# Pushing the Boundaries of Experimental Design with Design of Experiments (DOE)

There are multiple industries (e.g. automotive, aerospace, consumer electronics, etc.) where engineers are subjected to intense pressure to deliver optimized designs.

Design of experiments (DOE) is a systematic, rigorous approach to engineering problem-solving that applies principles and techniques at the data collection stage so as to ensure the generation of valid, defensible, and supportable engineering conclusions. Engineers want to determine the optimal parameters to achieve the performance response they are aiming for. DOE helps provide engineers with the data needed to get the design right the first time.

In a system-level design, the performance of that system (output) can be affected by the variation of input values. Such input variations can be caused by component tolerances and/or changes in the usage environment, all of which are a fact of life. Therefore, it's critical that the Designer understands the sensitivity of the system performance across the potential spectrum of input parameters. In systems comprised of numerous individual components, the sheer number of permutations can quickly become unmanageable. Design of Experiments (DOE) is a statistical technique that systematically determines which inputs have a significant impact on the output in a cost effective and time efficient manner. The process designs a set of experiments (model runs of different configurations), which results in a response surface that identifies which variables have the most influence on the outcome. This can then guide the design to a less sensitive layout or it can guide tolerance selection to maintain acceptable performance.
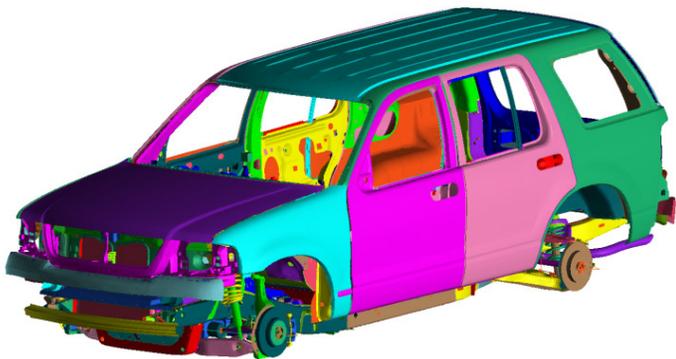

DOE Simulation in MSC Nastran

DOE provides key insights into the design process that ensures a valid data analysis by:

- Reducing the number of physical experiments
- Allowing for the understanding of the Design Space
- Reducing the potential number of numerical experiments
- Allowing users to explore additional parameters

MSC's software solutions enables engineers to meet competing design goals by cost-effectively leveraging Design of Experiments (DOE), Optimization, Stochastics, and other techniques to perform large numbers of parameterized simulations. Users can run up to a thousand or more simulation jobs at one time. The simulations inputs for DOE are generated algorithmically according to the rules of the particular technique. The results from DOE simulations are not viewed on an individual basis, but statistical techniques are applied to look at behaviors and trends across all of the simulations.
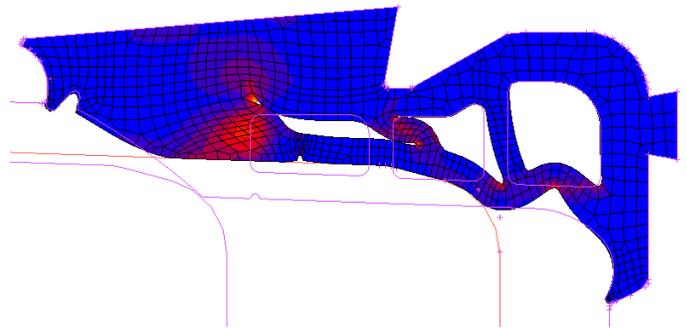
DOE Simulation in Marc

MSC Software collaborates with a number of partners to create a healthy ecosystem for DOE in the engineering simulation community. As an example, Insight offers a native connection to Adams and can also be used in conjunction with most MSC products to run DOE. Insight provides users with a basic DOE toolbox and a place to get started.

For more advanced DOE and Optimization capabilities, MSC actively supports a variety of third-party applications such as:

- Fast Concept Modelling (CONTACT Software)

- MeshWorks (Detroit Engineered Products)

- modeFRONTIER (Esteco)

- ModelCenter (Phoenix Integration)

- Optimus (Noesis Solutions)

- And many others!

For a complete list of MSC Technology Partners who provide these capabilities, view http://partners.mscsoftware.com
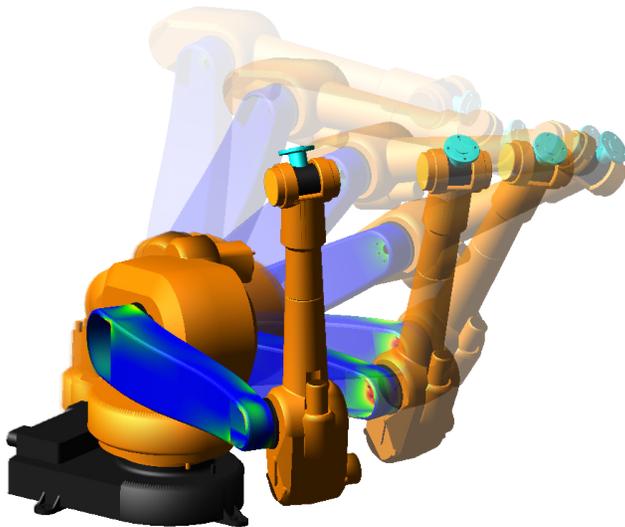
As an extension to MSC's core products, DOE is a very cost effective way of running engineering simulations. As an example, Insight is already part of the MSC One token system and Master Key Plus. MSC's Multi-Run Solver Suite is specifically tailored for multi-run situations, at a range of job sizes suitable for everything from a screening DOE to a comprehensive optimization. Customers who have a limited number of tokens (or already operate near the capacity of their token pool) would especially benefit. MSC's solver-specific, multi-run license pools address this barrier by allowing customers to lease or purchase a pool of licenses dedicated specifically to multi-run situations, at a cost that ensures an attractive ROI.

MSC's Multi-Run Solver Suite includes access to SMP, DMP, GPU, and multi-core capabilities so that users can utilize Design of Experiments (DOE), Optimization, Stochastics, and other techniques to perform larger numbers of parameterized simulations.

DOE can ultimately provide engineers with a more optimized design. MSC is poised in implementing this technique to ensure that users can get their design right the first time.

DOE Simulation in Adams

Corporate
MSC Software Corporation
4675 MacArthur Court
Suite 900
Newport Beach, CA 92660
Telephone 714.540.8900
www.mscsoftware.com

Europe, Middle East, Africa
MSC Software GmbH
Am Moosfeld 13
81829 Munich, Germany
Telephone 49.89.21093224
Ext.4950

Asia-Pacific
MSC Software Japan LTD.
Shinjuku First West 8F
23-7 Nishi Shinjuku
1-Chome, Shinjuku-Ku
Tokyo, Japan 160-0023
Telephone 81.3.6911.1200

Asia-Pacific
MSC Software (S) Pte. Ltd.
100 Beach Road
#16-05 Shaw Towers
Singapore 189702
Telephone 65.6272.0082

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