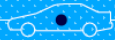




Durability Analysis of a Suspension Part by use of the VTL

W.M.Kyoung, J.W.Jeon, and S.G.Joo
Senior Research Engineer
Hyundai Motor Company



Contents

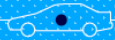


BACK GROUND

Virtual Test Lab(VTL)

DURABILITY ANALYSIS PROCEDURE

CONCLUSION



Back Ground



EVERY BODY WANTS
EXCELENT STYLE, LOW PRICE,
HIGH POWER, GOOD RIDE &
HANDLING, SAFE MORE & MORE,
NO TROUBLE,etc.....

PRODUCT DEVELOPMENT CONFERENCE



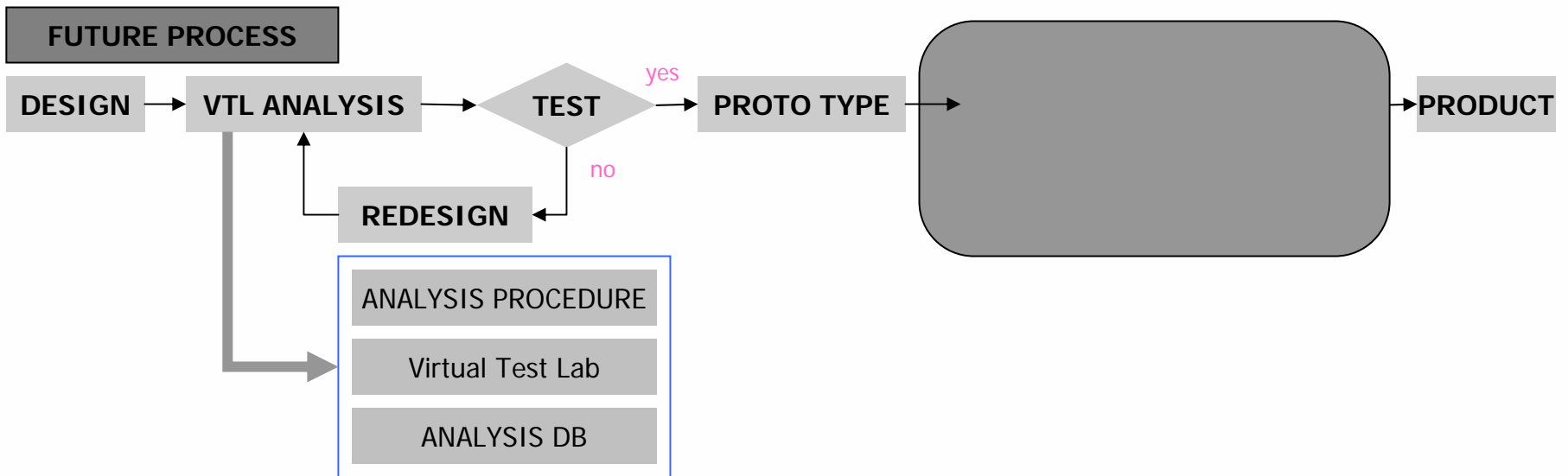
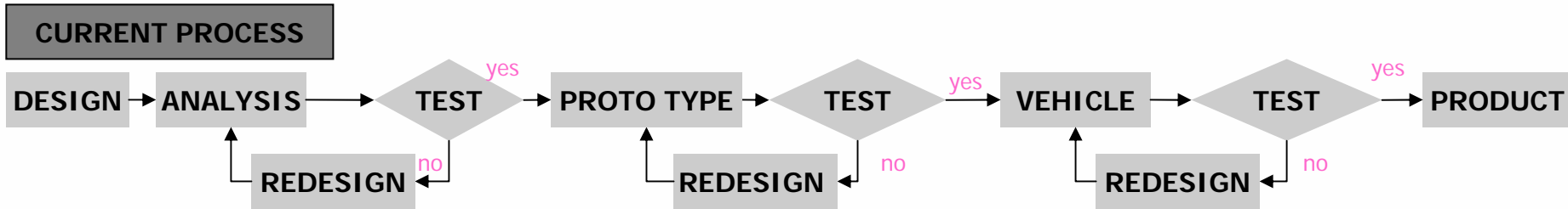
Virtual Test Lab.



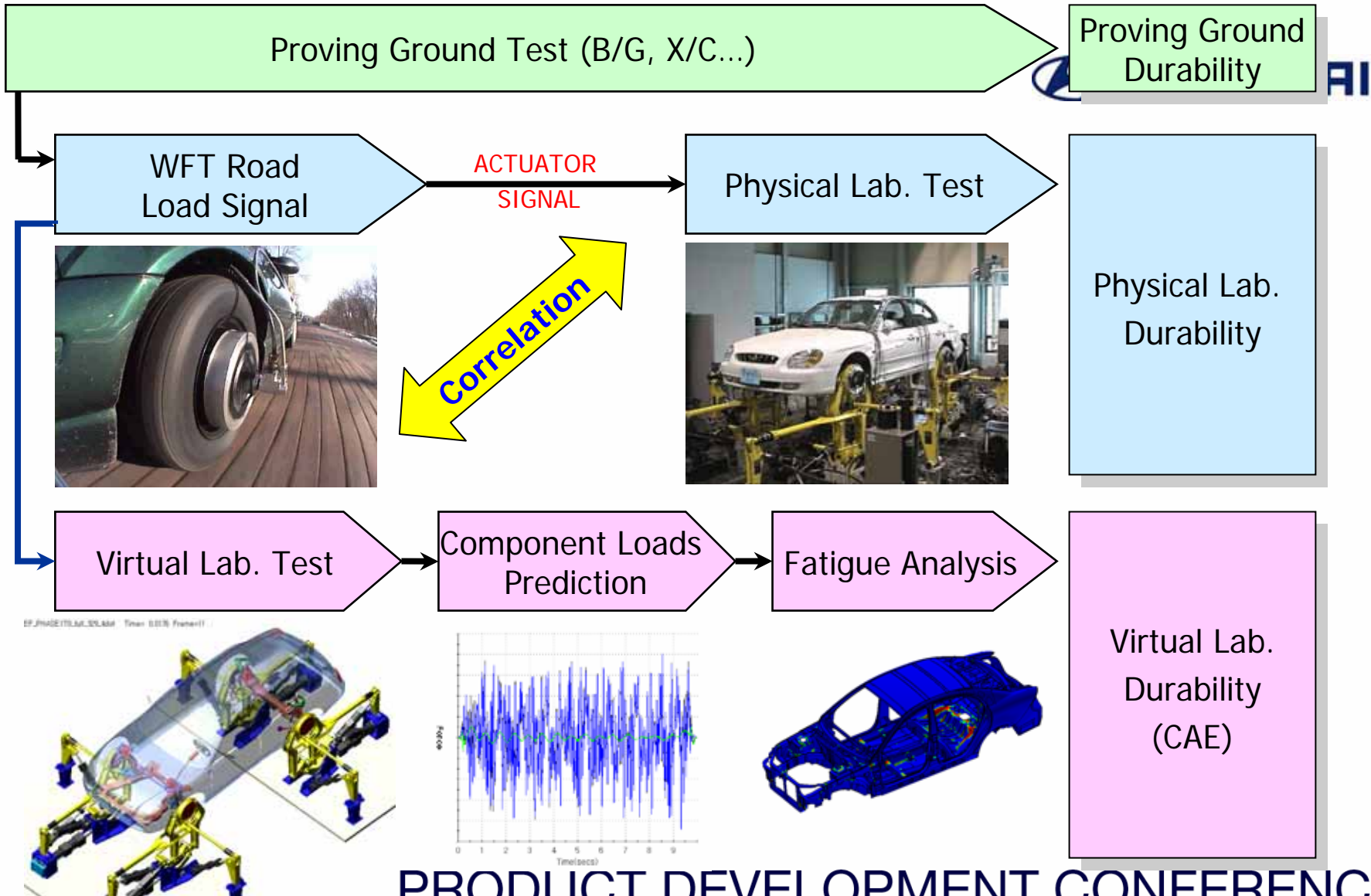
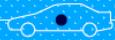
- Replications of Physical Prototype Test on TEST RIG
- Engineers must evaluate a large number of conceptual design models
 - Analysts can validate models by use of VTL
- Eliminate Repeat Testing for additional Info
 - Virtual validation must emulate physical validation

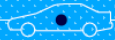


Durability Analysis by using VTL HYUNDAI

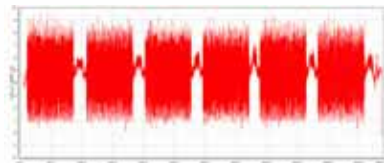


PRODUCT DEVELOPMENT CONFERENCE

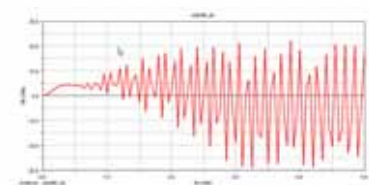




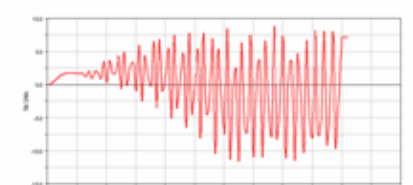
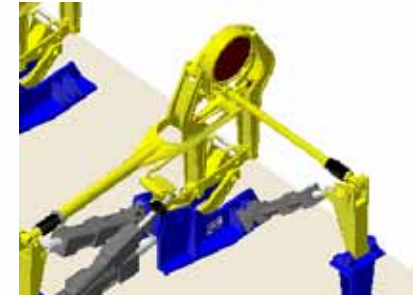
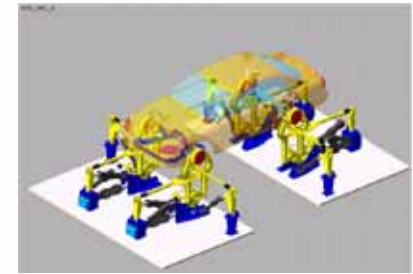
Virtual Test Lab.



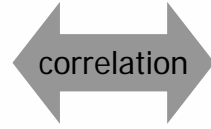
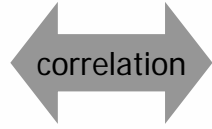
VEHICLE DURABILITY



TEST RIG DURABILITY



VTL DURABILITY



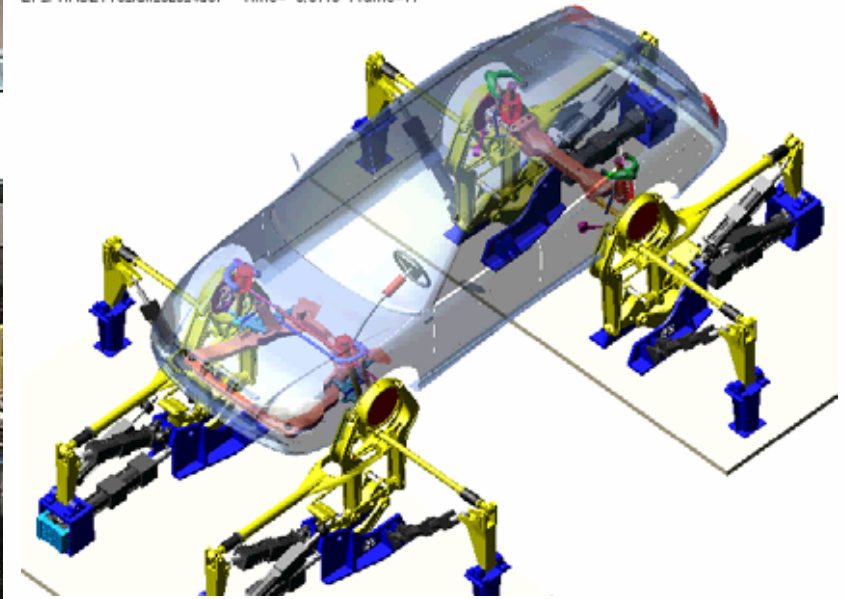


Virtual Test Lab.



TEST RIG

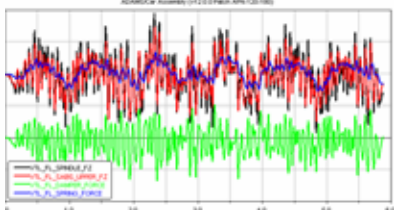
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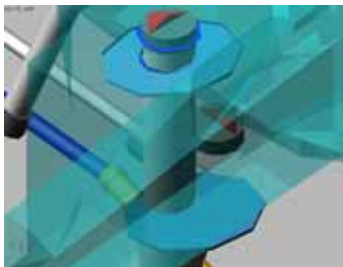
VTL DURABILITY



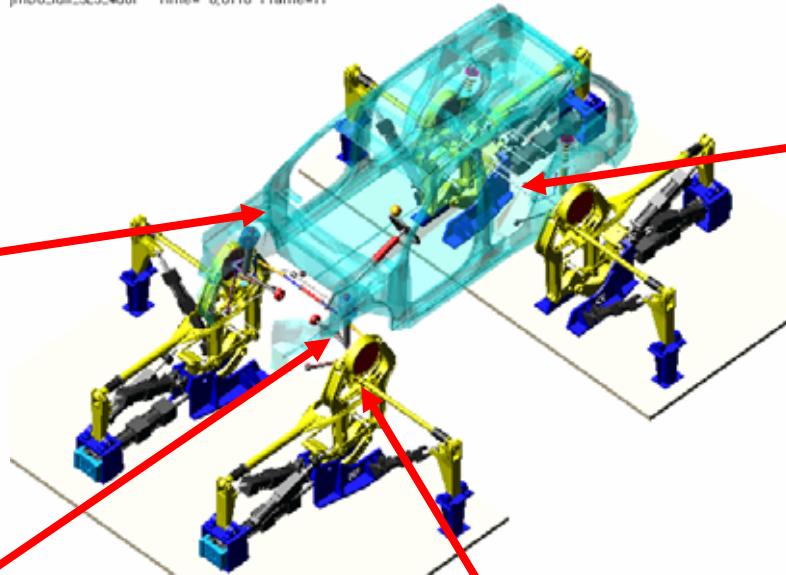
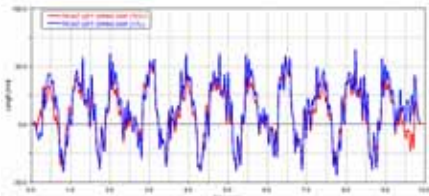
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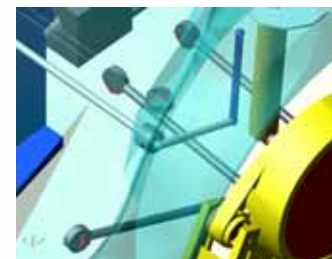
BIW MTG POINT



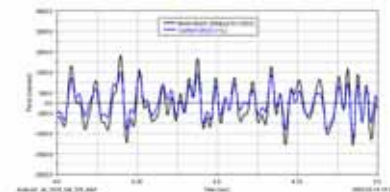
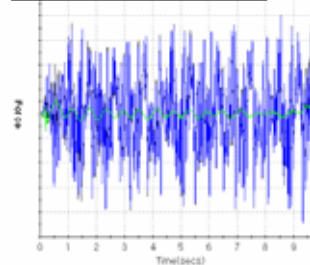
SPRING DISPLACEMENT



LINK LOAD



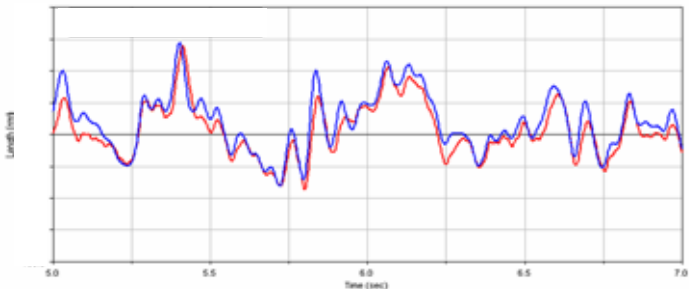
SPINDLE LOAD



PRODUCT DEVELOPMENT CONFERENCE

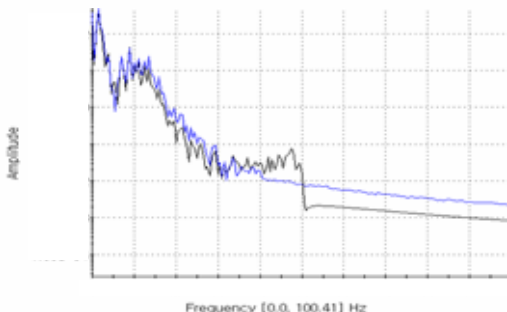


SPRING DISP.

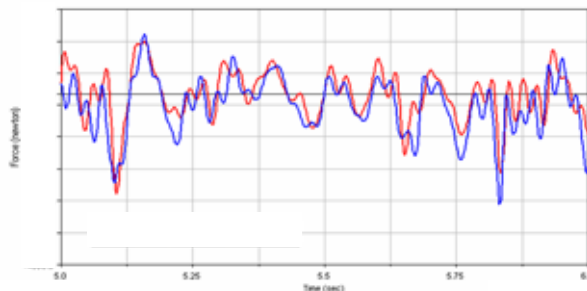
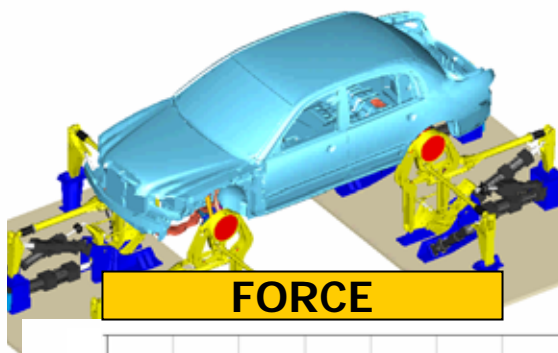


TIME HISTORY

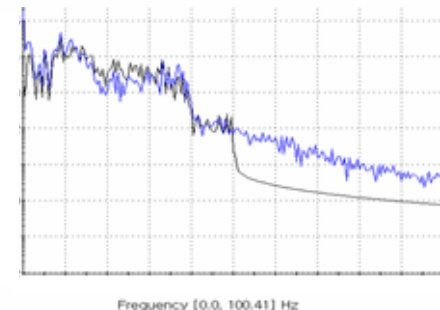
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PSD CURVE



TIME HISTORY

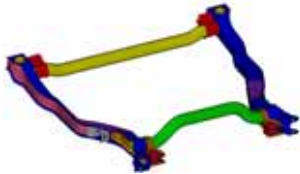





PSD CURVE



Quasi Static or Dynamic ?



COMPONENT				
	FR SUBFRAME	FR LARM	KNUCKLE	CTBA
1 ST MODE FREQ.	80 Hz	500 Hz	1500 Hz	20 Hz



Quasi Static or Dynamic ?



QUASI STATIC ANALYSIS

- The Simplest and Fastest method
- Fails to capture ANY DYNAMIC RESPONSES

DYNAMIC ANALYSIS IN TIME DOMAIN

- The most Accurate method
- Consumes VERY LARGE AMOUNT of computer resources

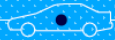
DYNAMIC ANALYSIS IN FREQUENCY DOMAIN

- Captures the Dynamic stress response
- So MANY ERROR SOURCES, Human errors, Stress-life analysis, etc...

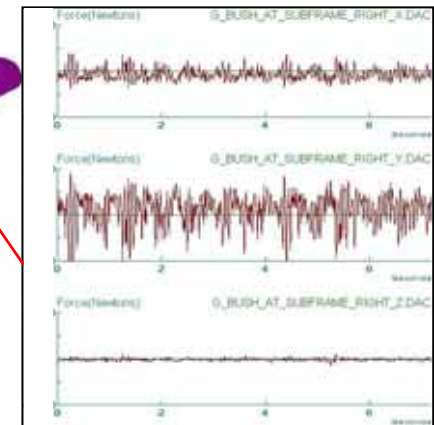
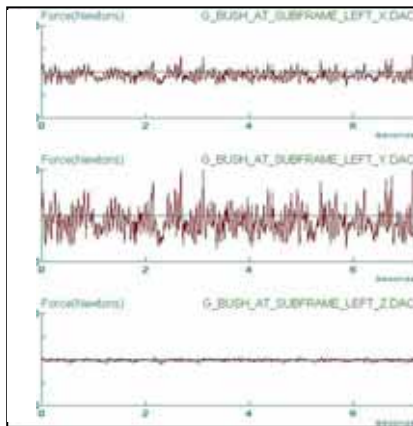
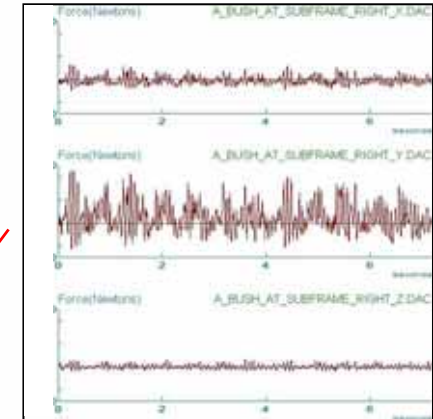
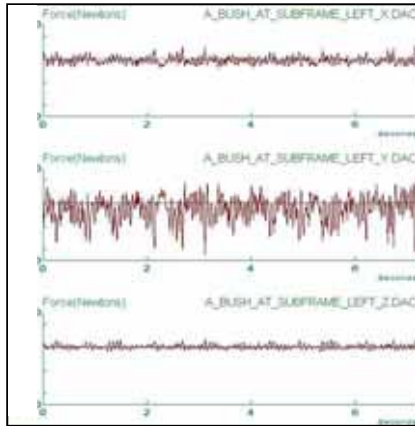


MODAL SUPERPOSITION METHOD

- Simple as QUASI-STATIC, and Accurate as DYNAMIC TRANSIENT
- Quasi-Static modal stresses (NORMAL MODE ANALYSIS) are scaled by the modal participation factors (MODAL TRANSIENT ANALYSIS) in the time domain
- Somewhat complicate process UP TO NOW....



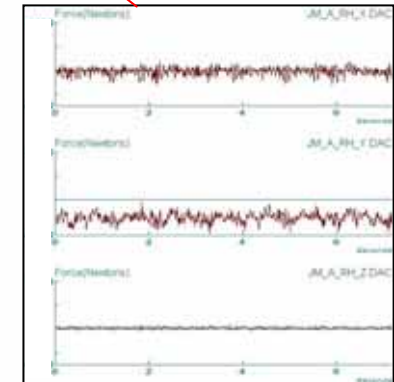
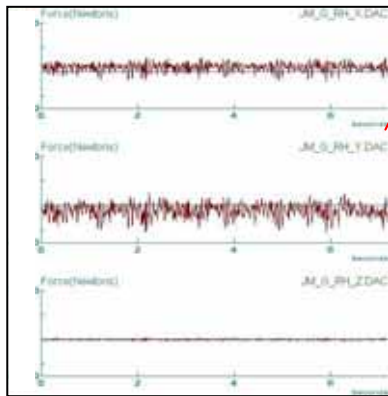
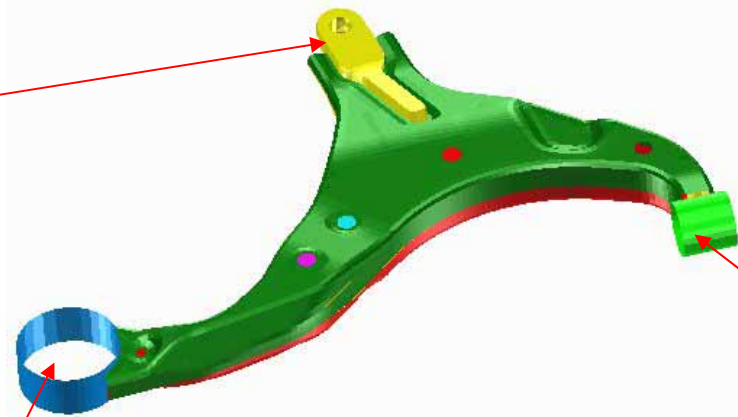
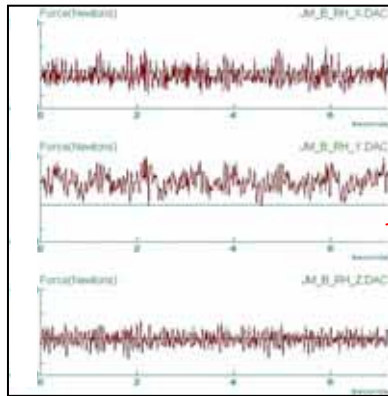
Quasi Static Analysis – X/MBR



PRODUCT DEVELOPMENT CONFERENCE



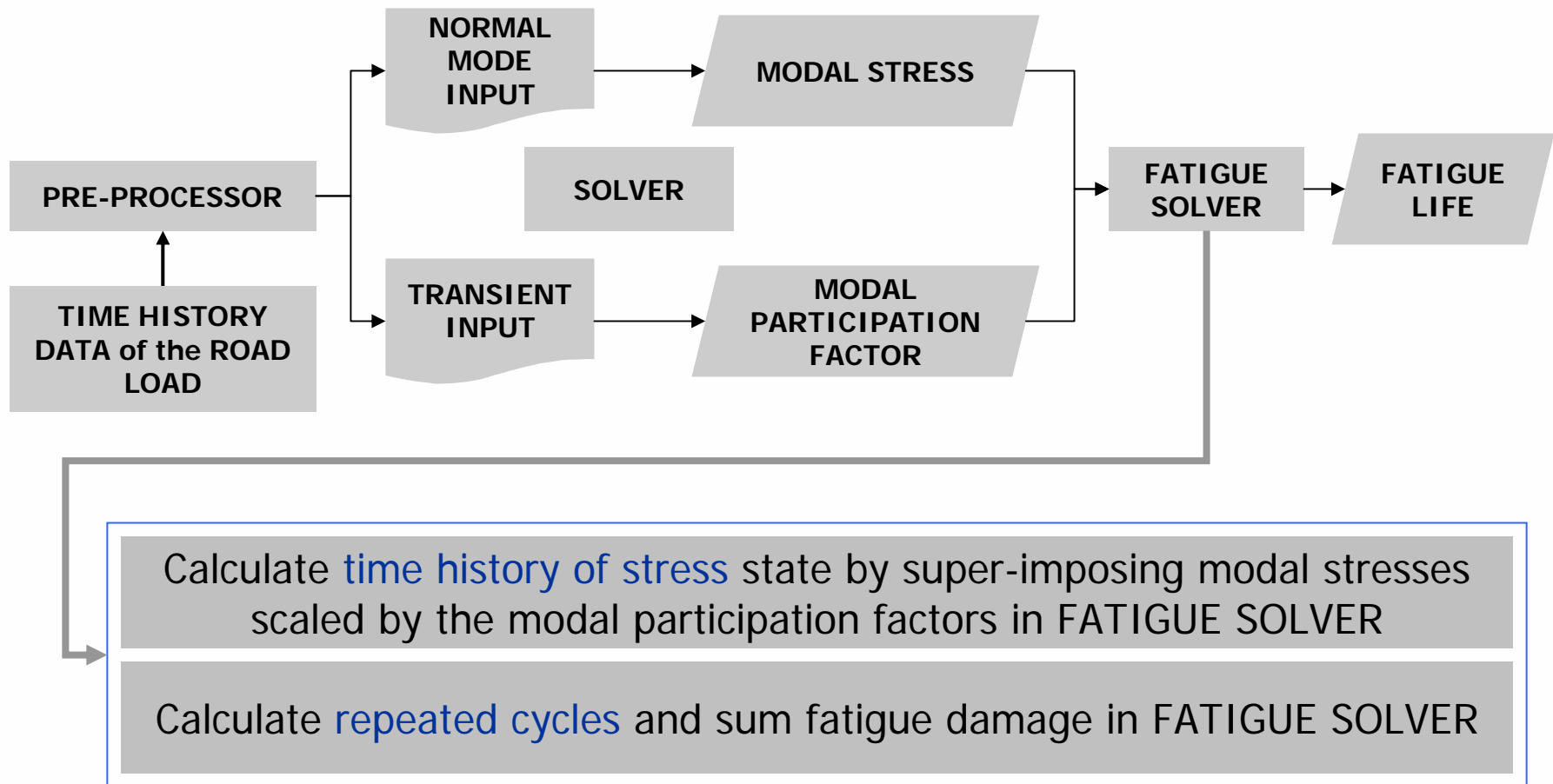
Quasi Static Analysis – L/ARM



PRODUCT DEVELOPMENT CONFERENCE

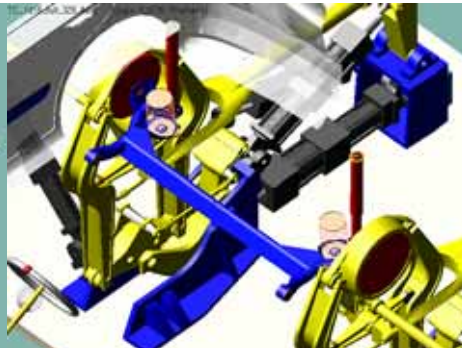
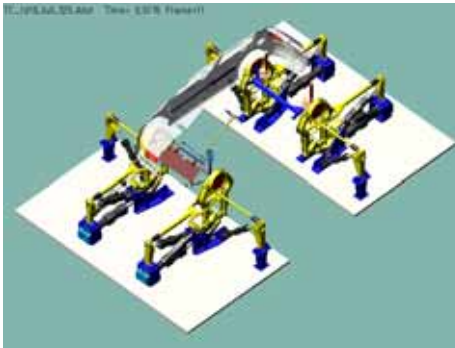
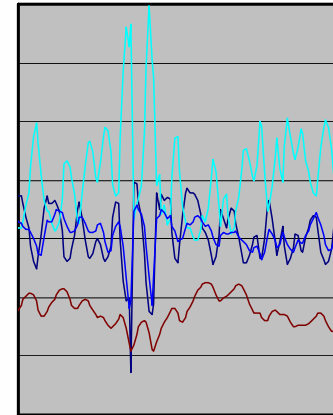
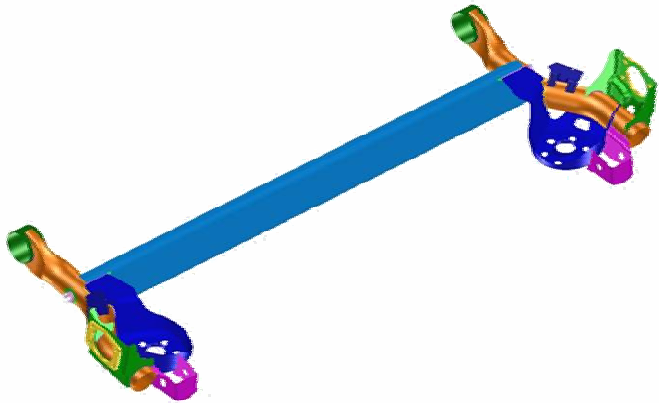


Modal Superposition Method





Dynamic Analysis - CTBA



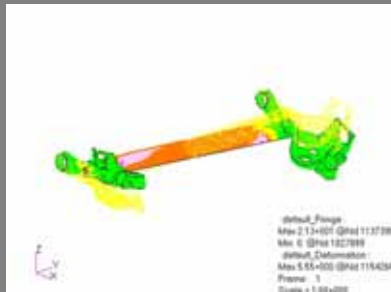
PRODUCT DEVELOPMENT CONFERENCE



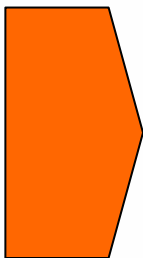
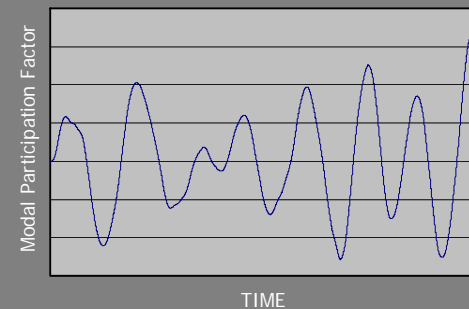
Dynamic Analysis - CTBA



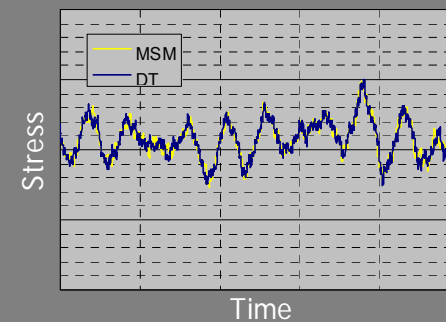
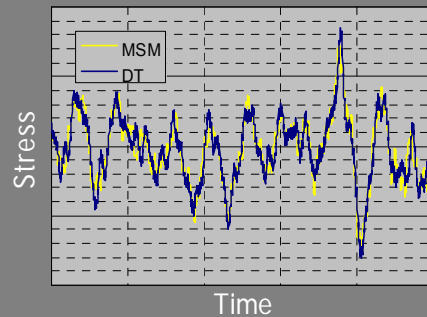
NORMAL MODE ANALYSIS



MODAL TRANSIENT ANALYSIS



ELEMENT STRESS TIME HISTORY



PRODUCT DEVELOPMENT CONFERENCE



Summary



Durability Analysis

- VTL
 - Virtual Test Lab. for the LOAD HISTORY
- Quasi Static Analysis
 - Suspension components
- Dynamic Analysis
 - Modal Superposition Method
 - BIW and Suspension components of resonance domain