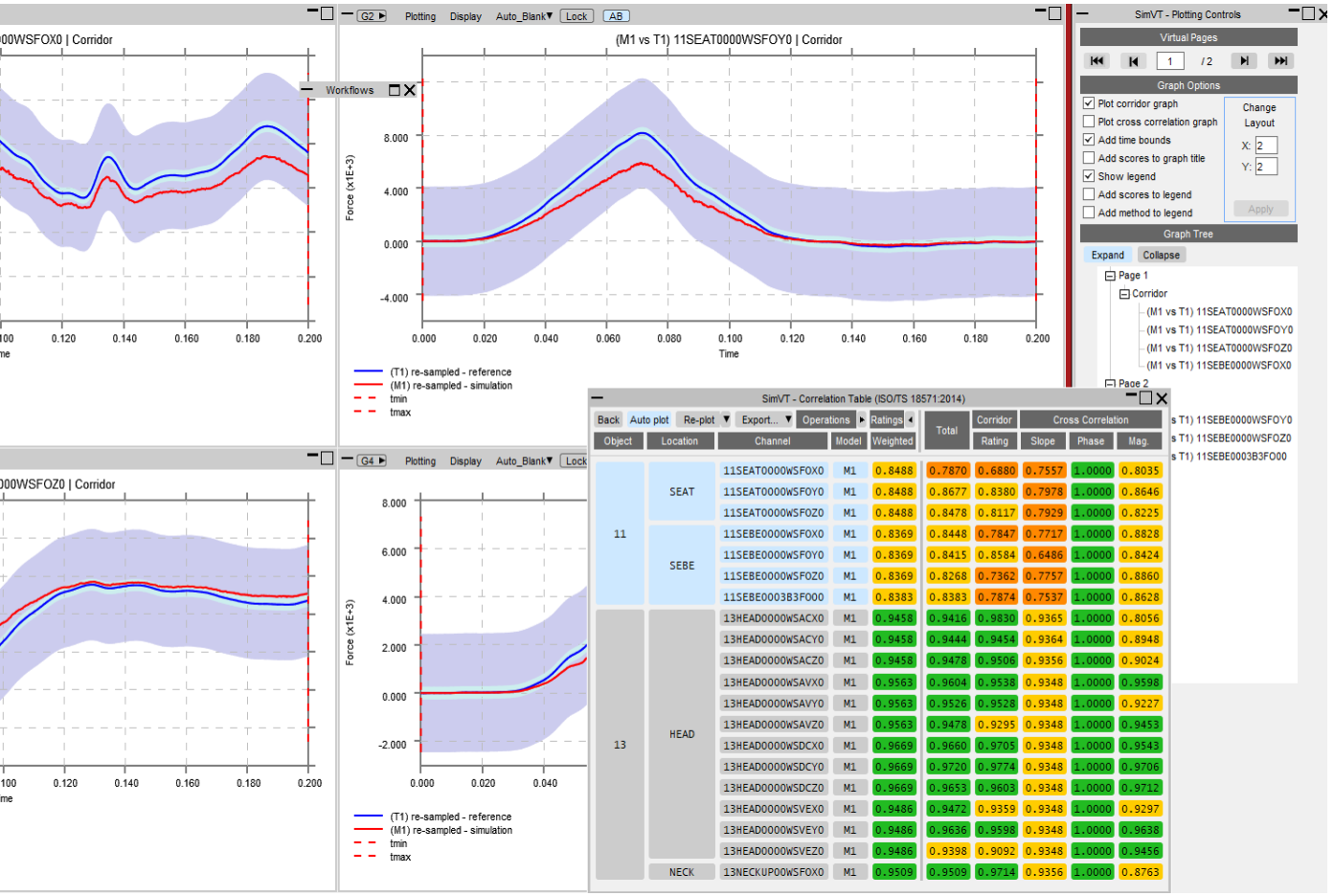


Simulation Versus Test

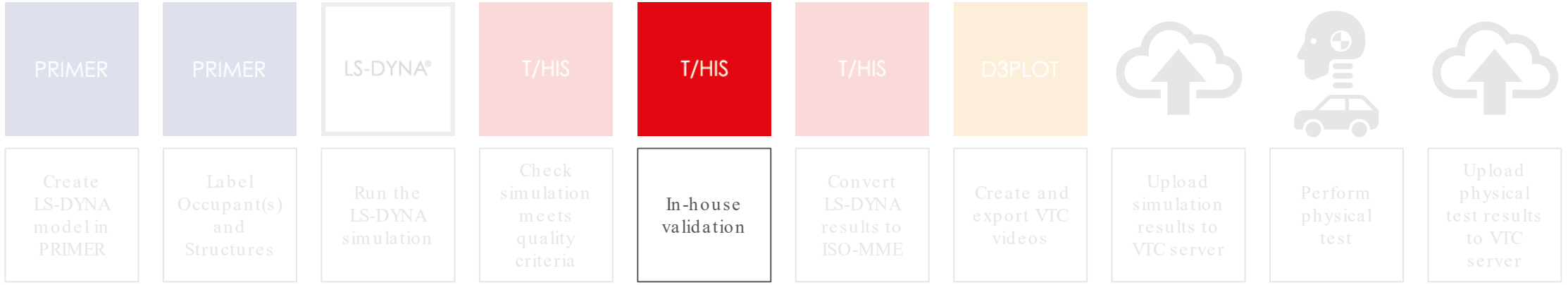


Simulation **V**irtual **T**esting

Sim VT

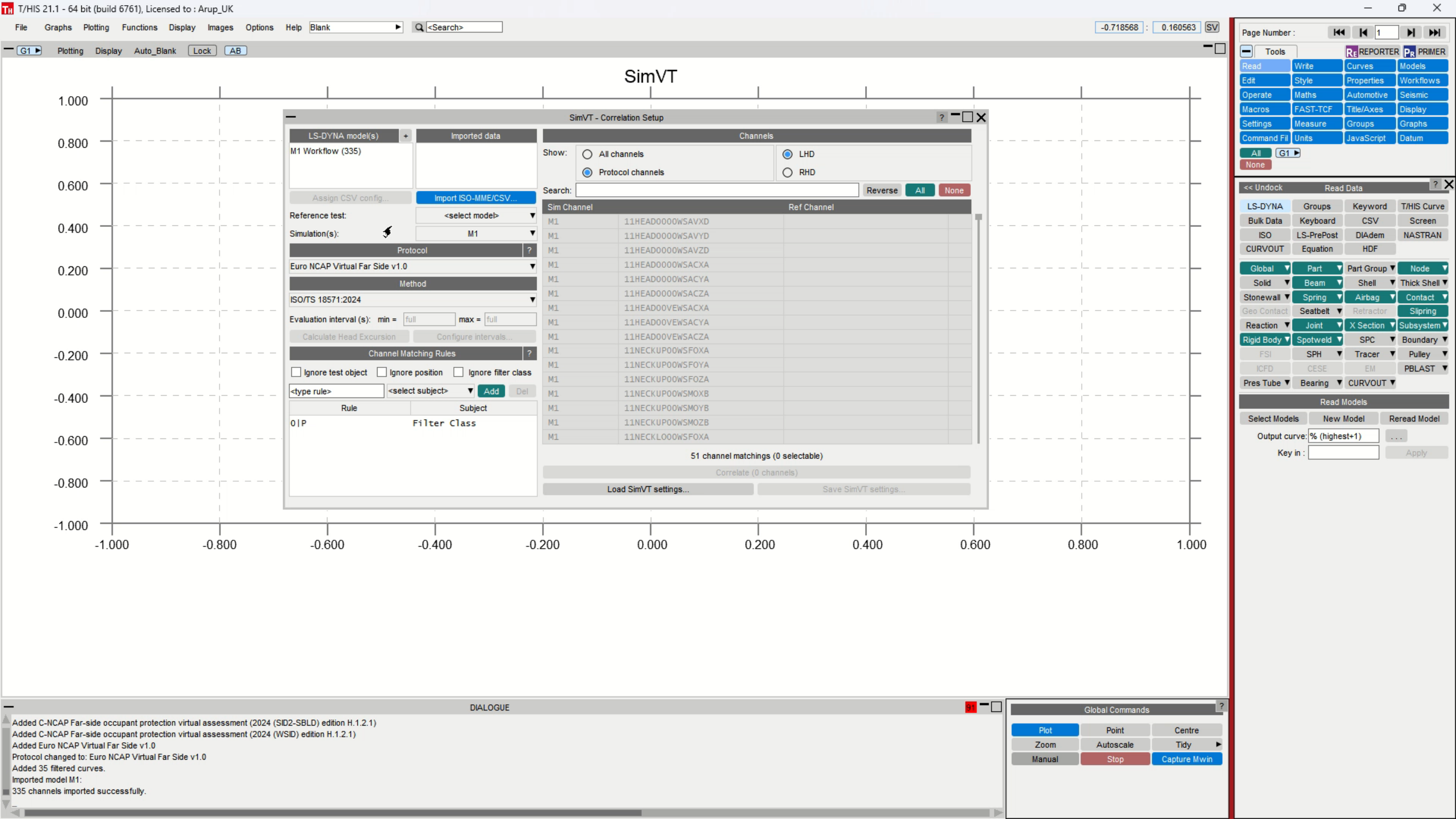

(M1 vs T1) 11SEAT0000WSFOY0 | Corridor
Force (x1E-3)
Time
(T1) re-sampled - reference
(M1) re-sampled - simulation
tmin
tmax
Workflows
SimVT - Plotting Controls
Virtual Pages
Graph Options
Plot corridor graph
Plot cross correlation graph
Add time bounds
Add scores to graph title
Show legend
Add scores to legend
Add method to legend
Change Layout
Graph Tree
Expand
Collapse
Page 1
Corridor
(M1 vs T1) 11SEAT0000WSFOX0
(M1 vs T1) 11SEAT0000WSFOY0
(M1 vs T1) 11SEAT0000WSFOZ0
(M1 vs T1) 11SEBE0000WSFOX0
Page 2
SimVT - Correlation Table (ISO/TS 18571:2014)
Back
Auto plot
Re-plot
Export...
Operations
Ratings
Object
Location
Channel
Model
Weighted
Total
Corridor
Rating
Cross Correlation
Slope
Phase
Mag.
SEAT
SEBE
HEAD
NECK
11SEAT0000WSFOX0
11SEAT0000WSFOY0
11SEAT0000WSFOZ0
11SEBE0000WSFOX0
11SEBE0000WSFOY0
11SEBE0000WSFOZ0
11SEBE0003B3FO00
13HEAD0000WSACX0
13HEAD0000WSACY0
13HEAD0000WSACZ0
13HEAD0000WSAVX0
13HEAD0000WSAVY0
13HEAD0000WSAVZ0
13HEAD0000WSDCX0
13HEAD0000WSDCY0
13HEAD0000WSDCZ0
13HEAD0000WSVEX0
13HEAD0000WSVEY0
13HEAD0000WSVEZ0
13NECKUP00WSFOX0

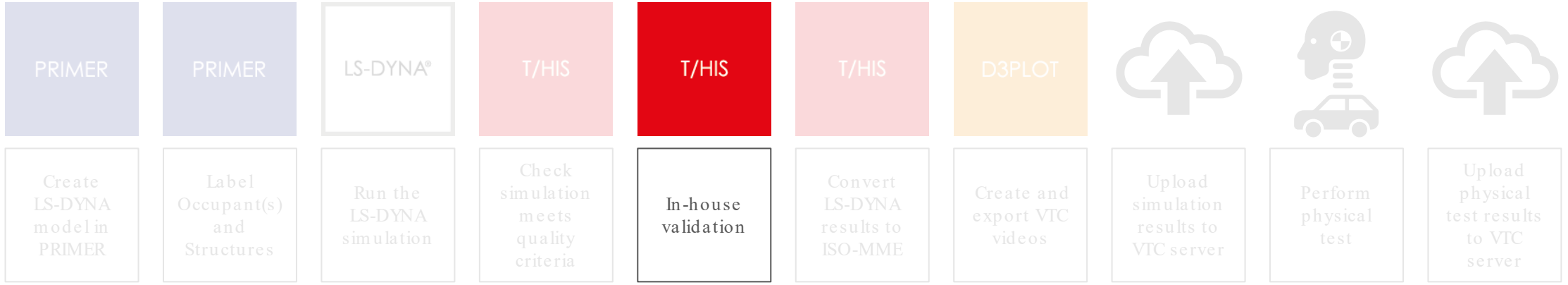

Euro NCAP Virtual Far Side 2024 VC1 (ISO Scores)
Head Excursion (Simulation)
M1 Head Excursion = | Head - Sled | + 0.08
t_end ≥ 1.2 t_max
FAIL
Euro NCAP Virtual Far Side 2024 VC1 (ISO Scores)
11SHRIRI00WSD
Sensor score > 0.5
Euro NCAP Virtual Far Side 2024 VC1 (ISO Scores)
11HEAD0000WSAV_D
Sensor score > 0.5
PASS



Sim VT

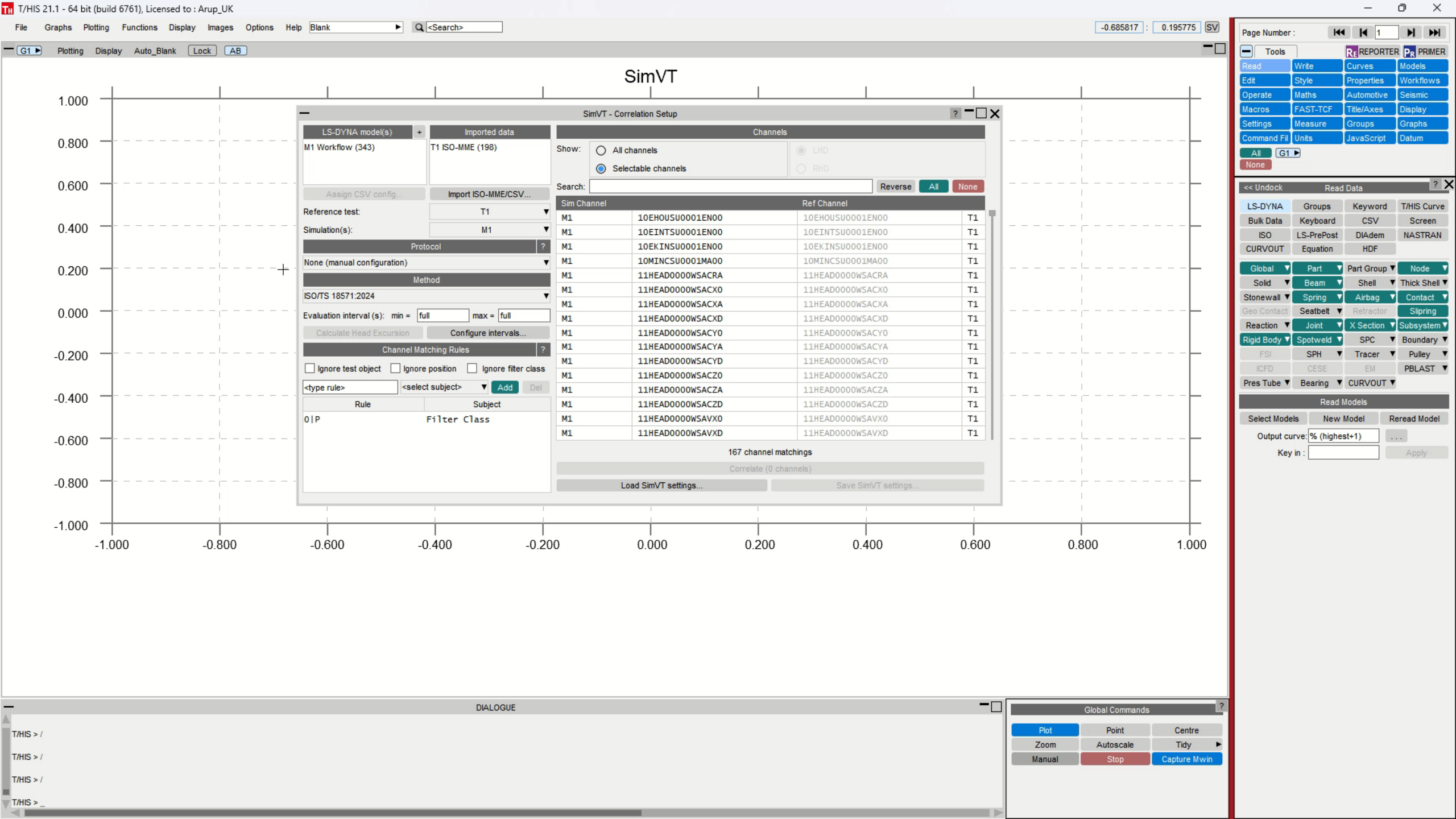
Importing Test Data


T/HIS 21.1 - 64 bit (build 6761), Licensed to : Arup_UK
File Graphs Plotting Functions Display Images Options Help Blank <Search>
-0.718568 : 0.160563 SV
G1 Plotting Display Auto_Blank Lock AB
SimVT
1.000 0.800 0.600 0.400 0.200 0.000 -0.200 -0.400 -0.600 -0.800 -1.000
-1.000 -0.800 -0.600 -0.400 -0.200 0.000 0.200 0.400 0.600 0.800 1.000
SimVT - Correlation Setup
LS-DYNA model(s)
M1 Workflow (335)
Imported data
Assign CSV config...
Import ISO-MME/CSV...
Reference test: <select model>
Simulation(s): M1
Protocol
Euro NCAP Virtual Far Side v1.0
Method
ISO/TS 18571:2024
Evaluation interval (s): min = full max = full
Calculate Head Excursion
Configure intervals...
Channel Matching Rules
Ignore test object
Ignore position
Ignore filter class
<type rule>
<select subject>
Add
Del
Rule
Subject
0|P Filter Class
Channels
Show: All channels Protocol channels LHD RHD
Search:
Reverse All None
Sim Channel Ref Channel
M1 11HEAD0000WSAVXD
M1 11HEAD0000WSAVYD
M1 11HEAD0000WSAVZD
M1 11HEAD0000WSACXA
M1 11HEAD0000WSACYA
M1 11HEAD0000WSACZA
M1 11HEAD00VEWSACXA
M1 11HEAD00VEWSACYA
M1 11HEAD00VEWSACZA
M1 11NECKUP00WSFOXA
M1 11NECKUP00WSFOYA
M1 11NECKUP00WSFOZA
M1 11NECKUP00WSMOXB
M1 11NECKUP00WSMOYB
M1 11NECKUP00WSMOZB
M1 11NECKLO00WSFOXA
51 channel matchings (0 selectable)
Correlate (0 channels)
Load SimVT settings...
Save SimVT settings...
Page Number : 1
Tools REPORTER PRIMER
Read Write Curves Models
Edit Style Properties Workflows
Operate Maths Automotive Seismic
Macros FAST-TCF Title/Axes Display
Settings Measure Groups Graphs
Command Fil Units JavaScript Datum
All G1
None
<< Undock Read Data
LS-DYNA Groups Keyword T/HIS Curve
Bulk Data Keyboard CSV Screen
ISO LS-PrePost DIAdem NASTRAN
CURVOUT Equation HDF
Global Part Part Group Node
Solid Beam Shell Thick Shell
Stonewall Spring Airbag Contact
Geo Contact Seatbelt Retractor Slipring
Reaction Joint X Section Subsystem
Rigid Body Spotweld SPC Boundary
FSI SPH Tracer Pulley
ICFD CESE EM PBLAST
Pres Tube Bearing CURVOUT
Read Models
Select Models New Model Reread Model
Output curve: % (highest+1)
Key in :
Apply
DIALOGUE
Added C-NCAP Far-side occupant protection virtual assessment (2024 (SID2-SBLD) edition H.1.2.1)
Added C-NCAP Far-side occupant protection virtual assessment (2024 (WSID) edition H.1.2.1)
Added Euro NCAP Virtual Far Side v1.0
Protocol changed to: Euro NCAP Virtual Far Side v1.0
Added 35 filtered curves.
Imported model M1:
335 channels imported successfully.
Global Commands
Plot Point Centre
Zoom Autoscale Tidy
Manual Stop Capture Mwin



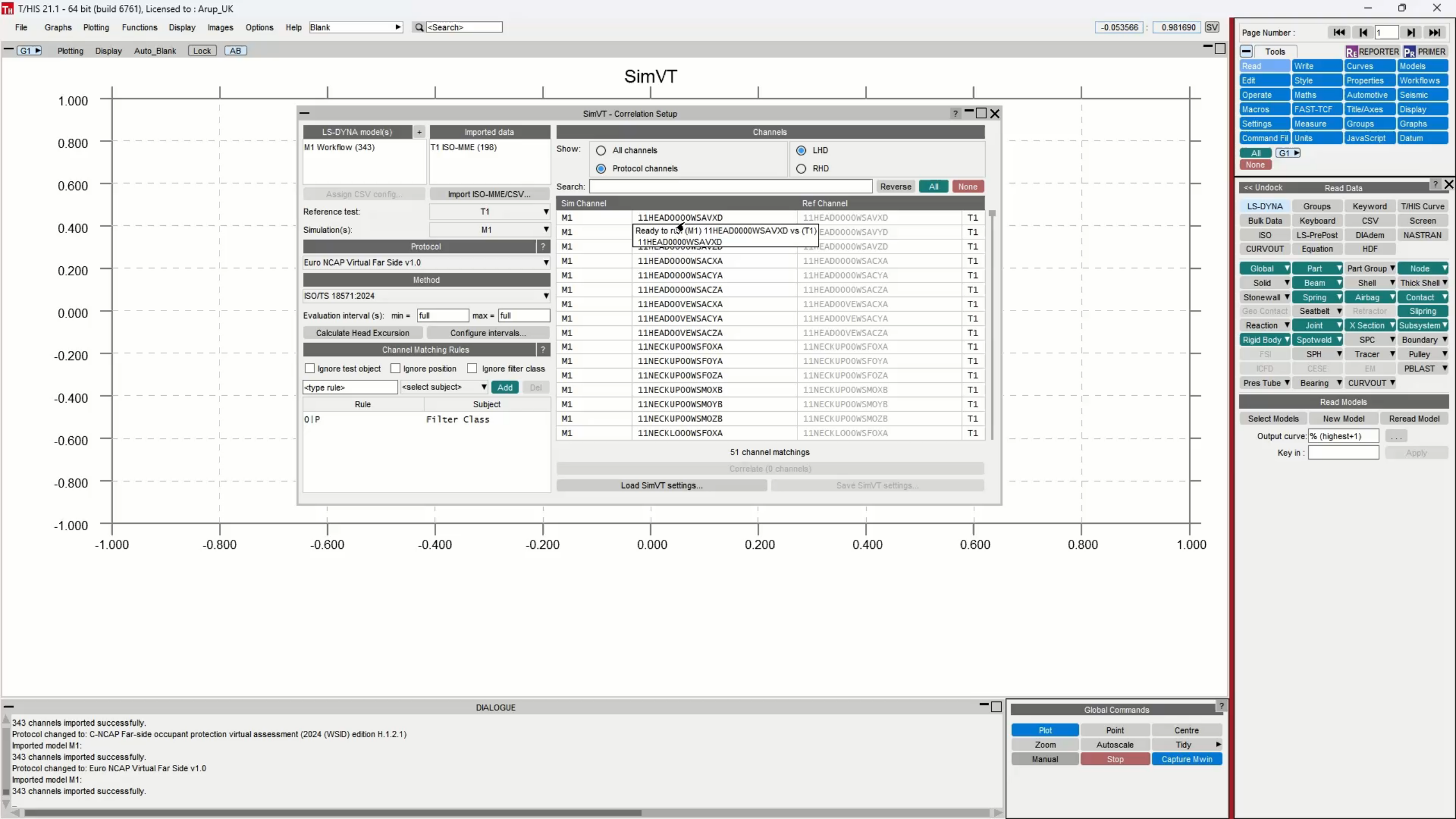
Sim VT

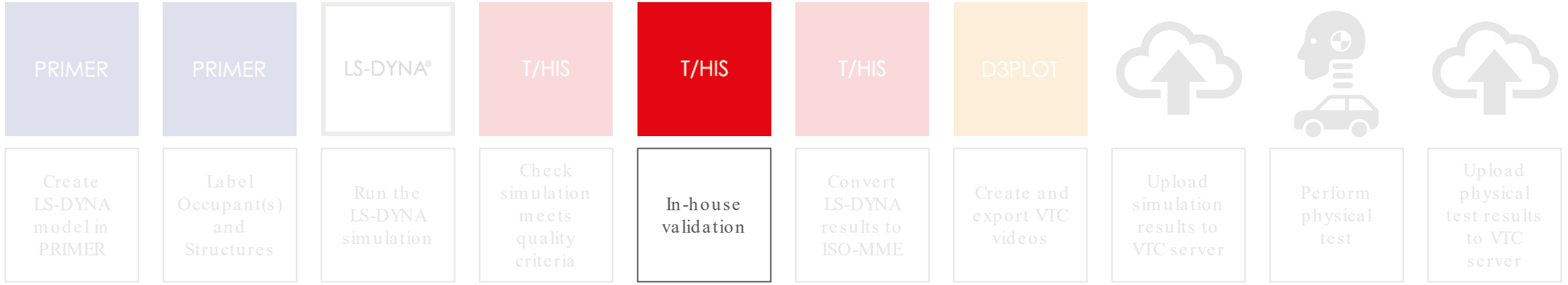
Virtual Testing Protocols


T/HIS 21.1 - 64 bit (build 6761), Licensed to : Arup_UK
File Graphs Plotting Functions Display Images Options Help Blank <Search>
-0.685817 : 0.195775 SV
G1 Plotting Display Auto_Blank Lock AB
SimVT
1.000 0.800 0.600 0.400 0.200 0.000 -0.200 -0.400 -0.600 -0.800 -1.000
-1.000 -0.800 -0.600 -0.400 -0.200 0.000 0.200 0.400 0.600 0.800 1.000
SimVT - Correlation Setup
LS-DYNA model(s)
M1 Workflow (343)
Imported data
T1 ISO-MME (198)
Assign CSV config...
Import ISO-MME/CSV...
Reference test: T1
Simulation(s): M1
Protocol
None (manual configuration)
Method
ISO/TS 18571:2024
Evaluation interval (s): min = full max = full
Calculate Head Excursion
Configure intervals...
Channel Matching Rules
Ignore test object
Ignore position
Ignore filter class
<type rule>
<select subject>
Add
Del
Rule
Subject
0|P Filter Class
Channels
Show: All channels Selectable channels
LHD RHD
Search:
Reverse All None
Sim Channel
Ref Channel
M1 10EHOUSU0001EN00 10EHOUSU0001EN00 T1
M1 10EINTSU0001EN00 10EINTSU0001EN00 T1
M1 10EKINSU0001EN00 10EKINSU0001EN00 T1
M1 10MINCSU0001MA00 10MINCSU0001MA00 T1
M1 11HEAD0000WSACRA 11HEAD0000WSACRA T1
M1 11HEAD0000WSACX0 11HEAD0000WSACX0 T1
M1 11HEAD0000WSACXA 11HEAD0000WSACXA T1
M1 11HEAD0000WSACXD 11HEAD0000WSACXD T1
M1 11HEAD0000WSACY0 11HEAD0000WSACY0 T1
M1 11HEAD0000WSACYA 11HEAD0000WSACYA T1
M1 11HEAD0000WSACYD 11HEAD0000WSACYD T1
M1 11HEAD0000WSACZ0 11HEAD0000WSACZ0 T1
M1 11HEAD0000WSACZA 11HEAD0000WSACZA T1
M1 11HEAD0000WSACZD 11HEAD0000WSACZD T1
M1 11HEAD0000WSAVX0 11HEAD0000WSAVX0 T1
M1 11HEAD0000WSAVXD 11HEAD0000WSAVXD T1
167 channel matchings
Correlate (0 channels)
Load SimVT settings...
Save SimVT settings...
Page Number : 1
Tools REPORTER PRIMER
Read Write Curves Models
Edit Style Properties Workflows
Operate Maths Automotive Seismic
Macros FAST-TCF Title/Axes Display
Settings Measure Groups Graphs
Command Fil Units JavaScript Datum
All G1
None
<< Undock Read Data
LS-DYNA Groups Keyword T/HIS Curve
Bulk Data Keyboard CSV Screen
ISO LS-PrePost DIAdem NASTRAN
CURVOUT Equation HDF
Global Part Part Group Node
Solid Beam Shell Thick Shell
Stonewall Spring Airbag Contact
Geo Contact Seatbelt Retractor Slipring
Reaction Joint X Section Subsystem
Rigid Body Spotweld SPC Boundary
FSI SPH Tracer Pulley
ICFD CESE EM PBLAST
Pres Tube Bearing CURVOUT
Read Models
Select Models New Model Reread Model
Output curve: % (highest+1)
Key in :
Apply
DIALOGUE
T/HIS > /
T/HIS > /
T/HIS > /
T/HIS > _
Global Commands
Plot Point Centre
Zoom Autoscale Tidy
Manual Stop Capture Mwin

Sim VT

Correlation

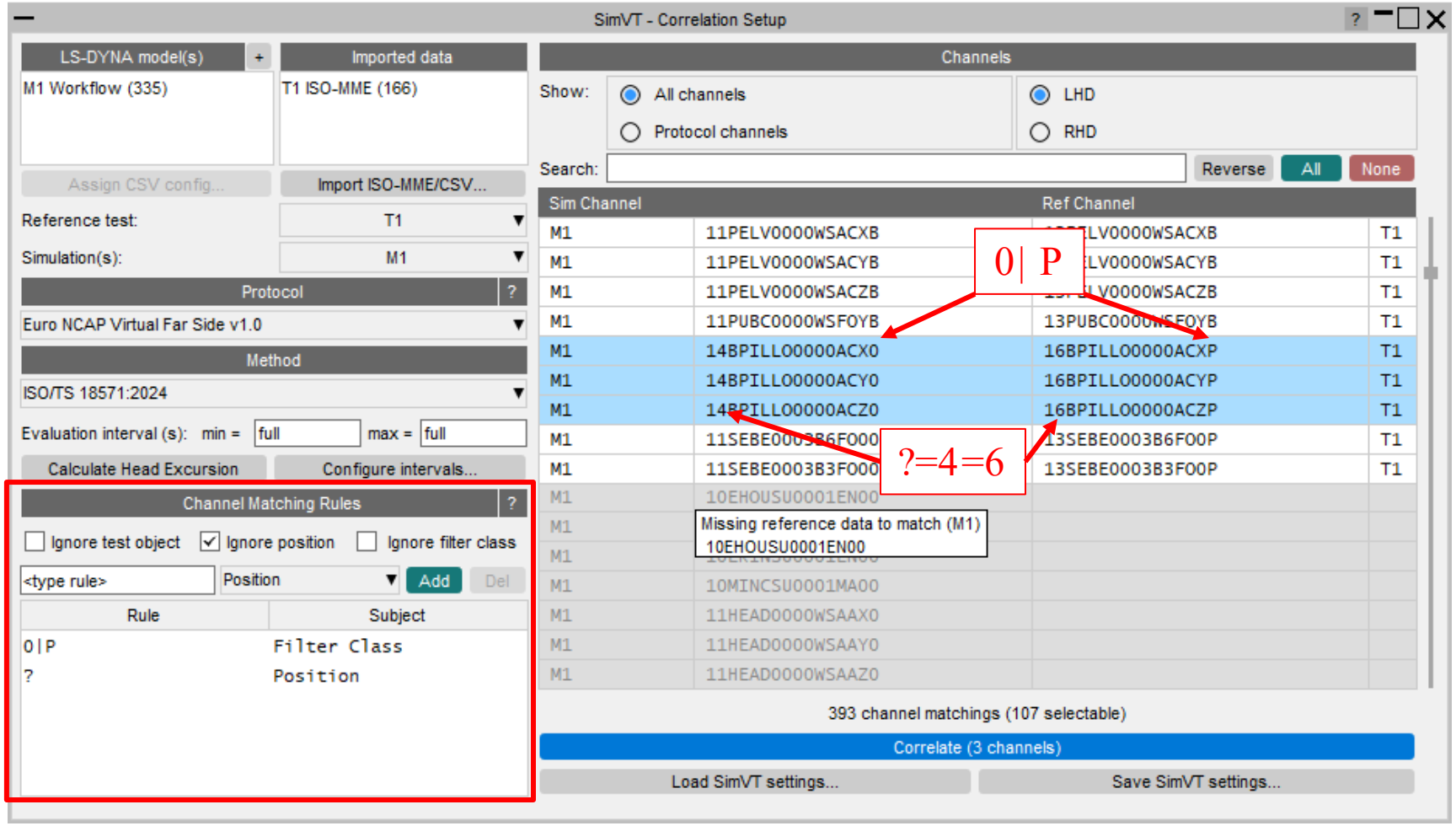

T/HIS 21.1 - 64 bit (build 6761), Licensed to : Arup_UK
File Graphs Plotting Functions Display Images Options Help Blank <Search>
-0.053566 : 0.981690 SV
G1 Plotting Display Auto_Blank Lock AB
SimVT
1.000 0.800 0.600 0.400 0.200 0.000 -0.200 -0.400 -0.600 -0.800 -1.000
-1.000 -0.800 -0.600 -0.400 -0.200 0.000 0.200 0.400 0.600 0.800 1.000
SimVT - Correlation Setup
LS-DYNA model(s)
M1 Workflow (343)
Imported data
T1 ISO-MME (198)
Assign CSV config...
Import ISO-MME/CSV...
Reference test: T1
Simulation(s): M1
Protocol
Euro NCAP Virtual Far Side v1.0
Method
ISO/TS 18571:2024
Evaluation interval (s): min = full max = full
Calculate Head Excursion
Configure intervals...
Channel Matching Rules
Ignore test object
Ignore position
Ignore filter class
<type rule>
<select subject>
Add
Del
Rule
Subject
0|P Filter Class
Channels
Show: All channels Protocol channels LHD RHD
Search:
Reverse All None
Sim Channel Ref Channel
M1 11HEAD0000WSAVXD 11HEAD0000WSAVXD T1
M1 11HEAD0000WSAVYD T1
M1 11HEAD0000WSAVZD T1
M1 11HEAD0000WSACXA 11HEAD0000WSACXA T1
M1 11HEAD0000WSACYA 11HEAD0000WSACYA T1
M1 11HEAD0000WSACZA 11HEAD0000WSACZA T1
M1 11HEAD00VEWSACXA 11HEAD00VEWSACXA T1
M1 11HEAD00VEWSACYA 11HEAD00VEWSACYA T1
M1 11HEAD00VEWSACZA 11HEAD00VEWSACZA T1
M1 11NECKUP00WSFOXA 11NECKUP00WSFOXA T1
M1 11NECKUP00WSFOYA 11NECKUP00WSFOYA T1
M1 11NECKUP00WSFOZA 11NECKUP00WSFOZA T1
M1 11NECKUP00WSMOXB 11NECKUP00WSMOXB T1
M1 11NECKUP00WSMOYB 11NECKUP00WSMOYB T1
M1 11NECKUP00WSMOZB 11NECKUP00WSMOZB T1
M1 11NECKLO00WSFOXA 11NECKLO00WSFOXA T1
Ready to run (M1) 11HEAD0000WSAVXD vs (T1) 11HEAD0000WSAVXD
51 channel matchings
Correlate (0 channels)
Load SimVT settings...
Save SimVT settings...
Page Number : 1
Tools REPORTER PRIMER
Read Write Curves Models
Edit Style Properties Workflows
Operate Maths Automotive Seismic
Macros FAST-TCF Title/Axes Display
Settings Measure Groups Graphs
Command Fil Units JavaScript Datum
All G1
None
<< Undock Read Data
LS-DYNA Groups Keyword T/HIS Curve
Bulk Data Keyboard CSV Screen
ISO LS-PrePost DIAdem NASTRAN
CURVOUT Equation HDF
Global Part Part Group Node
Solid Beam Shell Thick Shell
Stonewall Spring Airbag Contact
Geo Contact Seatbelt Retractor Slipring
Reaction Joint X Section Subsystem
Rigid Body Spotweld SPC Boundary
FSI SPH Tracer Pulley
ICFD CESE EM PBLAST
Pres Tube Bearing CURVOUT
Read Models
Select Models New Model Reread Model
Output curve: % (highest+1)
Key in :
Apply
DIALOGUE
343 channels imported successfully.
Protocol changed to: C-NCAP Far-side occupant protection virtual assessment (2024 (WSID) edition H.1.2.1)
Imported model M1:
343 channels imported successfully.
Protocol changed to: Euro NCAP Virtual Far Side v1.0
Imported model M1:
343 channels imported successfully.
Global Commands
Plot Point Centre
Zoom Autoscale Tidy
Manual Stop Capture Mwin



Sim VT

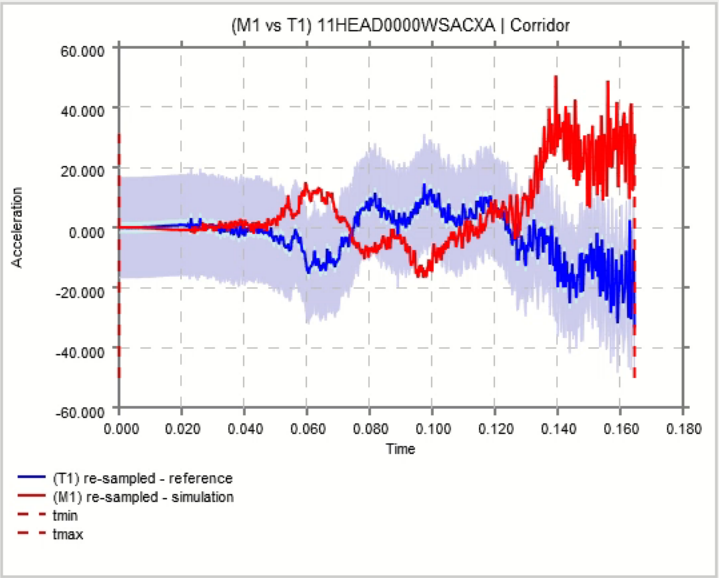
Dealing with inconsistent data

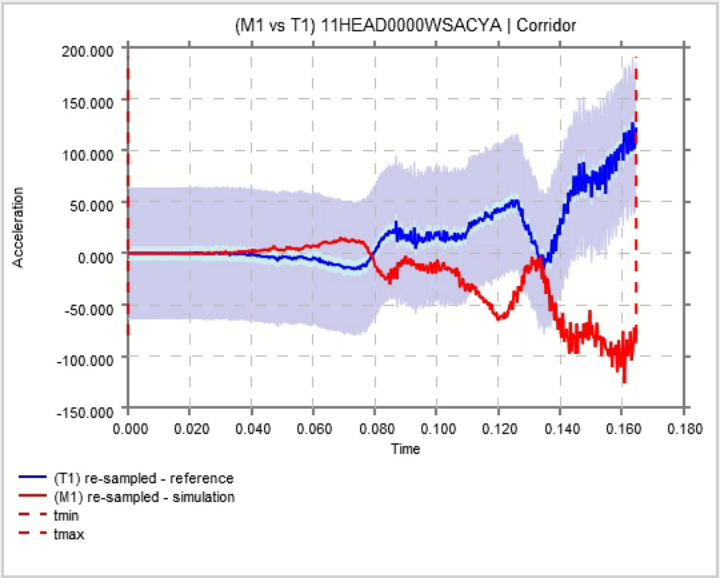
SimVT – Dealing with inconsistent data (Channel Matching)

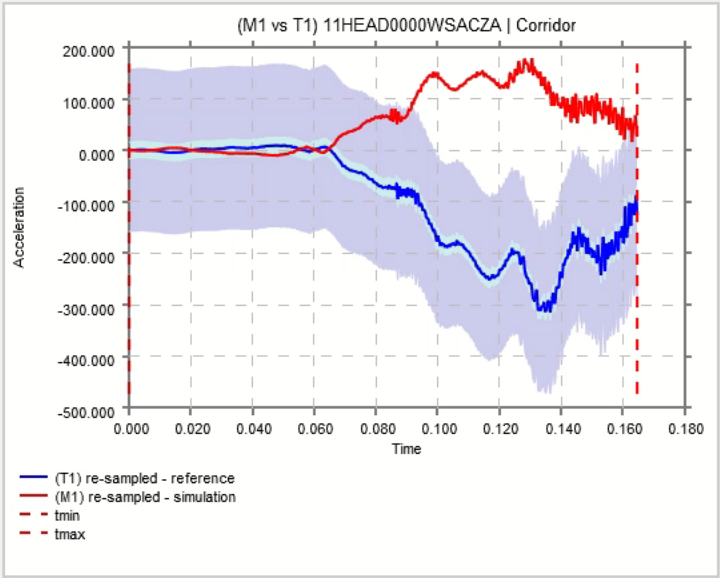


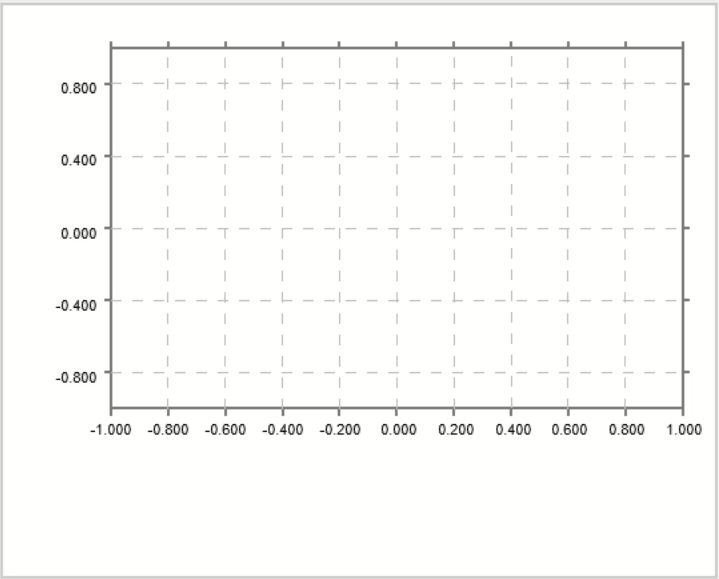
T/HIS 21.1 - 64 bit (build 6761), Licensed to : Arup_UK

File Graphs Plotting Functions Display Images Options Help Blank <Search> -0.869750 : 0.821687 SV

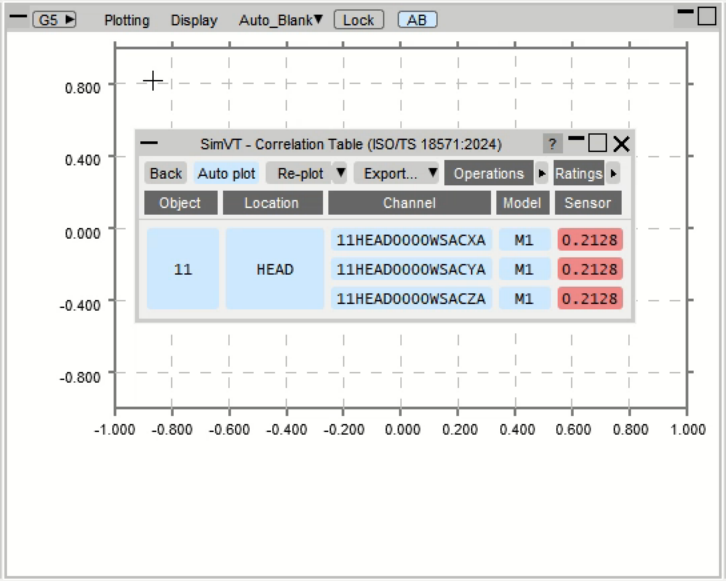








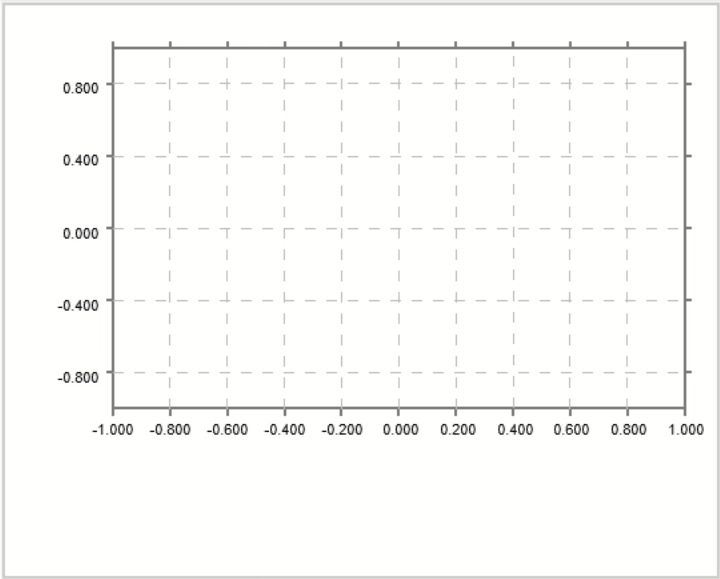
G5 Plotting Display Auto_Blank Lock AB



SimVT - Correlation Table (ISO/TS 18571:2024)

Back | Auto plot | Re-plot | Export... | Operations | Ratings

Object	Location	Channel	Model	Sensor
11	HEAD	11HEAD0000WSACXA	M1	0.2128
		11HEAD0000WSACYA	M1	0.2128
		11HEAD0000WSACZA	M1	0.2128



SimVT - Plotting Controls

Virtual Pages: 1 / 1

Graph Options

- [x] Plot corridor graph
- [ ] Plot cross correlation graph
- [x] Add time bounds
- [ ] Add scores to graph title
- [x] Show legend
- [ ] Add scores to legend
- [ ] Add method to legend

Change Layout X: 3 Y: 2 Apply

Graph Tree

Expand Collapse

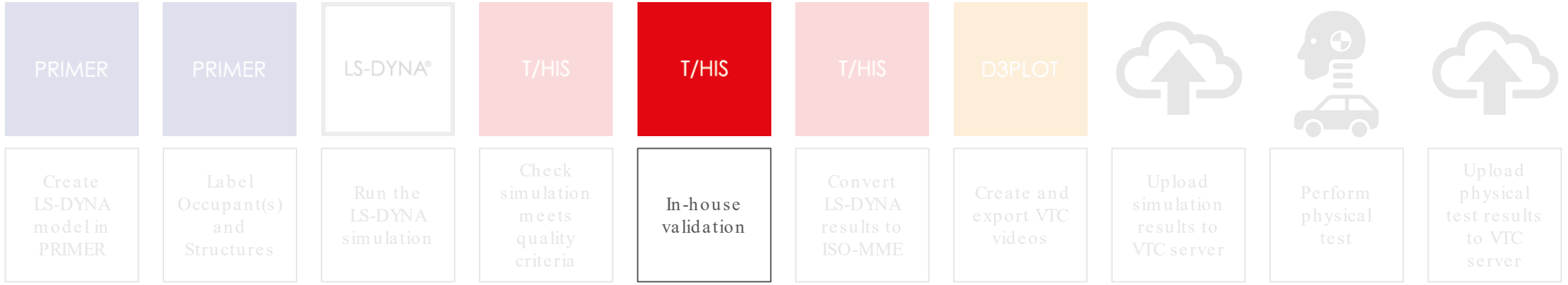
- Page 1
  - Corridor
    - (M1 vs T1) 11HEAD0000WSACXA
    - (M1 vs T1) 11HEAD0000WSACYA
    - (M1 vs T1) 11HEAD0000WSACZA

DIALOGUE

T/HIS >
T/HIS >
T/HIS >
T/HIS >
T/HIS >
T/HIS >
T/HIS >
T/HIS > _

Global Commands

Plot	Point	Centre
Zoom	Autoscale	Tidy
Manual	Stop	Capture Mwin



Sim VT

Virtual Testing Validation and Automated Reporting

Sim VT – VTP Sensor Scores and validation criteria

Euro NCAP Virtual Far Side 2024 VC1 (ISO Scores)

2024 (v1.0)

Results Summary

Sensor		1D or X Axis		Y Axis		Z Axis		Sensor Score	Mandatory in monitoring phase
Description	ISO Code	ISO Score	|Max|	ISO Score	|Max|	ISO Score	|Max|		
Head CoG Angular velocities	1_HEAD0000WSAV_D	0.866	38.252	0.887	14.355	0.956	16.842	0.892	YES
Head CoG Accelerations	1_HEAD0000WSAC_A	0.668	33.264	0.797	126.611	0.648	314.365	0.689	
Head CoG Accelerations (derived from velocities)	1_HEAD00VEWSAC_A	0.672	29.782	0.804	129.048	0.645	315.975	0.690	
Upper neck Forces	1_NECKUP00WSFO_A	0.722	164.005	0.809	582.462	0.642	1240.491	0.697	
Upper neck Moments	1_NECKUP00WSMO_B	0.779	19.259	0.707	22.694	0.813	6.978	0.751	
Lower neck Forces	1_NECKL000WSFO_A	0.704	467.050	0.693	1022.484	0.641	1285.656	0.671	
Lower neck Moments	1_NECKL000WSMO_B	0.833	129.110	0.766	61.047	0.787	6.388	0.811	
Spine – T4 Accelerations	1_THSP0400WSAC_C	0.705	69.759	0.714	165.482	0.631	124.467	0.684	YES
Spine – T12 Accelerations	1_THSP1200WSAC_C	0.767	124.022	0.747	185.241	0.615	79.222	0.726	YES
Pelvis accelerations	1_PELV0000WSAC_B	0.805	216.938	0.748	301.571	0.695	106.102	0.759	YES
Lumbar spine loadcell Forces	1_LUSP0000WSFO_B	0.653	343.551	0.618	970.252	0.713	2183.339	0.681	
Lumbar spine loadcell Moments	1_LUSP0000WSMO_B	0.713	63.431	0.699	16.936	0.765	21.252	0.721	
Shoulder joint Forces	1_SHLD__00WSFO_B	0.745	431.442	0.774	985.000	0.668	886.773	0.728	
Shoulder – rib Displacement (corrected)	1_SHRI__00WSDS0C	0.799	0.006					0.799	
Thorax - Upper rib Displacement (corrected)	1_TRRI__01WSDS0C	0.710	0.002					0.710	
Thorax - Mid rib Displacement (corrected)	1_TRRI__02WSDS0C	0.744	0.002					0.744	
Thorax - Lower rib Displacement (corrected)	1_TRRI__03WSDS0C	0.805	0.004					0.805	
Abdomen – Upper rib Displacement (corrected)	1_ABRI__01WSDS0C	0.774	0.003					0.774	
Abdomen – Lower rib Displacement (corrected)	1_ABRI__02WSDS0C	0.560	0.005					0.560	
Pubic Symphysis Loadcell Forces	1_PUBC0000WSFOYB	0.694	584.021					0.694	
B-Pillar (non-struck side) Accelerations	1_BPILL00000AC_0	0.638	73.623	0.637	210.811	0.466	88.679	0.597	YES
Lap Belt (B6) Force	1_SEBE0003B3FO00	0.631	2107.680					0.631	
Shoulder Belt (B3) Force	1_SEBE0003B6FO00	0.599	1826.294					0.599	YES

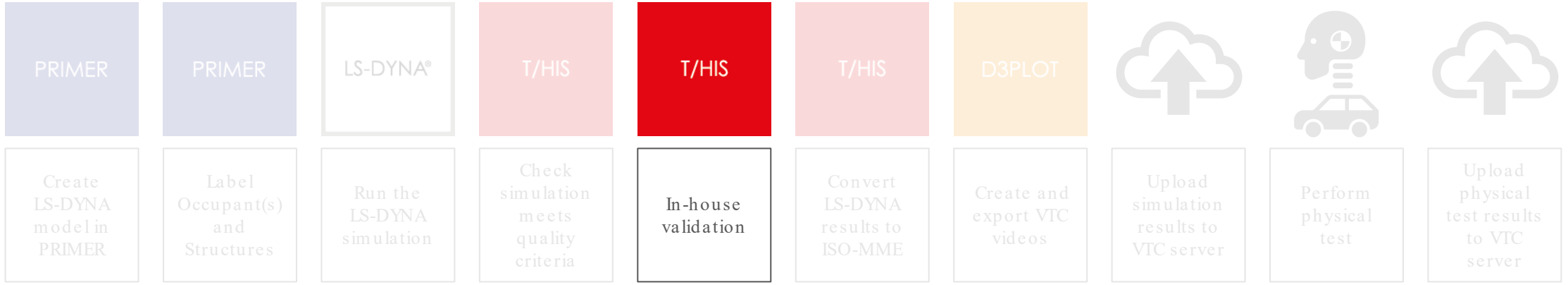
Validation criterion 1	PASS	t_end ≥ 1.2 t_max	FAIL

1/27

Sim C:\VC1\08_FS_AEMDB_75_x-ref_z-ref_50M_Sim_1\08_FS_AEMDB_75_x-ref_z-ref_50M_Sim_1.thf
Test C:\VC1\FS_AEMDB_75_x-ref_z-ref_50M_Test_1\Far side\Channel\FS_AEMDB_75_x-ref_z-ref_50M_Test_1.chn

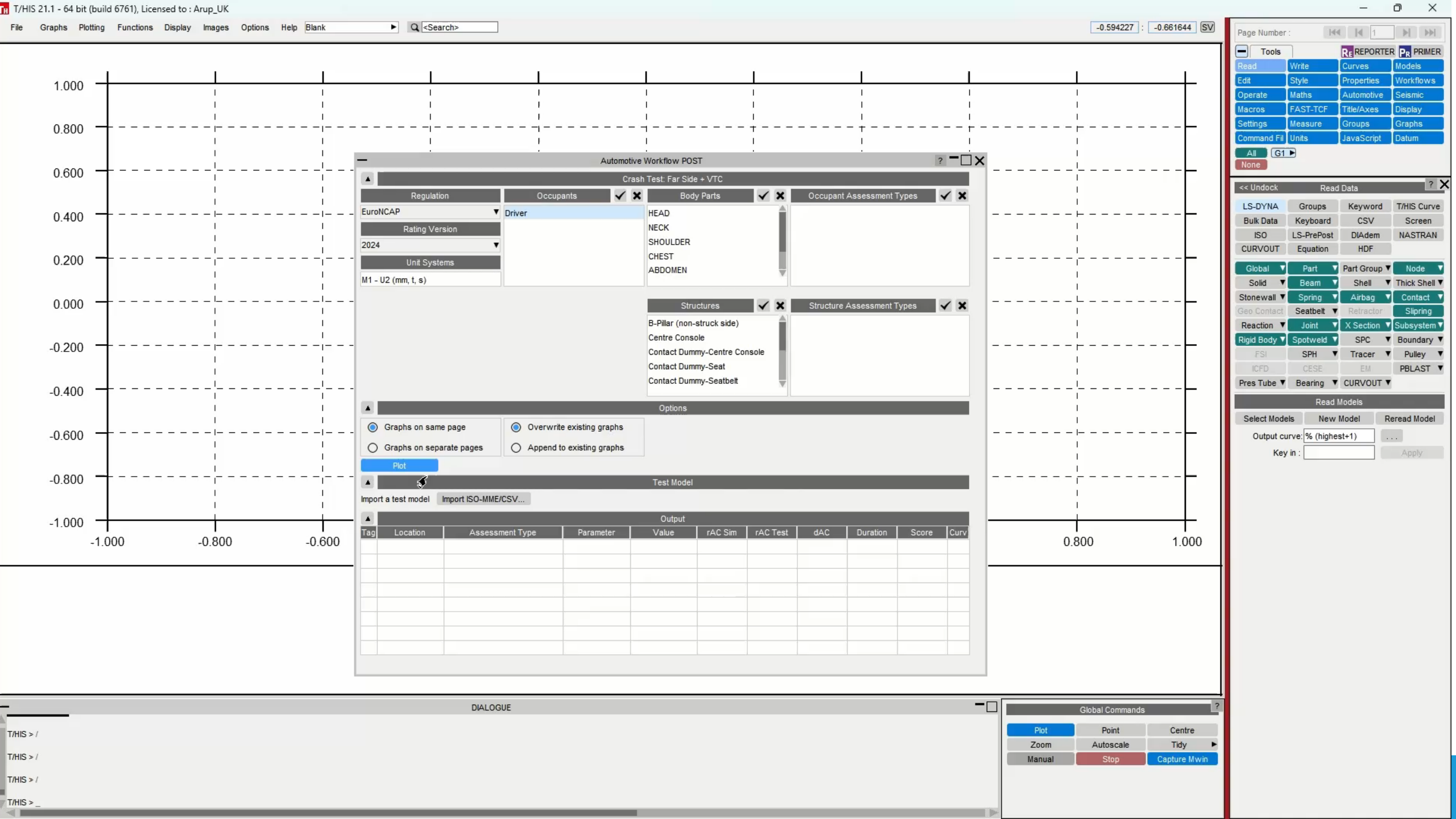
SimVT

Oasys



Automotive Assessments

Virtual and Physical Crash Test Injury


T/HIS 21.1 - 64 bit (build 6761), Licensed to : Arup_UK
File
Graphs
Plotting
Functions
Display
Images
Options
Help
Blank
<Search>
-0.594227
-0.661644
SV
Page Number :
Tools
REPORTER
PRIMER
Read
Write
Curves
Models
Edit
Style
Properties
Workflows
Operate
Maths
Automotive
Seismic
Macros
FAST-TCF
Title/Axes
Display
Settings
Measure
Groups
Graphs
Command Fil
Units
JavaScript
Datum
All
G1
None
1.000
0.800
0.600
0.400
0.200
0.000
-0.200
-0.400
-0.600
-0.800
-1.000
-1.000
-0.800
-0.600
0.800
1.000
Automotive Workflow POST
Crash Test: Far Side + VTC
Regulation
EuroNCAP
Rating Version
2024
Unit Systems
M1 - U2 (mm, t, s)
Occupants
Driver
Body Parts
HEAD
NECK
SHOULDER
CHEST
ABDOMEN
Occupant Assessment Types
Structures
B-Pillar (non-struck side)
Centre Console
Contact Dummy-Centre Console
Contact Dummy-Seat
Contact Dummy-Seatbelt
Structure Assessment Types
Options
Graphs on same page
Graphs on separate pages
Overwrite existing graphs
Append to existing graphs
Plot
Test Model
Import a test model
Import ISO-MME/CSV...
Output
Tag
Location
Assessment Type
Parameter
Value
rAC Sim
rAC Test
dAC
Duration
Score
Curv
<< Undock
Read Data
LS-DYNA
Groups
Keyword
T/HIS Curve
Bulk Data
Keyboard
CSV
Screen
ISO
LS-PrePost
DIAdem
NASTRAN
CURVOUT
Equation
HDF
Global
Part
Part Group
Node
Solid
Beam
Shell
Thick Shell
Stonewall
Spring
Airbag
Contact
Geo Contact
Seatbelt
Retractor
Slipring
Reaction
Joint
X Section
Subsystem
Rigid Body
Spotweld
SPC
Boundary
FSI
SPH
Tracer
Pulley
ICFD
CESE
EM
PBLAST
Pres Tube
Bearing
CURVOUT
Read Models
Select Models
New Model
Reread Model
Output curve:
% (highest+1)
Key in :
Apply
DIALOGUE
T/HIS > /
T/HIS > /
T/HIS > /
T/HIS > _
Global Commands
Plot
Point
Centre
Zoom
Autoscale
Tidy
Manual
Stop
Capture Mwin

Report Viewer

oasys-software.com/dyna/reportviewer/

REPORT VIEWER

Oasys | LS-DYNA ENVIRONMENT

EuroNCAP_Virtual_Far_Side_20

EuroNCAP_Virtual

Search EuroN

New | Details

automotive_assessment_results.csv
EuroNCAP_Virtual_Far_Side_2024_VC2_Assessment_Criteria.orrx
EuroNCAP~Far Side + VTC~2024~AIRBAG~AIRBAG_HOURGLASS_ENERGY.csv
EuroNCAP~Far Side + VTC~2024~AIRBAG~AIRBAG_HOURGLASS_ENERGY.cur
EuroNCAP~Far Side + VTC~2024~AIRBAG~AIRBAG_HOURGLASS_ENERGY.png
EuroNCAP~Far Side + VTC~2024~AIRBAG~AIRBAG_INTERNAL_ENERGY.csv
EuroNCAP~Far Side + VTC~2024~AIRBAG~AIRBAG_INTERNAL_ENERGY.cur
EuroNCAP~Far Side + VTC~2024~AIRBAG~AIRBAG_INTERNAL_ENERGY.png
EuroNCAP~Far Side + VTC~2024~AIRBAG~AIRBAG_KINETIC_ENERGY.csv
EuroNCAP~Far Side + VTC~2024~AIRBAG~AIRBAG_KINETIC_ENERGY.cur
EuroNCAP~Far Side + VTC~2024~AIRBAG~AIRBAG_KINETIC_ENERGY.png
EuroNCAP~Far Side + VTC~2024~B-PILLAR-(NON-STRUCK-SIDE)~B_PILLAR_ACCELERAT
EuroNCAP~Far Side + VTC~2024~B-PILLAR-(NON-STRUCK-SIDE)~B_PILLAR_ACCELERAT
EuroNCAP~Far Side + VTC~2024~B-PILLAR-(NON-STRUCK-SIDE)~B_PILLAR_ACCELERAT
EuroNCAP~Far Side + VTC~2024~B-PILLAR-(NON-STRUCK-SIDE)~B_PILLAR_ACCELERAT
EuroNCAP~Far Side + VTC~2024~B-PILLAR-(NON-STRUCK-SIDE)~B_PILLAR_ACCELERAT

176 items | 1 item selected 3.91 MB

New to Report Viewer? **Find out more**

Drop your Reporter.orrx file here or click to browse from your device.

or load files from:

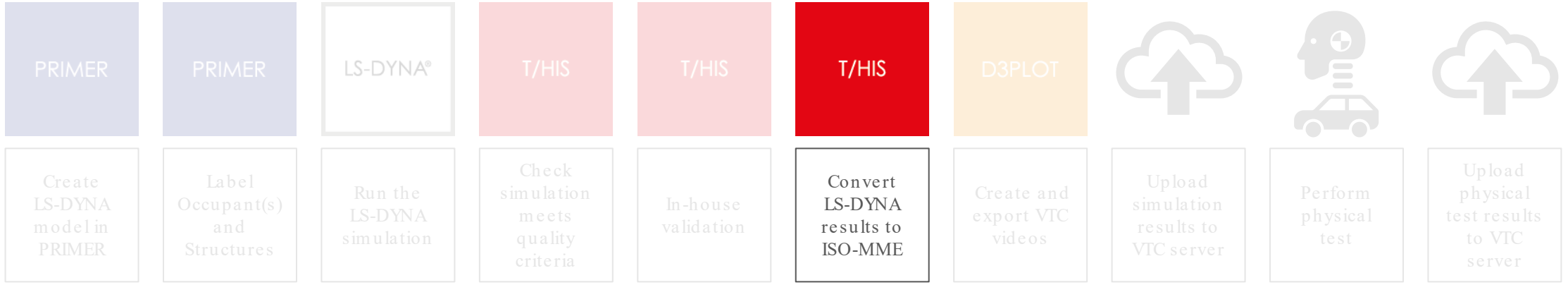
My device | **OneDrive** | **Dropbox**

All of your report data stays in your browser – it doesn't get uploaded to our server.

Need to work offline? **Download the bundle**

Documentation - **Terms & Conditions** – **Privacy Policy** – **Contact us**

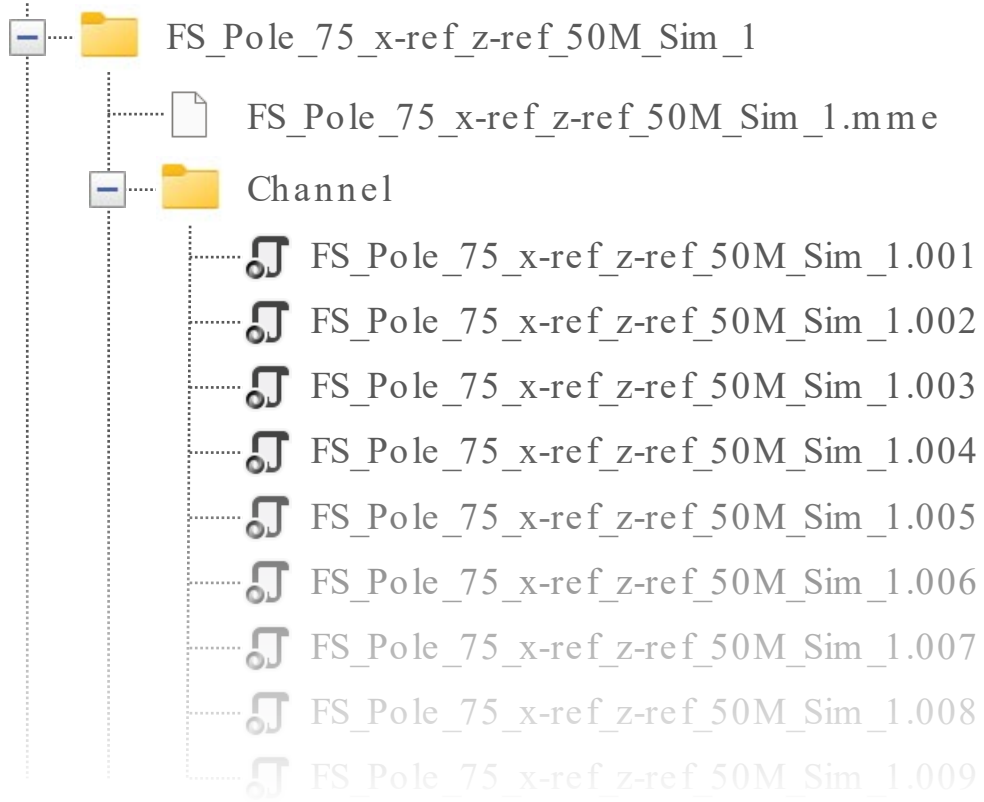
Report Viewer version: 1.7.1



LS-DYNA to ISO-MME

LS-DYNA to ISO-MME

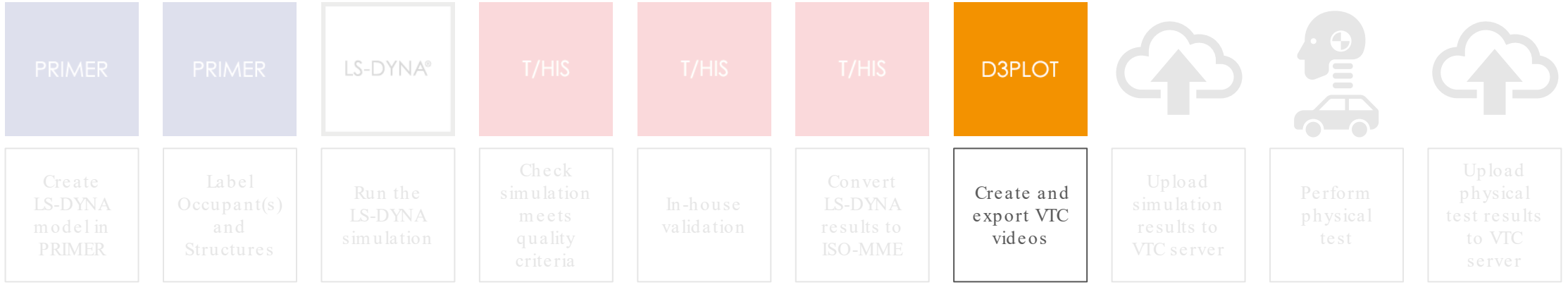
ISO-MME File Structure



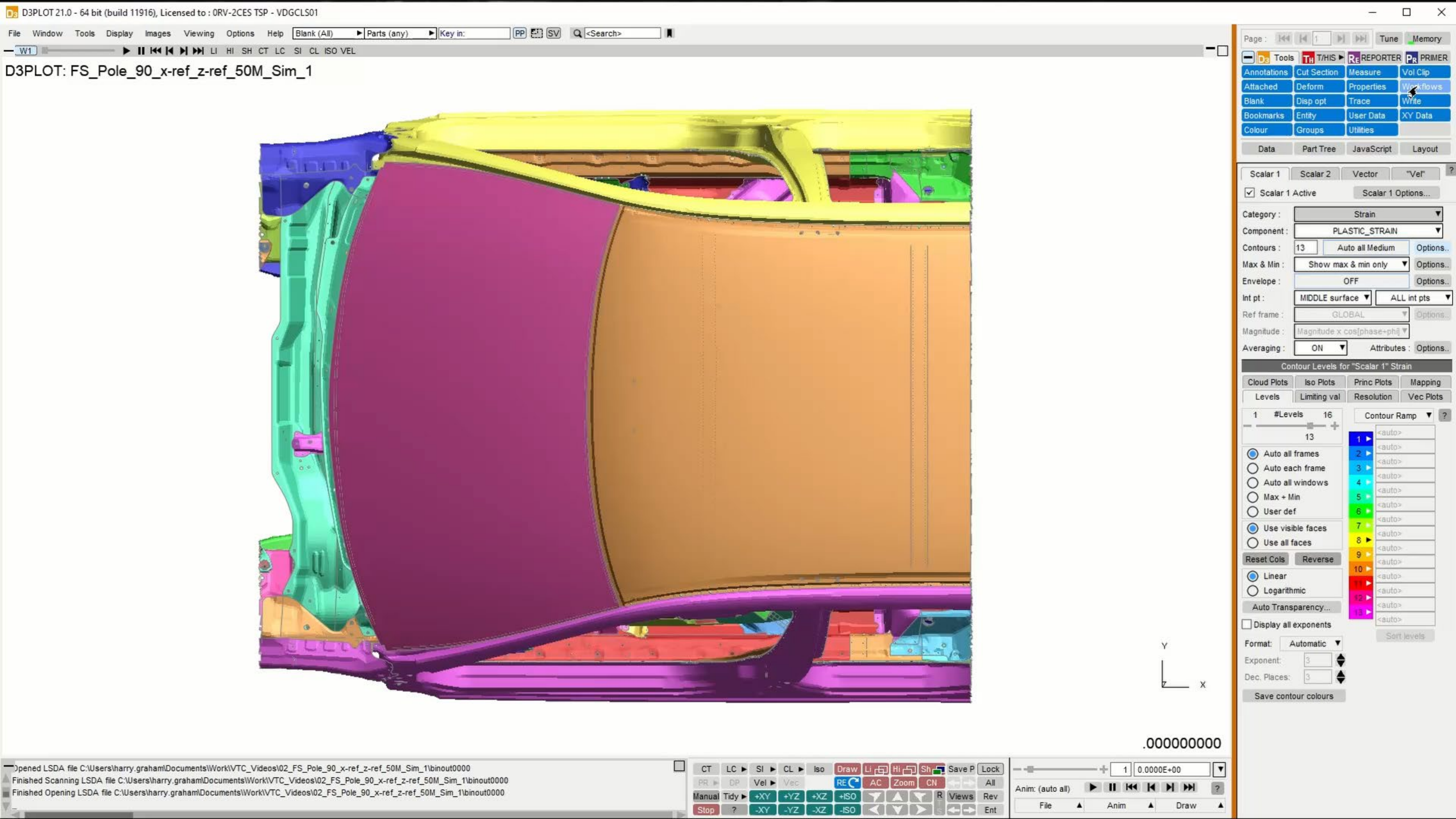
Header Item	Remarks
Dummy Simulation Model Specification	e.g. WSID 50 M v3.4.1. (Humanetics)
Solver Name	e.g. LS-DYNA
Solver Version	e.g. ls-dyna_mpp_s_R9_3_1_x64_ centos65_ifort131_sse2_openmpi183
Solver Precision	SP or DP
Platform Name	e.g. centos78_openmpi2.1.3
Number of CPUs	e.g. 2x32
Time step setting	e.g. min. time step 1-e7 s
Contact Type between dummy and seat	S2S SOFT2 FS=0.2
Contact Type between dummy and seatbelt	S2S SOFT2 FS=0.0
Number of contacts used in the overall simulation setup	e.g. 10
Number of elements	e.g. 20000

LS-DYNA to ISO-MME

Oasys


PRIMER
PRIMER
LS-DYNA®
T/HIS
T/HIS
T/HIS
D3PLOT
Create LS-DYNA model in PRIMER
Label Occupant(s) and Structures
Run the LS-DYNA simulation
Check simulation meets quality criteria
In-house validation
Convert LS-DYNA results to ISO-MME
Create and export VTC videos
Upload simulation results to VTC server
Perform physical test
Upload physical test results to VTC server

VTC Videos

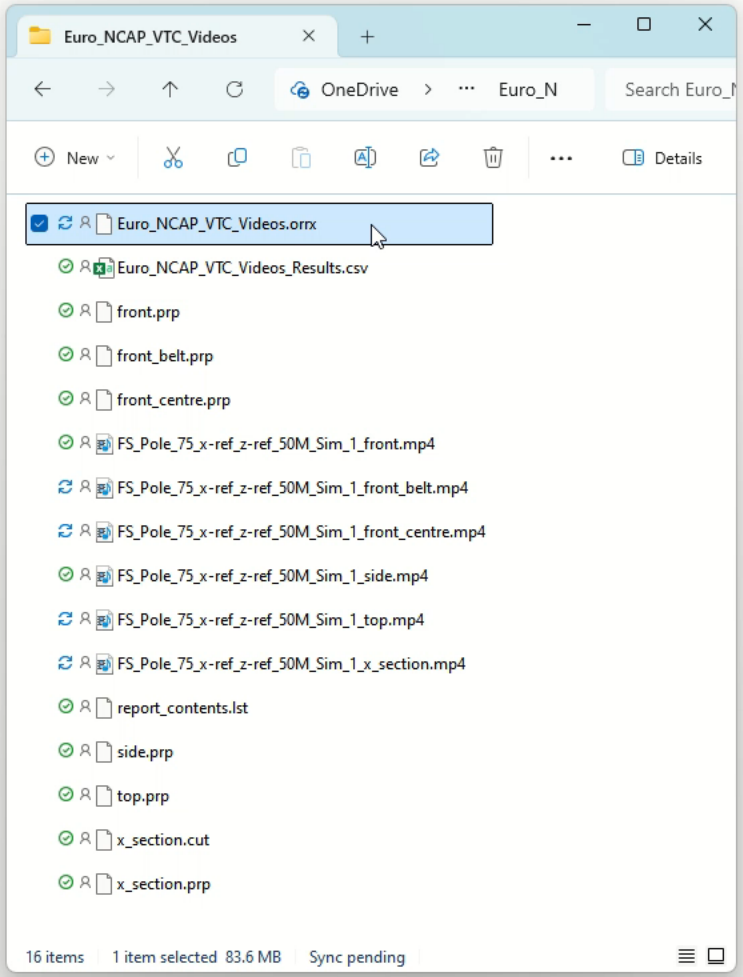

D3PLOT 21.0 - 64 bit (build 11916), Licensed to : 0RV-2CES TSP - VDGCLS01
File Window Tools Display Images Viewing Options Help
Blank (All) Parts (any) Key in: <Search>
W1 LI HI SH CT LC SI CL ISO VEL
D3PLOT: FS_Pole_90_x-ref_z-ref_50M_Sim_1
Page : Tune Memory
Tools T/HIS REPORTER PRIMER
Annotations Cut Section Measure Vol Clip
Attached Deform Properties Workflows
Blank Disp opt Trace Write
Bookmarks Entity User Data XY Data
Colour Groups Utilities
Data Part Tree JavaScript Layout
Scalar 1 Scalar 2 Vector "Vel"
Scalar 1 Active Scalar 1 Options...
Category : Strain
Component : PLASTIC_STRAIN
Contours : 13 Auto all Medium Options..
Max & Min : Show max & min only Options..
Envelope : OFF Options..
Int pt : MIDDLE surface ALL int pts
Ref frame : GLOBAL Options..
Magnitude : Magnitude x cos[phase+phi]
Averaging : ON Attributes : Options..
Contour Levels for "Scalar 1" Strain
Cloud Plots Iso Plots Princ Plots Mapping
Levels Limiting val Resolution Vec Plots
1 #Levels 16
13
Auto all frames
Auto each frame
Auto all windows
Max + Min
User def
Use visible faces
Use all faces
Reset Cols Reverse
Linear
Logarithmic
Auto Transparency...
Display all exponents
Contour Ramp
<auto>
Sort levels
Format: Automatic
Exponent: 3
Dec. Places: 3
Save contour colours
Y
X
.000000000
Opened LSDA file C:\Users\harry.graham\Documents\Work\VTC_Videos\02_FS_Pole_90_x-ref_z-ref_50M_Sim_1\binout0000
Finished Scanning LSDA file C:\Users\harry.graham\Documents\Work\VTC_Videos\02_FS_Pole_90_x-ref_z-ref_50M_Sim_1\binout0000
Finished Opening LSDA file C:\Users\harry.graham\Documents\Work\VTC_Videos\02_FS_Pole_90_x-ref_z-ref_50M_Sim_1\binout0000
CT LC SI CL Iso Draw Li Hi Sh Save P Lock
PR DP Vel Vec RE AC Zoom CN All
Manual Tidy +XY +YZ +XZ +ISO R Views Rev
Stop ? -XY -YZ -XZ -ISO Ent
1 0.0000E+00
Anim: (auto all)
File Anim Draw

Report Viewer

oasys-software.com/dyna/reportviewer/

REPORT VIEWER

Oasys | LS-DYNA ENVIRONMENT



New to Report Viewer? **Find out more**

Drop your Reporter.orrx file here or click to browse from your device.

or load files from:

My device **OneDrive** **Dropbox**

All of your report data stays in your browser – it doesn't get uploaded to our server.

Need to work offline? **Download the bundle**

Documentation - **Terms & Conditions** – **Privacy Policy** – **Contact us**

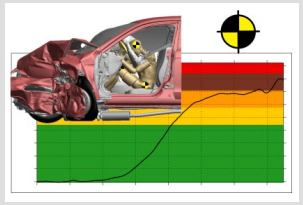
Report Viewer version: 1.7.1

Summary

Protocol Requirements • Solve • Quality Check • Validation • Injury Assessment • Data Submission and Test

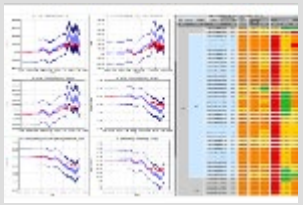
PRIMER	PRIMER	LS-DYNA®	T/HIS	T/HIS	T/HIS	D3PLOT
Create LS-DYNA model in PRIMER	Label Occupant(s) and Structures	Run the LS-DYNA simulation	Check simulation meets quality criteria	In-house validation	Convert LS-DYNA results to ISO-MME	Create and export VTC videos

Upload simulation results to VTC server	Perform physical test	Upload physical test results to VTC server

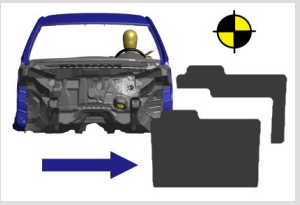


Automotive Assessments

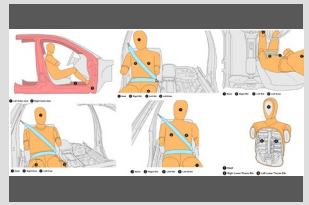
VTC Quality Criteria



Sim VT



LS-DYNA to ISO-MME



VTC Videos

Euro NCAP, C-NCAP, and future protocols

★ ★ ★ ★ ★

Questions / Contact

https://www.oasys-software.com/dyna