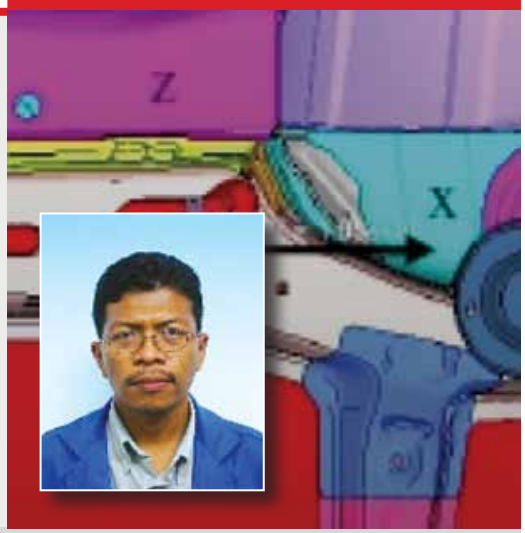
USER CASE STUDY



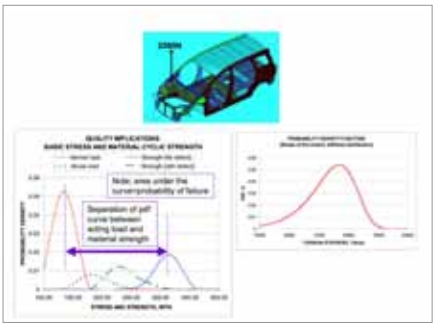
PROTON

Customer Profile: Noor Hisham Bin Ismail

Mr Noor Hisham Bin Ismail is head of CAE at PROTON based in Kuala Lumpur, Malaysia. Mr Ismail and other members of the computer-aided engineering team are responsible for improving the virtual development of mechanical and structural components, sub systems and complete vehicle system at PROTON. Through Mr Ismail's innovative process of probabilistic analysis, PROTON has been able to effectively identify areas of high-risk failure and fine-tuning engineering design alternatives.

Challenge

In developing complex mechanical and structural automotive components, going through multiple build-and-test hardware prototype cycles to verify performance, stress and fatigue life is just too time-consuming and expensive. This issue can be addressed by evaluating and refining designs with analysis tools up front in development, reducing test cycles later in the development process. PROTON's pioneering spirit naturally has led Mr ismail to not just stop at traditional methodologies in computer-aided engineering for design analysis. As the risk of failure in any design was becoming more and more significant and he was constantly looking at areas to assess risk parameters and minimize any risk factors, he needed to turn to industry-leading simulation analysis tools that would be able to provide him with the necessary accurate foundation to progress his methodology. Mr Ismail realized that conventional virtual development approaches are no longer sufficient to meet the increasing standards of accuracy required at PROTON. Conventional approaches do not take into consideration the variations that affect finite element analyses. Mr Ismail needed proven tools that produced the most accurate results, allowing him to capture the potential failures and provide the nature of failures so that these can be mitigated in the process. With resource efficiency on his mind, Ms Ismail also needed to manage test accuracy while reducing the dependency on running too many variations.



Basic Stress and Material Cyclic Strength

> "With MSC.Software, we have been able to cut costs while improving quality and reducing time-to-market."

Solution

MSC FEA (MSC Nastran and Patran),MSC Adams.

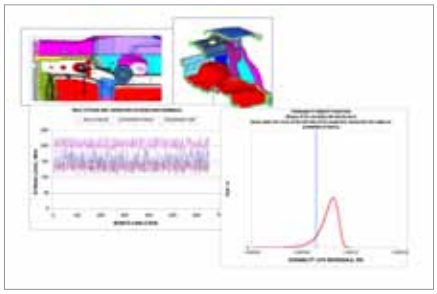
Benefits

- Visible quantification of design risk or reliability
- Identifies areas of high risk in a design
- Provides the ability to modify design variables relative to reliability
- Provides a means to compare differing designs

Case Study

PROTON can shorten the time-to-market by getting designs right the first time. Many of PROTON's automotive components need extensive lead times because of its strict adherence to safety and quality standards. Besides, traditional physical testing can take weeks or even months to validate a design. Leveraging analysis early in the process can eliminate unforeseen changes and repetition of lengthy test cycles, providing significant reductions in overall development time.

Mr Ismail's foundation of probabilistic design methodology uses design criteria based on reliability targets instead of deterministic criteria. First, design parameters such as applied loads, material strength, and operational parameters are researched and/or measured and then statistically defined. A probabilistic analysis model is then developed for the entire system and solutions performed to yield failure probabilities. With MSC's FEA, applied stress is obtained from finite element models. The general concept is to integrate the joint probability of applied stress and material strength over the region where stress exceeds strength. The result of the integration is the probability of structural failure and this helps to provide the necessary information for sensitivity analysis and design optimization.



Yield Stress and Operating Stress Performance

Relying on industry-leading solutions such as MSC's FEA and Adams, Mr Ismail is able to build a "Reliability Engineering" framework that provided the foundation for accurate analysis.

With MSC, Mr Ismail is able to conduct multi-run design improvement studies which can be used to assess design sensitivity to product and environment variability, discover unknown design variable interactions, and provide a global view of the overall design space.

But the analysis does not stop here; as Mr Ismail has further incorporate his finite analysis results in a stochastic simulation via the Monte Carlo technique that provides the statistical results of the variation distribution. Mr Ismail then further combines the results with critical parameters yielding an even stronger and more robust solution.

"All critical elements derived from simulation results are subjected to additional quantifiable risk analysis, this helps to mitigate probability of failures later during the development stage," said Mr Noor Hisham bin Ismail, PROTON Holdings Berhad. "Computer-aided engineering technology has provided the foundation for PROTON's success in a highly competitive automotive industry. With MSC.Software, we have been able to cut costs while improving quality and reducing time-to-market. Our drive for engineering innovation will enable us to continue enhancing our competitiveness by improving our engineering development process and driving production efficiency."

MSC Software

MSC Products Used:

MSC Adams

Capabilities

- Creation or import of component geometry in wireframe or 3D solids
- Extensive library of joints and constraints to define part connectivity
- Internal and external forces definition on the assembly to define your product's operating environment
- Model refinement with part flexibility, automatic control systems, joint friction and slip, hydraulic and pneumatic actuators, and parametric design relationships
- Ability to iterate to optimal design through definition of objectives, constraints, and variables
- Automatic generation of linear models and complex loads for export to structural analyses
- Comprehensive linear/nonlinear results for testing complex, large-motion designs
- Superior contact capabilities supporting 3D contact between modal flexible bodies and solid geometry

High Performance Computing (HPC)

- 64-bit support on Windows and Linux platforms
- Parallel processing support for Adams/Tire results
- Shared Memory Parallel solver
- Obtain nonlinear results for testing complex, large-motion designs

Adams Package includes:

- Adams/Solver
- Adams/Linear
- Adams/View
- Adams/Flex
- Adams/Durability
- Adams/Vibration
- Adams/Controls
- Adams/Exchange
- Adams/Foundation
- Adams/Insight
- Postprocessor
- Shared Memory Parallel (SMP)
- Tire API

Optional Modules

- Adams/Tire FTire

MSC Nastran

- Powerful Analysis Capabilities
  - Static Stress
  - Normal Modes
  - Linear Buckling
  - Dynamics
  - Static and Transient Heat Transfer
  - Dynamics
  - Frequency / Harmonic Response
  - Static and Transient Nonlinear
  - Rotor Dynamics
  - Interior Acoustics
- Full range of material models
  - Isotropic
  - Orthotropic
  - Anisotropic
  - Temperature-dependent
- Design Optimization
  - Shape
  - Size
  - Topology
- Adams Integration
- Superelements for increased collaboration and solution efficiency
- Efficient Solvers
  - Sparse matrix solvers
  - Iterative solvers
  - Parallel and vector processing

Patran

Pre-processing

- Standard Geometry Access from
  - Parasolid
  - STEP 203 and 209
  - IGES
  - VDA
  - I-DEAS
- Parametric Modeling Capabilities
- Wireframe and Solid Geometry Creation and Modification
- Mesh Generation
  - Automatic 2-D surface meshing
  - Automatic solid mesher
  - Generalized 1-D, 2-D, 3-D mapped mesher
  - Mesh on Mesh
  - Mesh editing and modification
- Comprehensive Element Library
- Element Property Creation and Edit
- Material Property Creation and Edit
- Load and Boundary Creation and Edit
- Easy Contact Definitions
- Model Visualization and Verification
- Support for multiple FEA solvers
  - Marc
  - Dytran
  - MSC Nastran
  - MD Nastran
  - 3rd party solvers

Post-processing

- Results Access
  - Nastran
  - Dytran
  - Marc
  - 3rd party solvers
- Results Visualization
  - Contours
  - Vector arrows
  - Fringe plots
  - Isosurfaces
  - Data History / Animation
  - X-Y plots
  - Imaging
- Results Templates

Company Profile

PROTON, established in 1983, is Malaysia's largest manufacturer of automobiles. With operations in key market centers from UK and Western Europe to the Middle East, and across South-East Asia and Australasia, PROTON produces cars to suit a range of consumer demands and preferences. The offerings include versatile and reliable four-door family vehicles, two-door hatchbacks for the young-at-heart, luxurious and stylish executive sedans, spacious and affordable multi-purpose vehicle, as well as the world-renowned sports cars from Lotus. PROTON's inception as a key driver of national development has seen the brand accelerate its learning curve through technology transfer with strategic partnerships and technical collaborations. PROTON cars are now steadily on track to achieving the mission for the future, gearing up to achieve the promise of a marquee brand which builds cars with passion and soul; cars which are a delight to drive and a pleasure to own.

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