

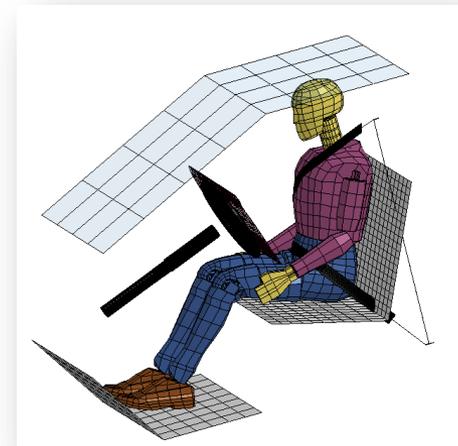
Introductory Course: Using LS-OPT[®] on the TRACC Cluster

2.5b - Probabilistic Analysis

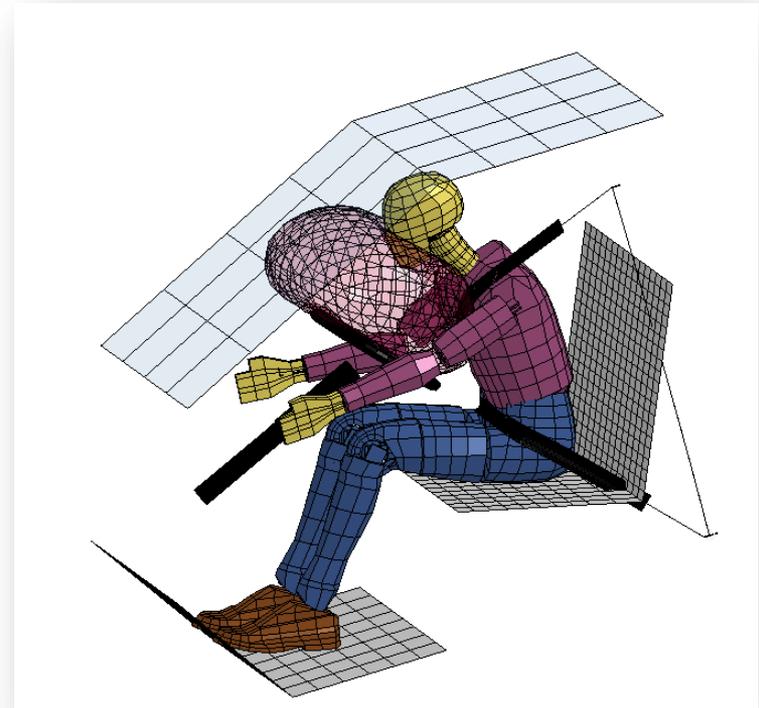
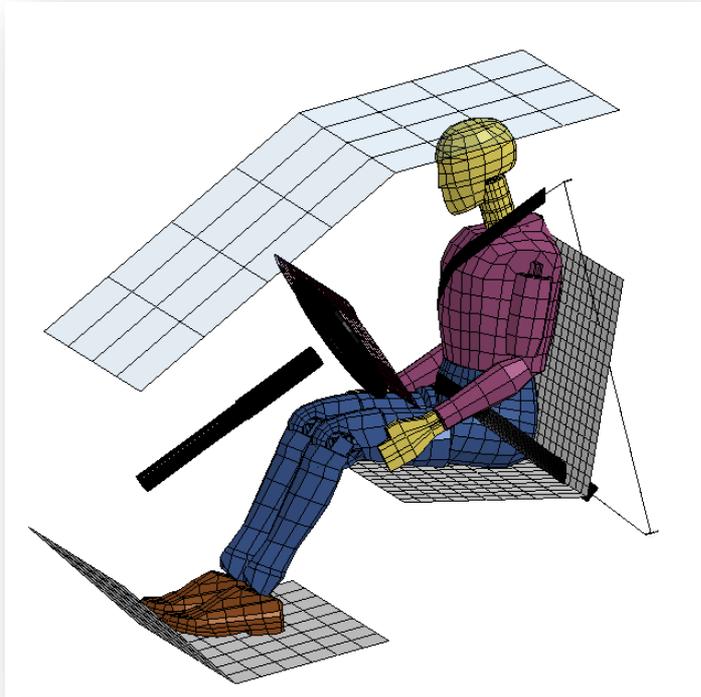
By: Cezary Bojanowski, PhD

Problem description

- This example is a Monte Carlo analysis of a sled test with a belted dummy
- The goal is to find stochastic contribution of several noise variables on HIC registered in the dummy's head.
- Noise variables:
 - Load curve specifying input mass flow rate or tank pressure versus time
 - Friction between belt and dummy's torso
 - Load curve for stress versus strain for MAT_FABRIC used for seatbelt
 - Load curve for loading and unloading in SEATBELT_RETRACTOR
 - Fed length in SEATBELT_RETRACTOR

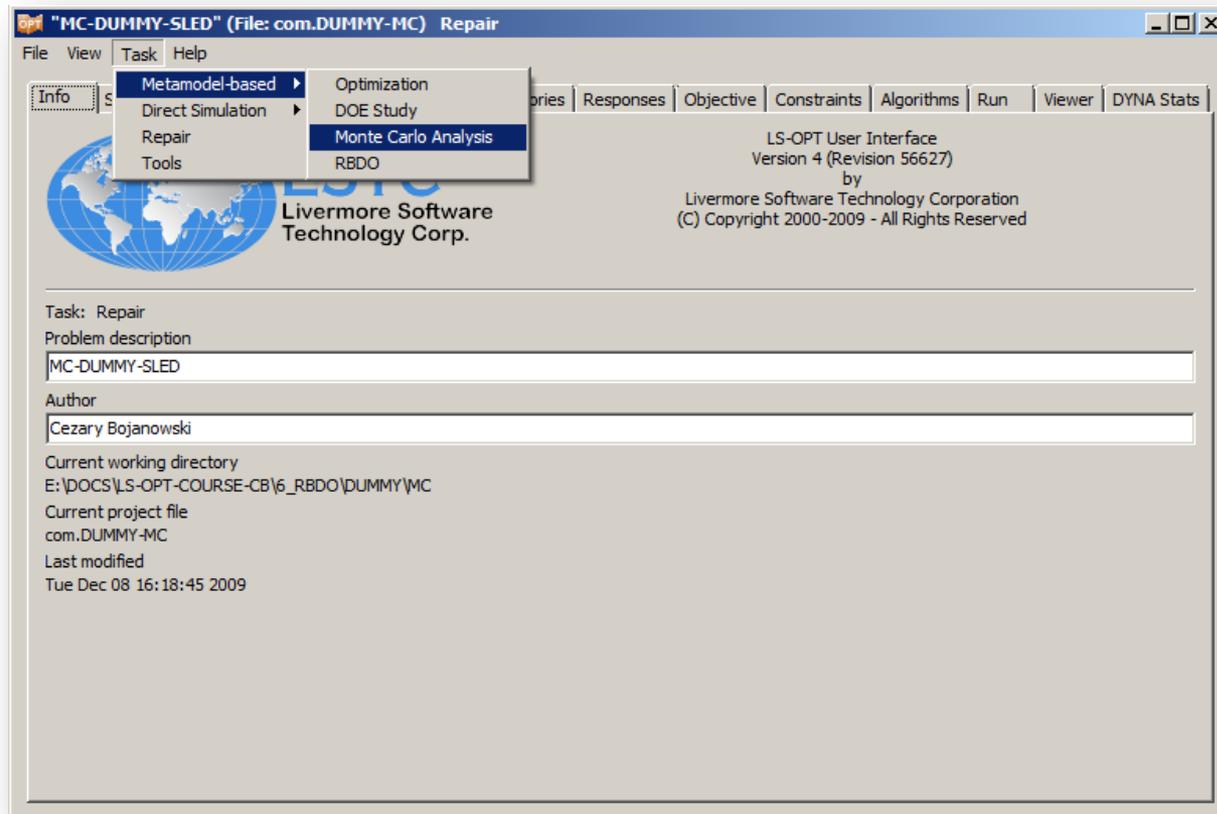


Problem description



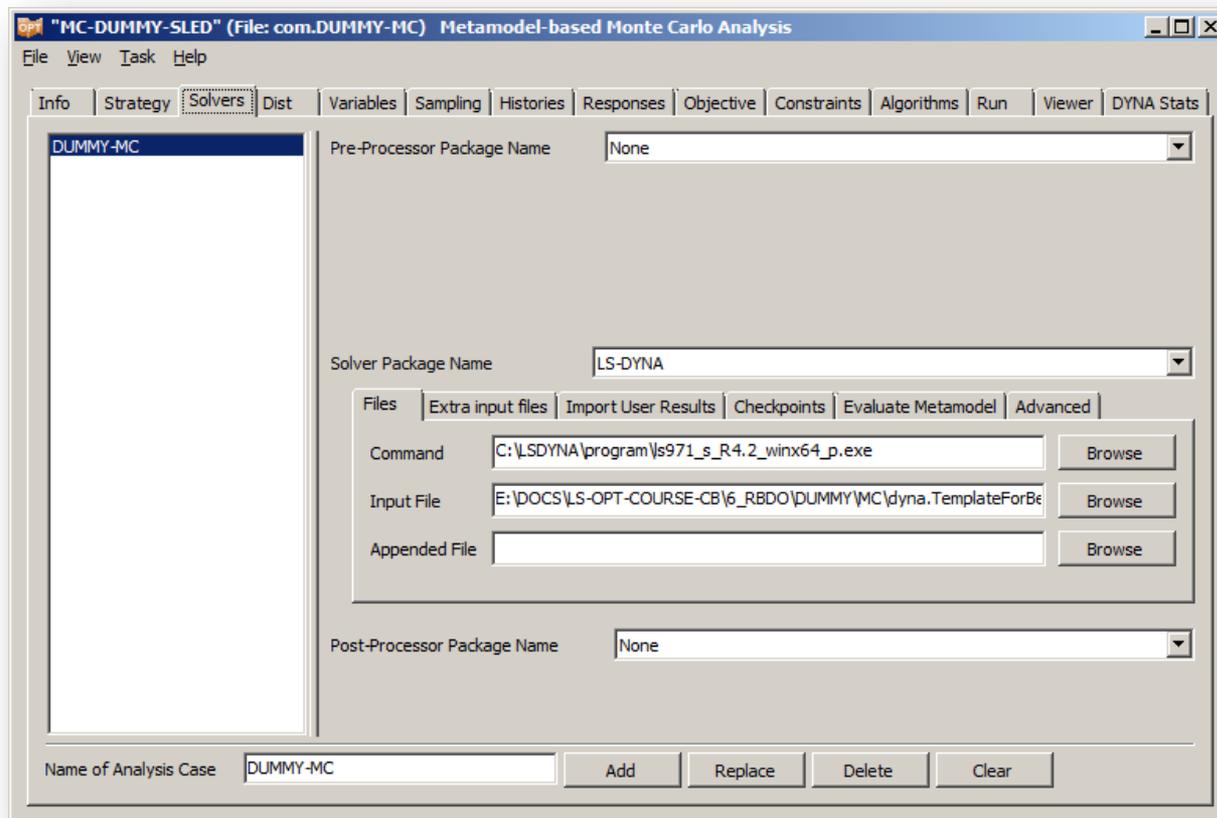
Task Tab

- Select Task – Metamodel-based Monte Carlo Analysis



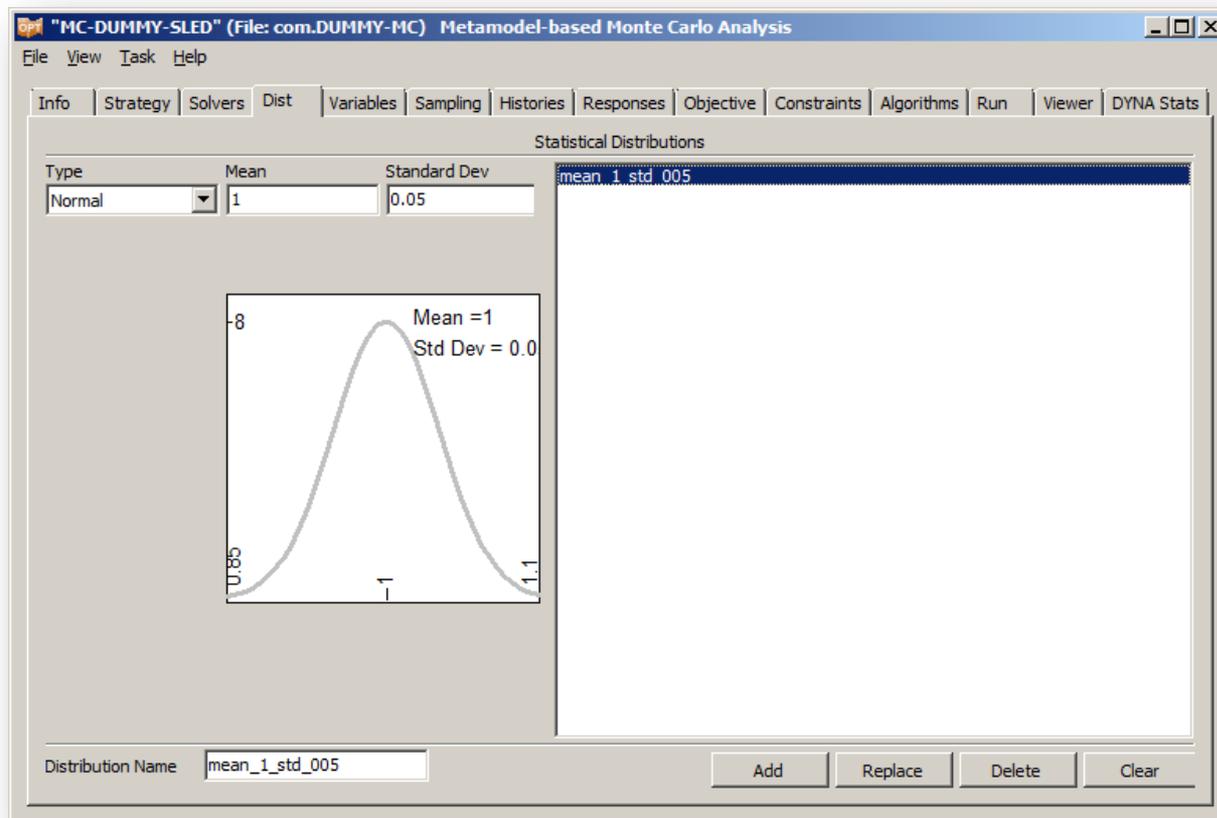
Solvers Tab

- In Solvers Tab find previously generated **Isopscript**
- Find Input file **DUMMY-SLED.k**
- Type **DUMMY-MC** in the Name of Analysis Case box and press Add



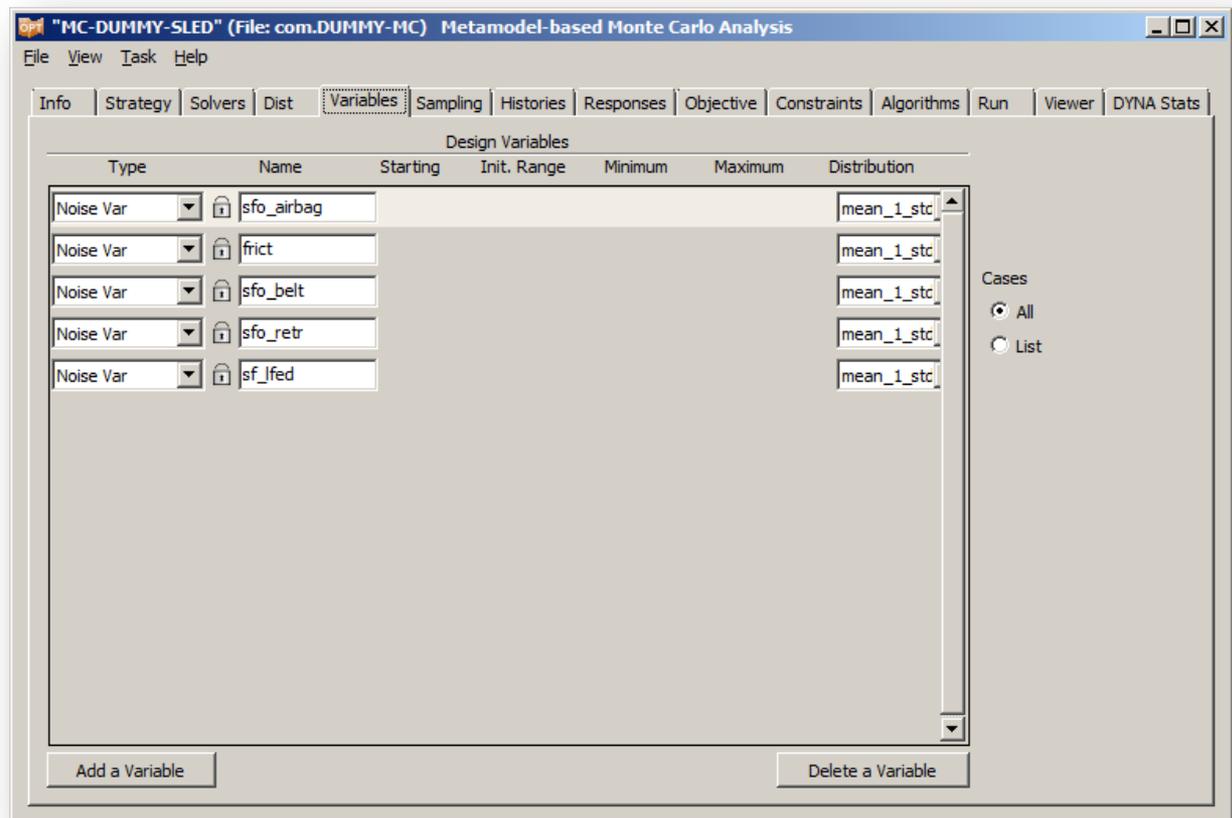
Distributions Tab

- Go to Distributions tab
- Define Normal Distribution `mean_1std_005` with mean `1` and Standard Deviation `0.05`



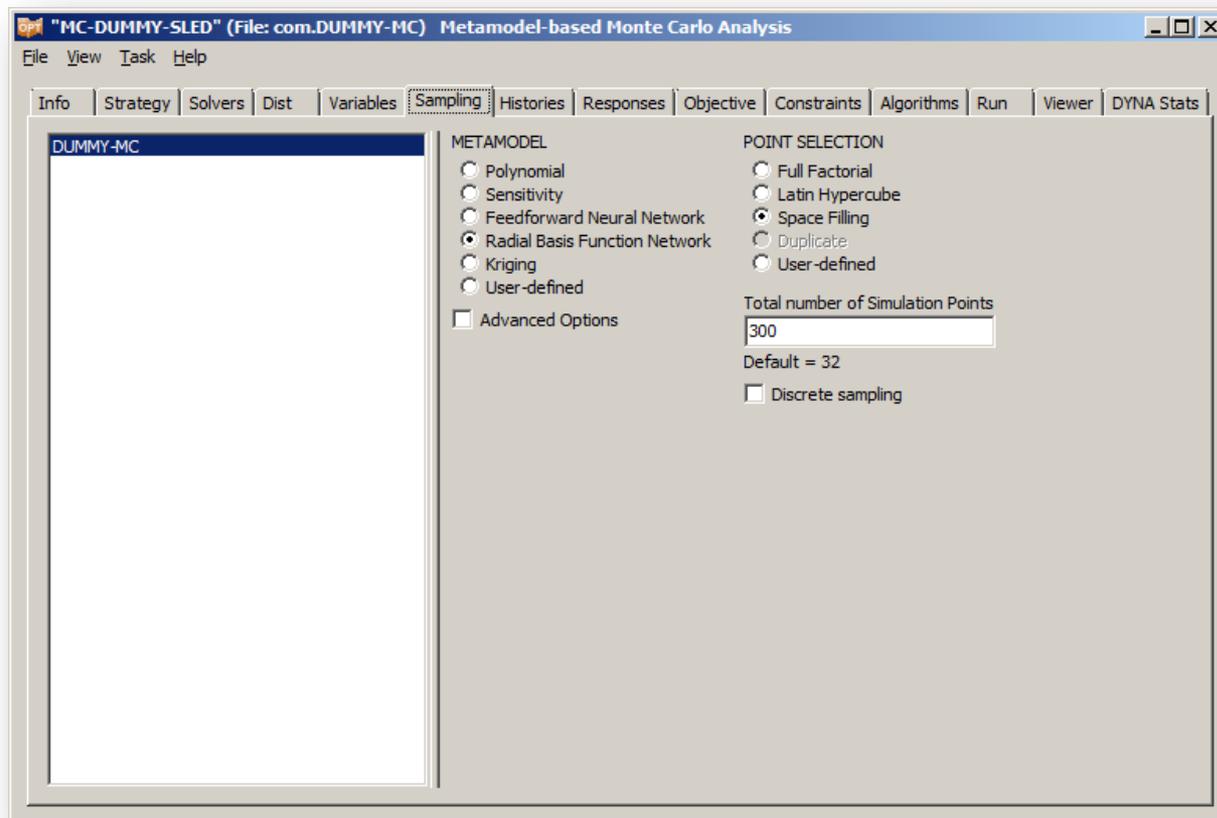
Variables Tab

- In the k-file all the noise variables are used as multipliers to the initial values thus they can be all defined the same way in LS-OPT
- When k-file is loaded to LS-OPT all five variables should be already present in Variables Tab
- Change all of them to Noise Variable type and Use Distribution `mean_1std_005`



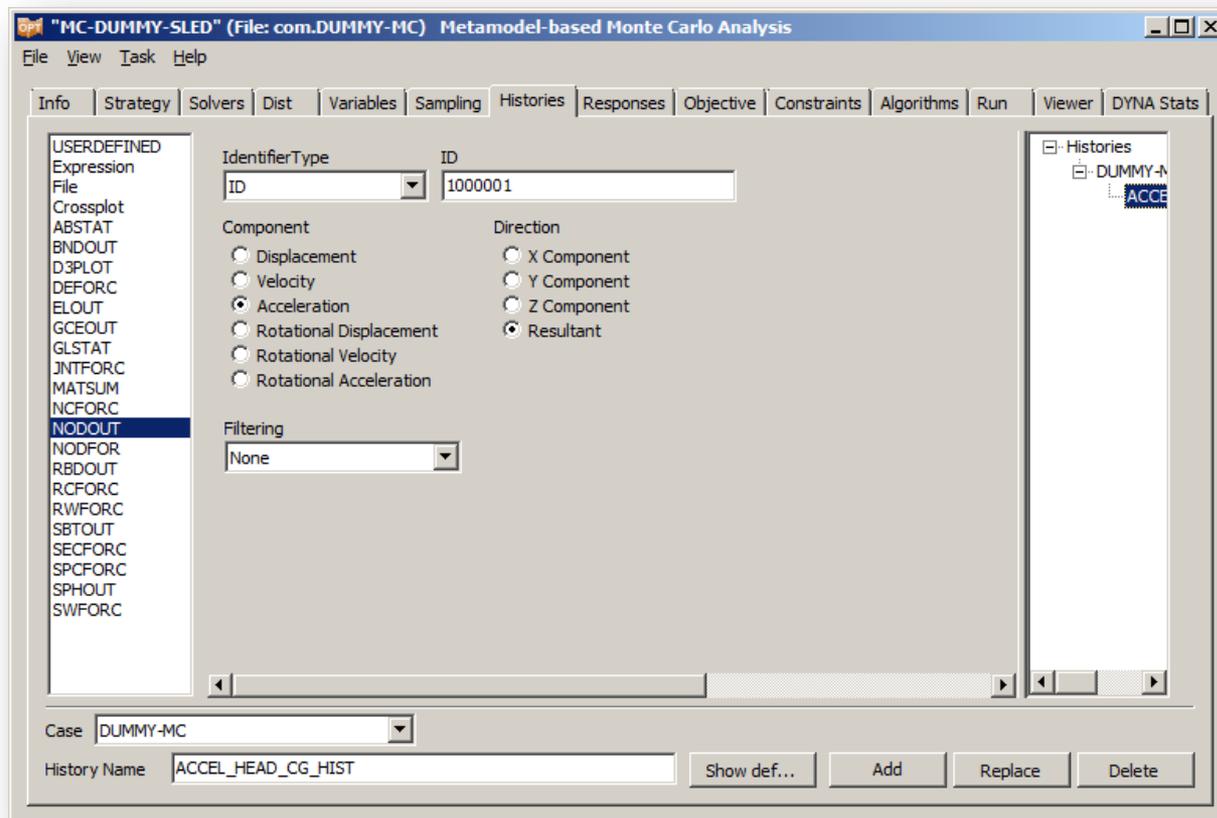
Sampling Tab

- Go to Sampling Tab
- Choose Radial Basis Function Network Metamodel Type
- Pick Space filling Point Selection method and
- Request 300 simulations



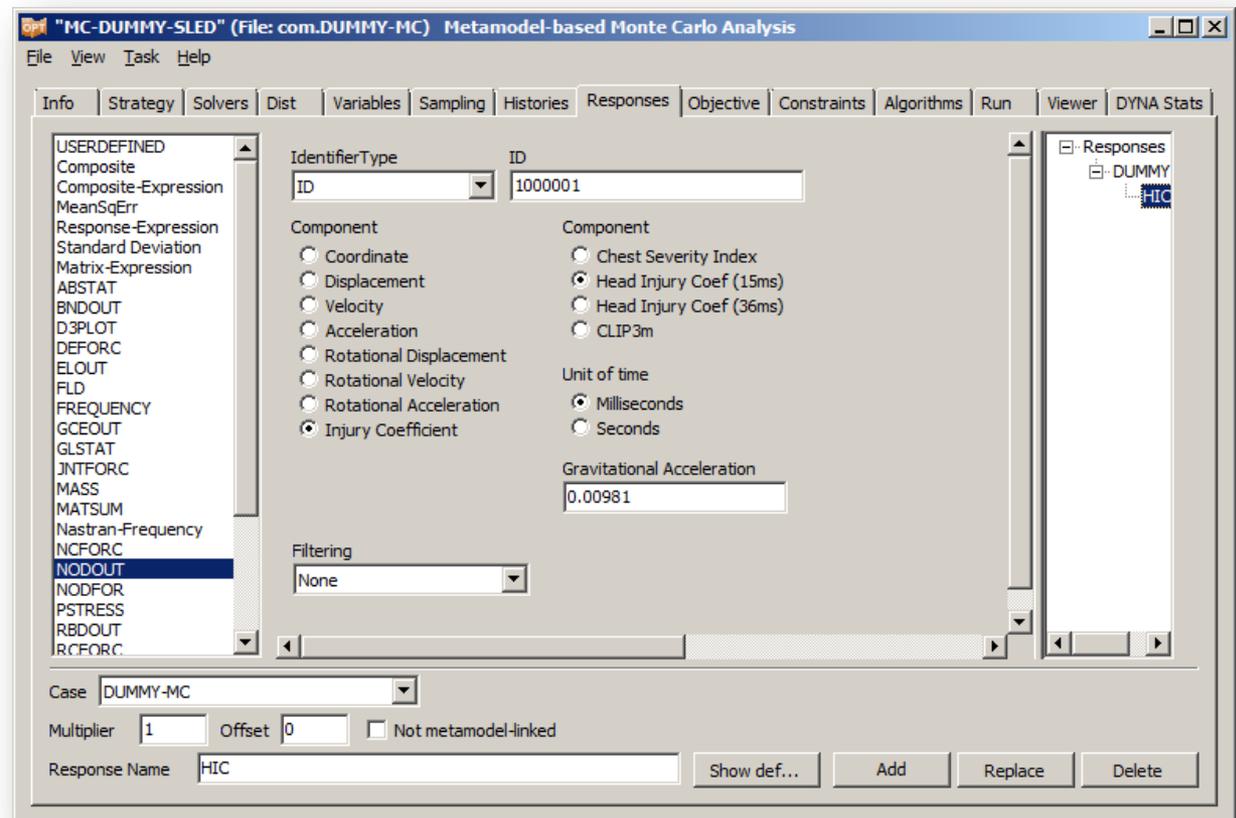
Histories Tab

- Select **NODOUT** and for ID Identifier Type enter **1000001** – node in the CG of the dummy's head
- For the component select Resultant Acceleration
- Enter History Name **ACCEL_HEAD_CG_HIST** and press Add



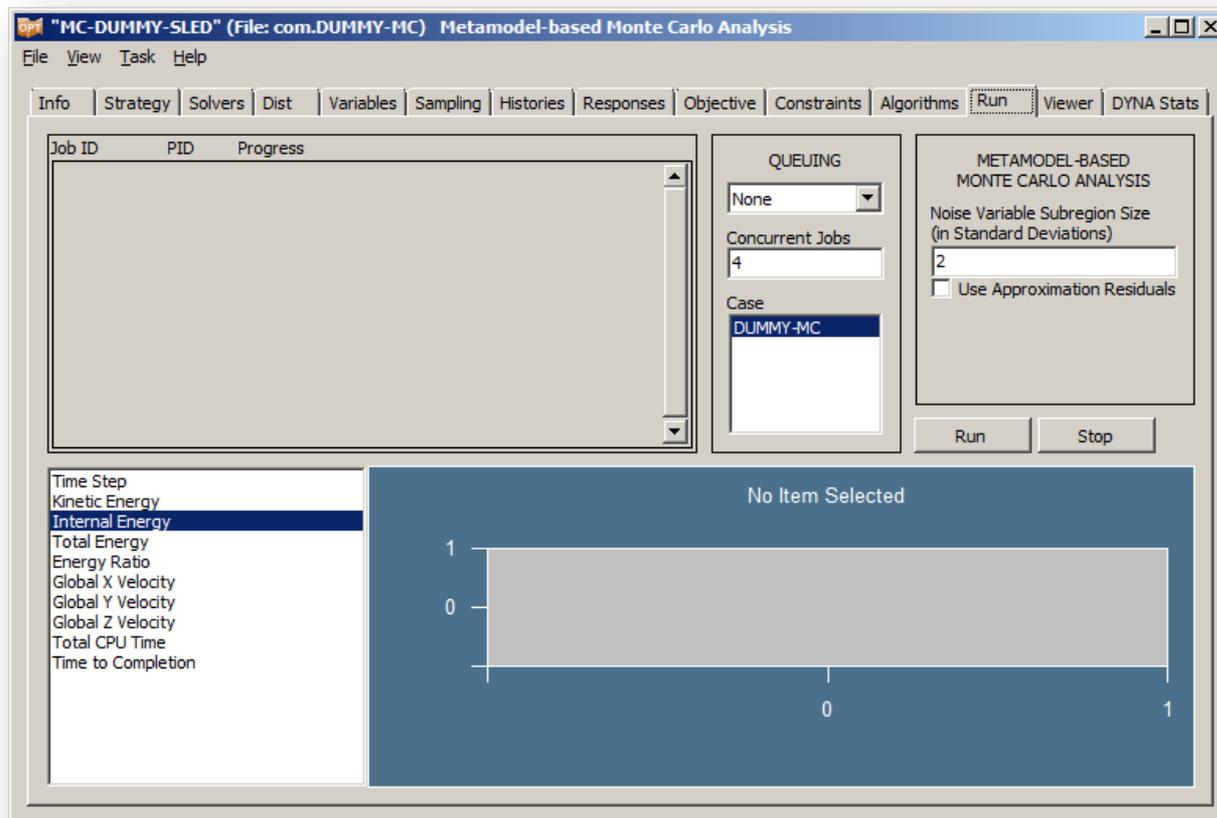
Responses Tab

- Select **NODOUT** and for ID Identifier Type enter **1000001** – node in the CG of the dummy's head
- Select Injury Coefficient and HIC15 as a Component –
- Units of time ms, Gravitational Acceleration = 0.00981
- Enter Response Name **HIC** and press Add



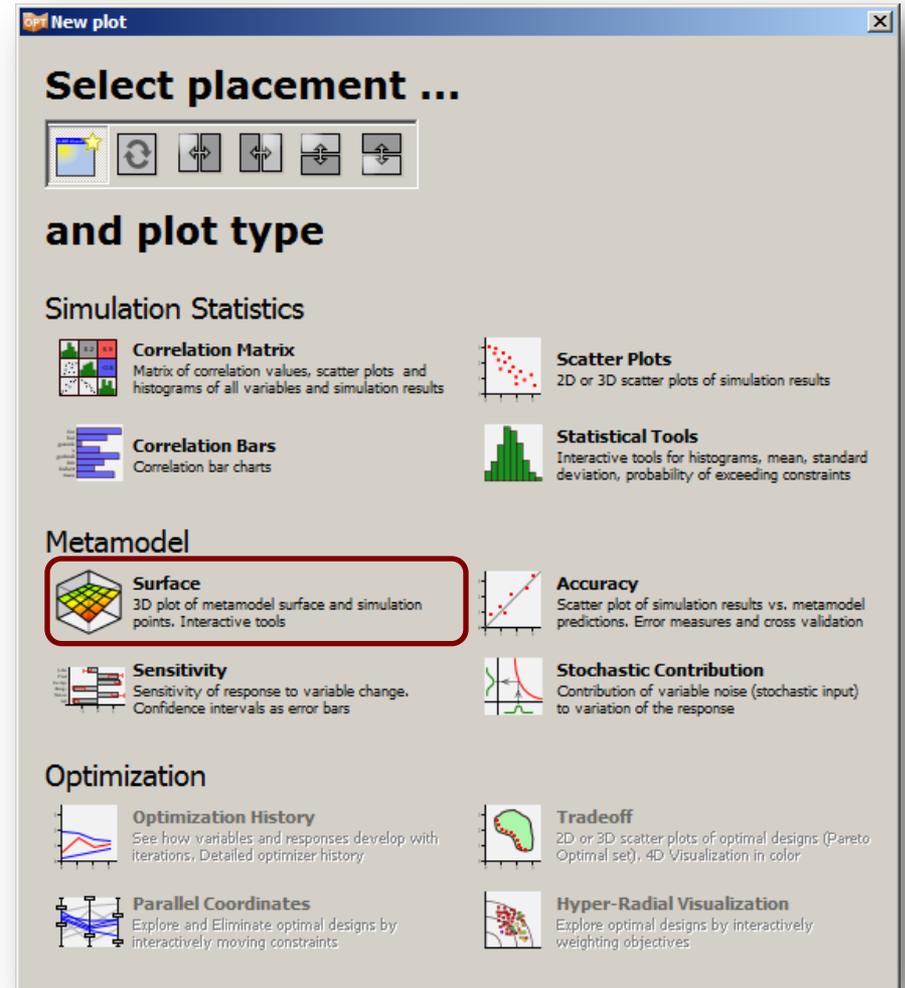
Run Tab

- Go to Run Tab
- Type 4 for Concurrent Jobs and
- Press Run



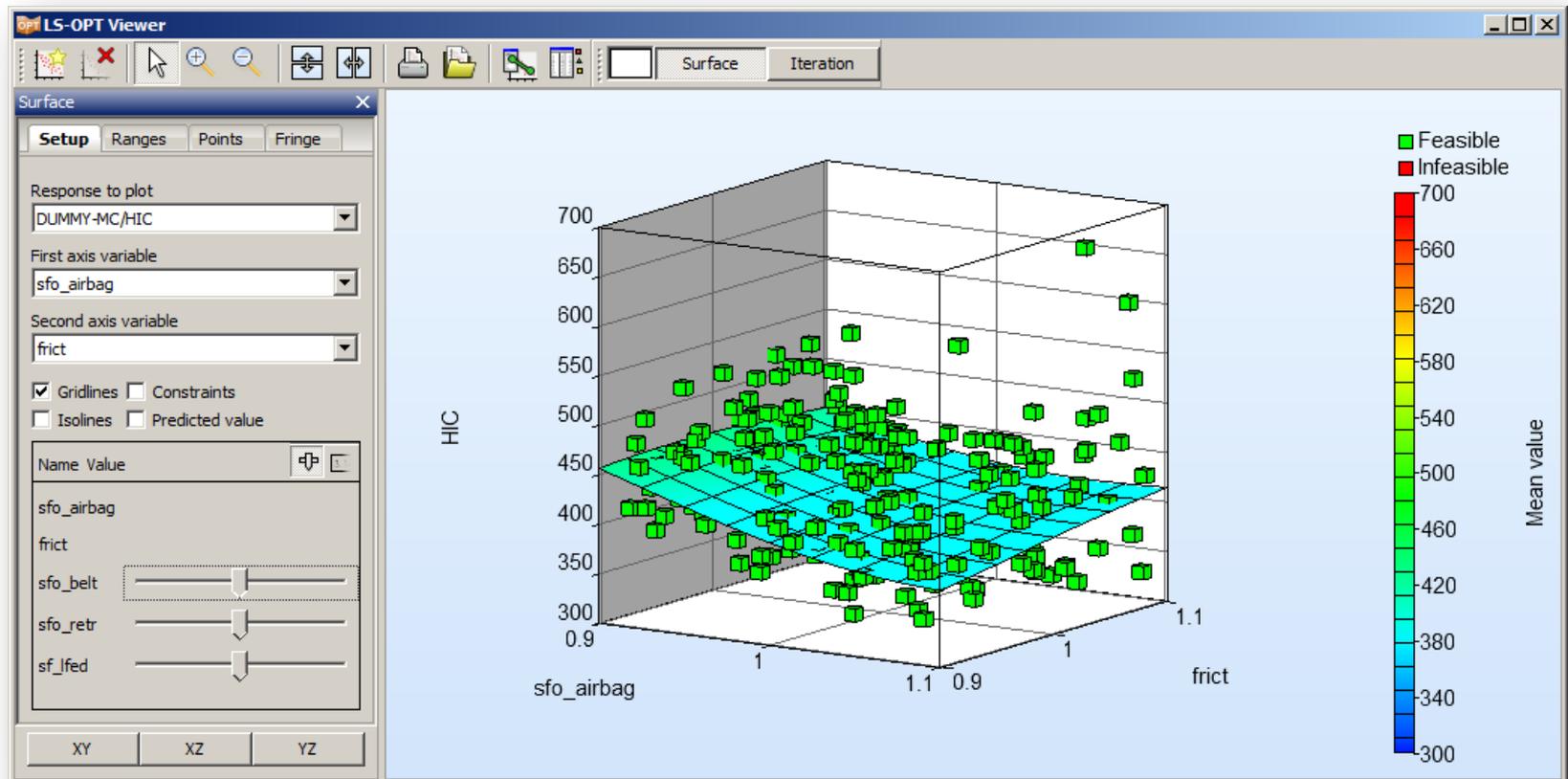
Viewer

- After the jobs are finished, go to Viewer tab in LS-OPTui
- Press Restart viewer button
- From Metamodel menu select “Surface”



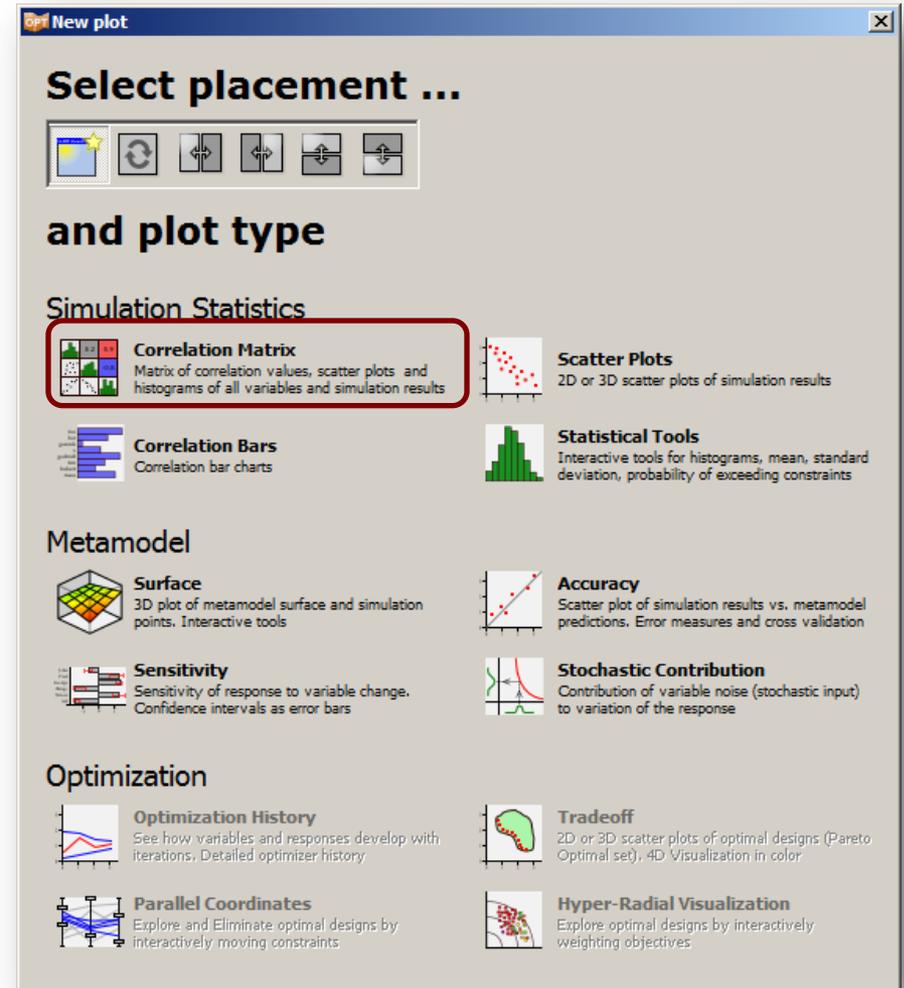
Metamodel Surface

- Set the Ranges from 300 to 700
- Set the variables to 1.0 using sliders



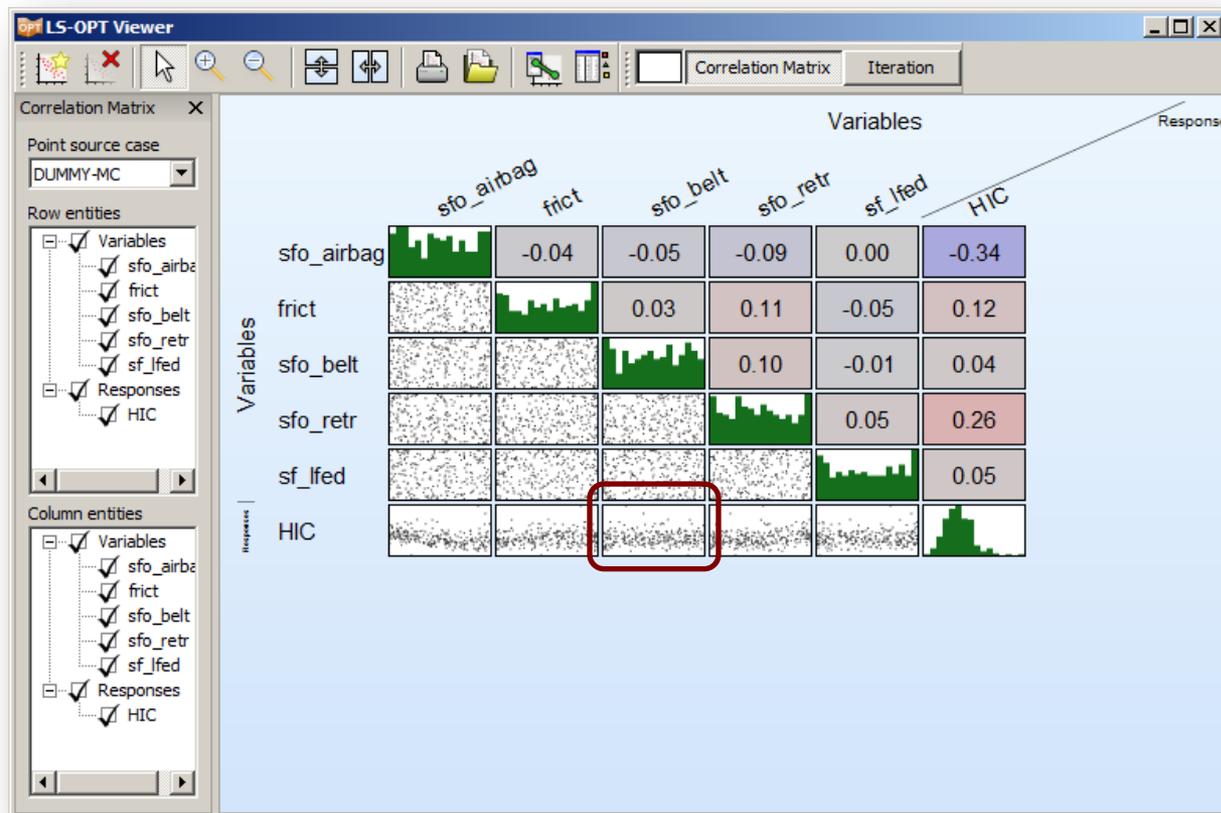
Viewer

- Go to Viewer tab in LS-OPTui
- Press Restart viewer button
- From Simulation Statistics menu select “Correlation Matrix”



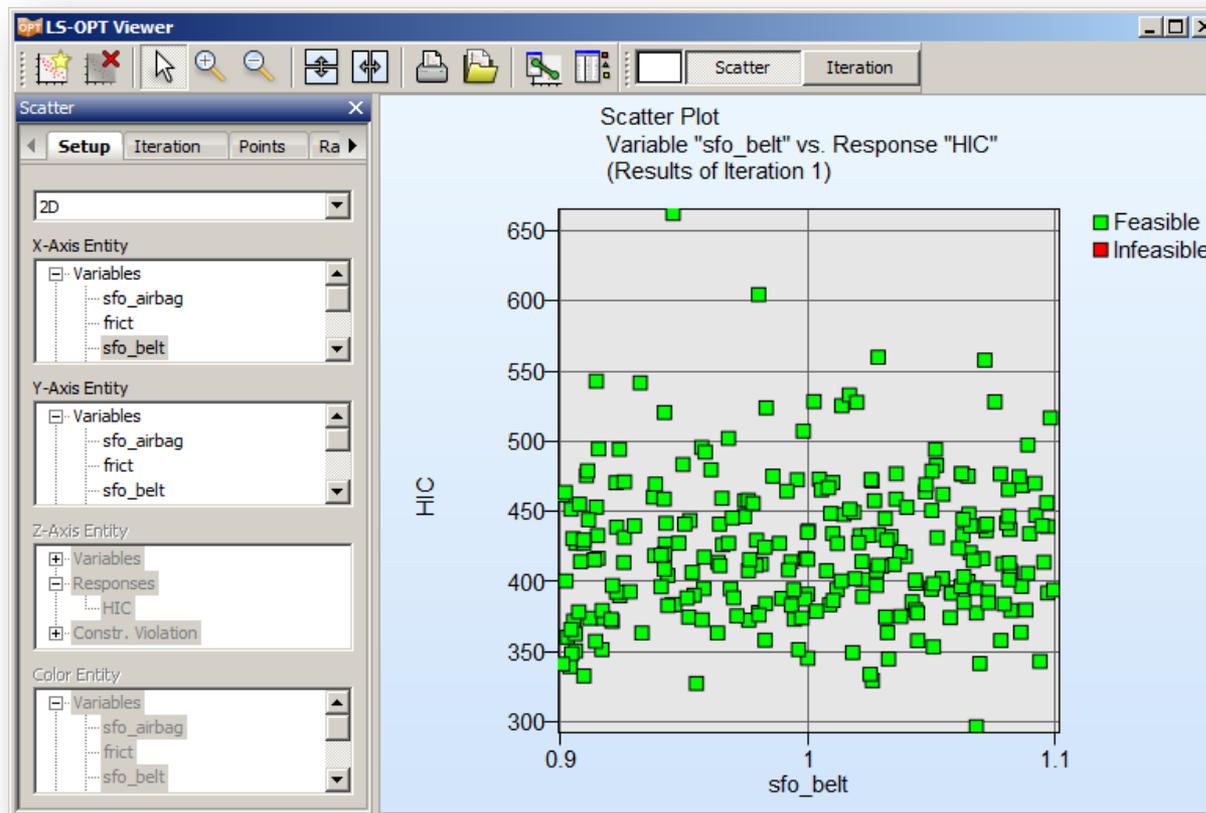
Correlation Matrix

- Click on the window HIC vs. sfo_belt to enlarge



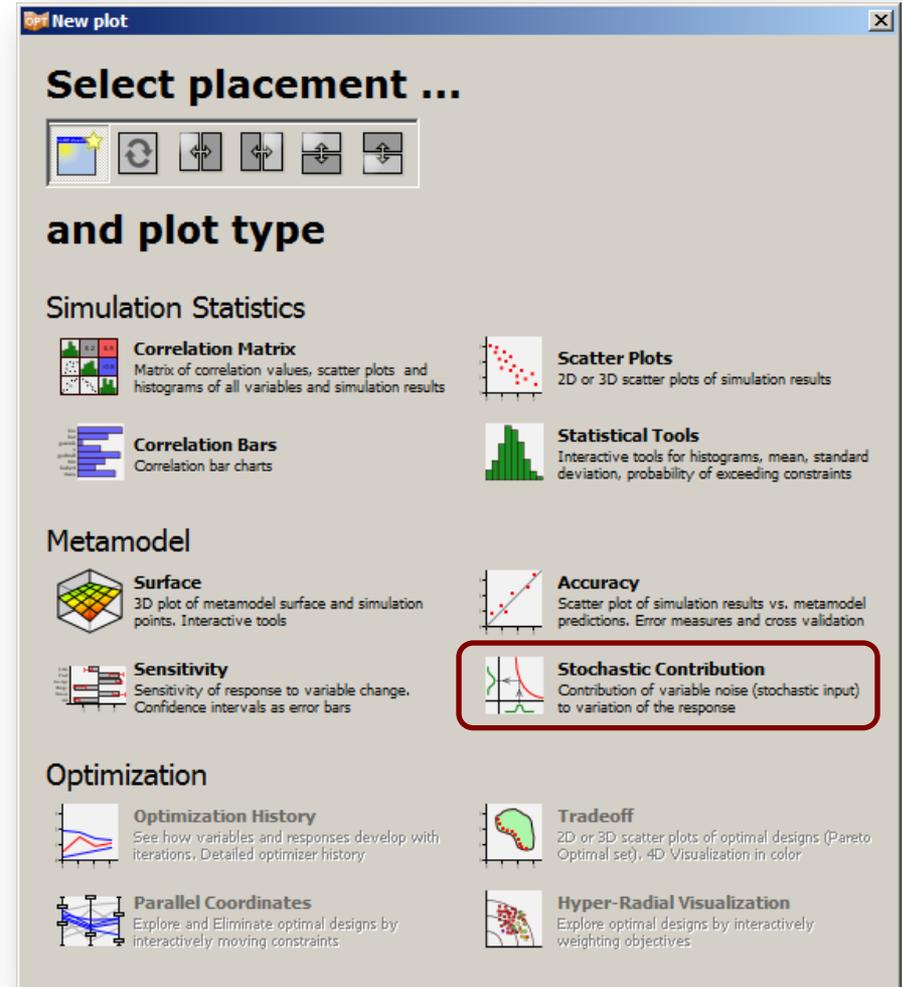
Correlation Plot

- There is large scarcity in the results and no trend can be identified. The quantities are not correlated



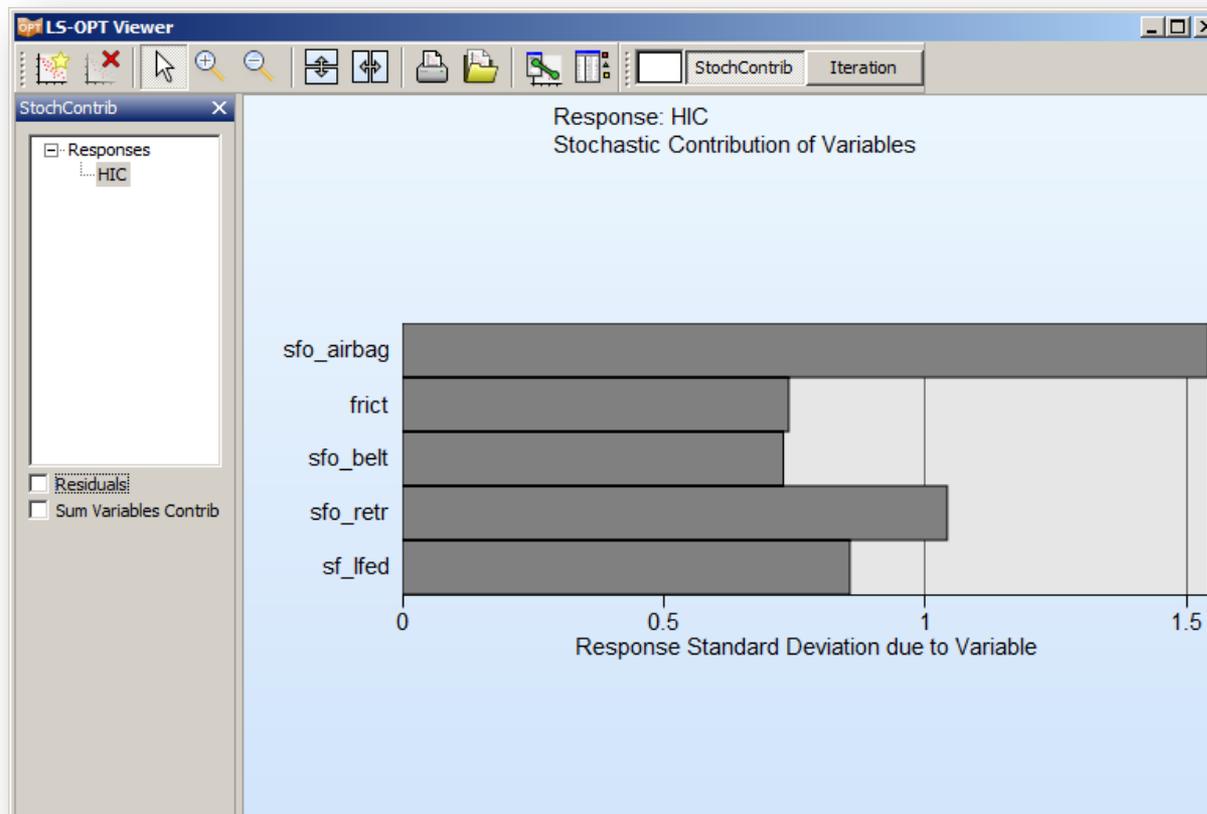
Viewer

- Go to Viewer tab in LS-OPTui
- Press Restart viewer button
- From Metamodel menu select “Stochastic Contribution”

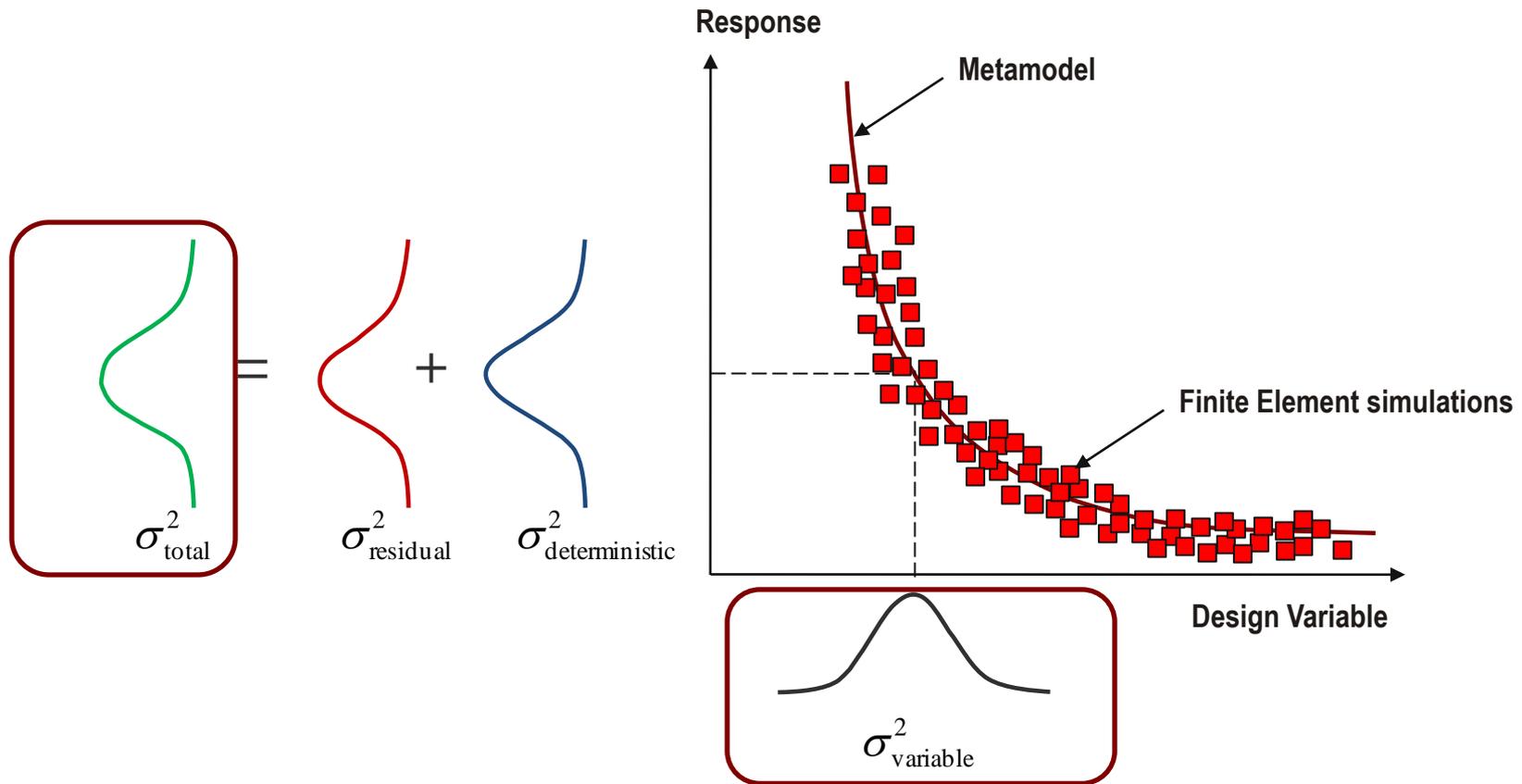


Stochastic Contribution

- The data shown is only based on results from metamodel



Stochastic Contribution in Metamodel based Monte Carlo Simulations



Stochastic Contribution

- Check the Residuals box. The Residuals govern the response. Their response of the dummy is very noisy.

