Renault uses ESI's Virtual Seat Solution to virtually design a new car seat

THE CHALLENGE

- Validate a new production seat model with simulation
- Evaluate all comfort issues related to an automotive seat (manufacturing, occupant seating, occupied seat vibration transmissibility)

THE STORY

"The models and methodology developed with Virtual Seat Solution enable the computation of predictive results, using only physical parameters and without any tuning of filtering. ***This good correlation between simulation and test results confirms the ability to assess the riding seat comfort in a full virtual process.***"

Jérôme Makala,
Head of Comfort and Safety Research Department, Renault Group.

THE BENEFITS

- Provide predictive and highly accurate results using Finite Elements
- Build a fully virtual preliminary design of a new seat and validate it with simulation
- Save on development costs and time
- Meet production targets

Automotive OEMs increasingly take into account seat comfort, as it's become an important criterion in the customer's purchase decision. Seat comfort is of first importance in the daily use of a car, no longer limited to driving on bumpy roads or over long distances.

Renault uses Virtual Seat Solution, ESI's solution for Virtual Seat Prototyping, in a new approach for numerical evaluations of the automotive seat comfort. Virtual Seat Prototyping consists of several chained steps ranging from seat manufacturing to static occupant seating and occupied seat NVH (Noise, Vibration and Harshness), where the stresses resulting from each step are communicated to the next one. Chaining is a necessary requirement to accurately predict the behavior of the seats under numerous loading conditions (trimming, dummy loading, various human anthropometries, and vibrations) and for various design changes (materials and shape).

The aim for Renault was to provide predictive results, including realistic mechanical seat modeling and a successful description of the materials' complex dynamic behavior. To do so, Renault's engineers built a detailed Finite Element (FE) model of one of their existing car seats using Virtual Seat Solution and simulated its complex mechanical behavior, with non-linear materials, large deflections of the foam blocks and springs. This allowed them to assess the dynamic seat comfort in a full virtual process.

DYNAMIC COMFORT TESTING

As part of the process of designing a new car seat, Renault runs a dynamic experimental test of seat transmissibility with a static weight. Helping to evaluate the seat frequency response, this test informs them of how the seat contributes to the vertical acceleration filtering of the car. It is used to improve and validate the seat design.

In order to characterize the dynamic seat comfort, the test can also be performed with human subjects and with dedicated dummies.

Renault's goal here was to replace some of these physical seat transmissibility tests with numerical simulation.

Experimental set-up and Finite Element model with Virtual Seat Solution.

SEAT AND VIBRATION MODELING

Renault simulated the experiment named the "Lead Buttock" mannequin test, which consists of a dynamic test of seat transmissibility with a static weight, in order to obtain the seat frequency response, meaning the amplification ratio between the seat sliding rail acceleration and the vertical acceleration of the dummy.

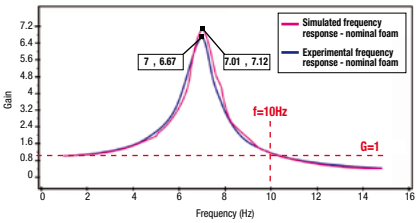
The Lead Buttock test was simulated using Virtual Seat Solution. First of all, the seat was modeled and assembled, in a detailed and realistic way: seat component materials were characterized and added to the model in order to inform their non-linear behavior. Springs were fastened on the seat metallic frame, and supported the polyurethane cushion foam. The seat was then trimmed with the cover, the fabric part of the seat, and the resulting equilibrium was computed.

The computation of vibration transmissibility was then divided in two phases. First, a static phase where the dummy was seated and where the equilibrium was computed to precisely know the stress and strain states of the various parts of the seat. This enabled improved accuracy for the second, dynamic phase where a vertical acceleration signal was applied to the seat rail to obtain the seat dynamic transmissibility at the interface with the dummy.

SEAT DYNAMIC TRANSMISSIBILITY

The seat dynamic transmissibility test was done using a middle class production seat, with two variants characterized by different foam stiffness, taking into account the manufacturing dispersion: one nominal configuration and one softer foam.

Computed results had a very good level of correlation with physical testing. Indeed, the computation time was about twenty hours with a four processors cluster (DMP4), and a frequency range of 1-15Hz.



Seat frequency response function with static weight - nominal foam

Renault successfully completed its first fully virtual preliminary design of a new seat using Virtual Seat Solution. In addition, as they were very satisfied with the results obtained with Virtual Seat Solution, Renault began to transfer this methodology to their seat providers and to Nissan.

To find out more about ESI's Virtual Seat Solution, visit: www.esi-group.com/VSS

*"This simulation input can truly be considered as an **ultra realistic model,** since it allows the simulation of the whole complex mechanical phenomena of the seat, the non-linearity of the materials, the large displacements of the cushion foam and springs, as well as the effect of the cover trimming."*

*"Using Virtual Seat Solution, within a short period of time, and with few resources, **we were able to deliver a new seat design meeting our objectives**"*

Jérôme Makala, Head of Comfort and Safety Research Department at Renault Group

ABOUT RENAULT

Renault S.A. (Euronext: RNO) is a French automaker producing cars, vans, buses, tractors, and trucks. The strategic alliance with the Japanese automaker Nissan in 1999, makes currently Renault the world's fourth largest automaker. Established in 1898 by the Renault brothers, the company is well-known for numerous revolutionary designs, security technologies and motor racing. Headquartered in Boulogne-Billancourt, France, Renault also owns the Romanian automaker Automobile Dacia and the Korean automaker Renault Samsung Motors. Renault vehicles are distributed worldwide, especially in Europe, Middle-East and Africa, South-America and Asia. For further information, visit www.renault.com

ABOUT ESI GROUP

ESI is a pioneer and world-leading provider in Virtual Prototyping that takes into account the physics of materials. ESI boasts a unique know-how in Virtual Product Engineering, based on an integrated suite of coherent, industry-oriented applications. Addressing manufacturing industries, Virtual Product Engineering aims to replace physical prototypes by realistically simulating a product's behavior during testing, to fine-tune fabrication and assembly processes in accordance with desired product performance, and to evaluate the impact on product use under normal or accidental conditions. ESI's solutions fit into a single collaborative and open environment for End-to-End Virtual Prototyping. These solutions are delivered using the latest technologies, including immersive Virtual Reality, to bring products to life in 3D; helping customers make the right decisions throughout product development. The company employs about 1000 high-level specialists worldwide covering more than 40 countries. ESI Group is a French company listed in compartment C of NYSE Euronext Paris.

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