

**PSA PEUGEOT CITROËN**

Technical Resources Department  
Numerical Simulations Development

# ROBUSTNESS ANALYSIS IN ADAMS

Automated simulation sequencer : iSIGHT/ADAMS

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# Introduction

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- **Technical centre of Vélizy (France)**
- **Technical Resources Department**
- **Numerical Simulations Development**
- ***ROBUSTNESS ANALYSIS IN ADAMS (iSIGHT/ADAMS tool)***

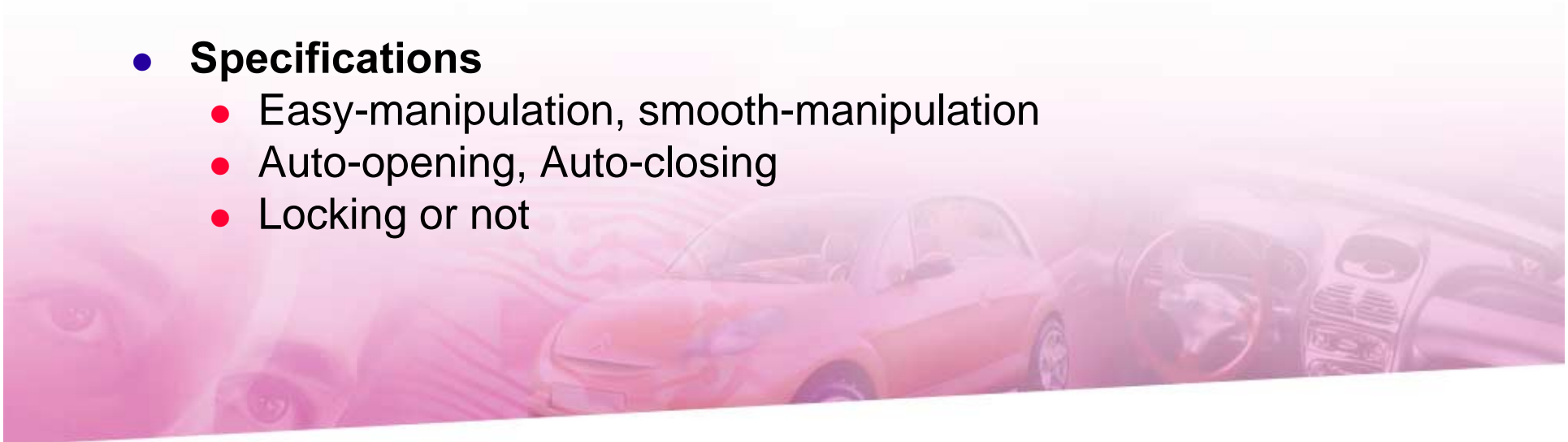


# Contents of the presentation

- **Ergonomics Simulations**
  - Introduction to ergonomics
  - Door handling? What is it?
  - Successful using of ADAMS simulation
- **A step further!**
  - Automatic simulation sequencer software : iSIGHT
  - PSA solution iSIGHT/ADAMS
- **The iSIGHT/ADAMS tool**
  - Optimisation pre-processing
  - The execution and post-processing
- **Conclusion and Discussion**

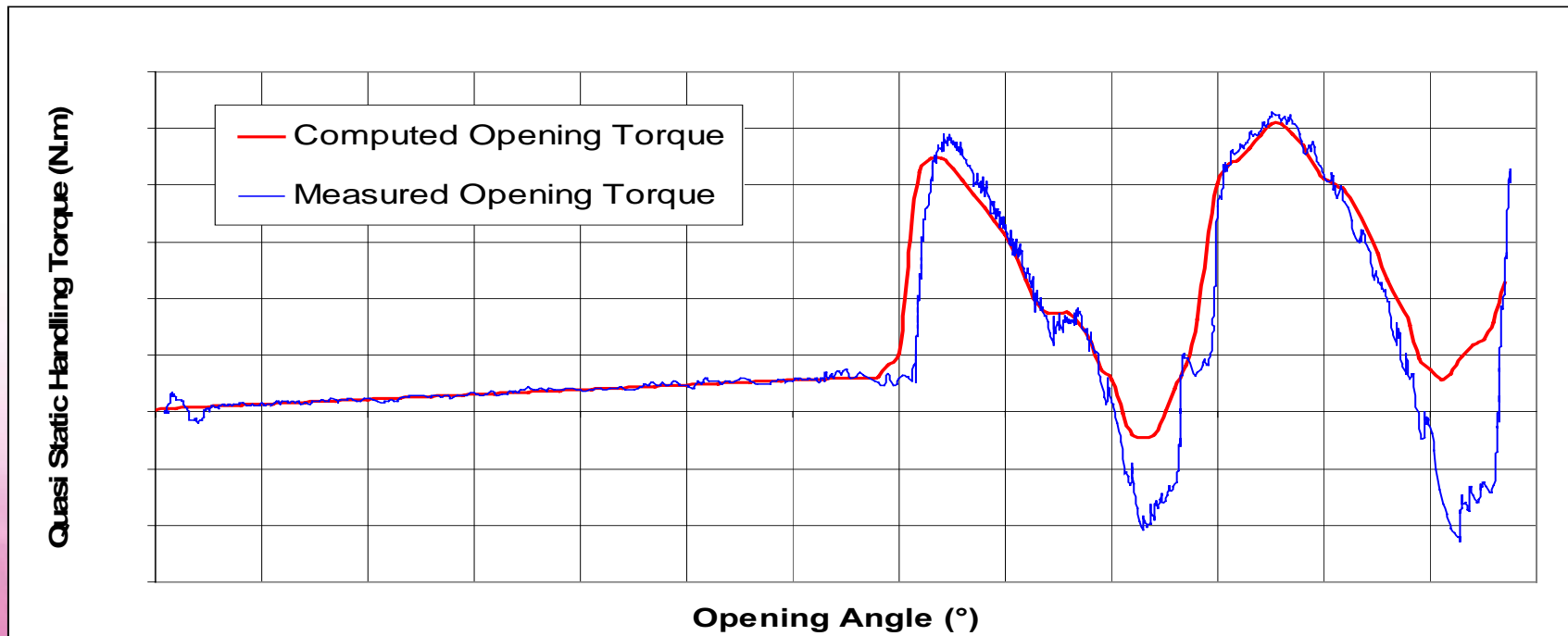
# Introduction to Ergonomics

- **Ergonomics**
  - What customer can feel when using its car
    - Force, Sight, Vibrations, Noise
- **Doors Ergonomics requirements**
  - Facility to manipulate doors (opening, closing, locking)
  - Facility to manipulate windows
- **Specifications**
  - Easy-manipulation, smooth-manipulation
  - Auto-opening, Auto-closing
  - Locking or not

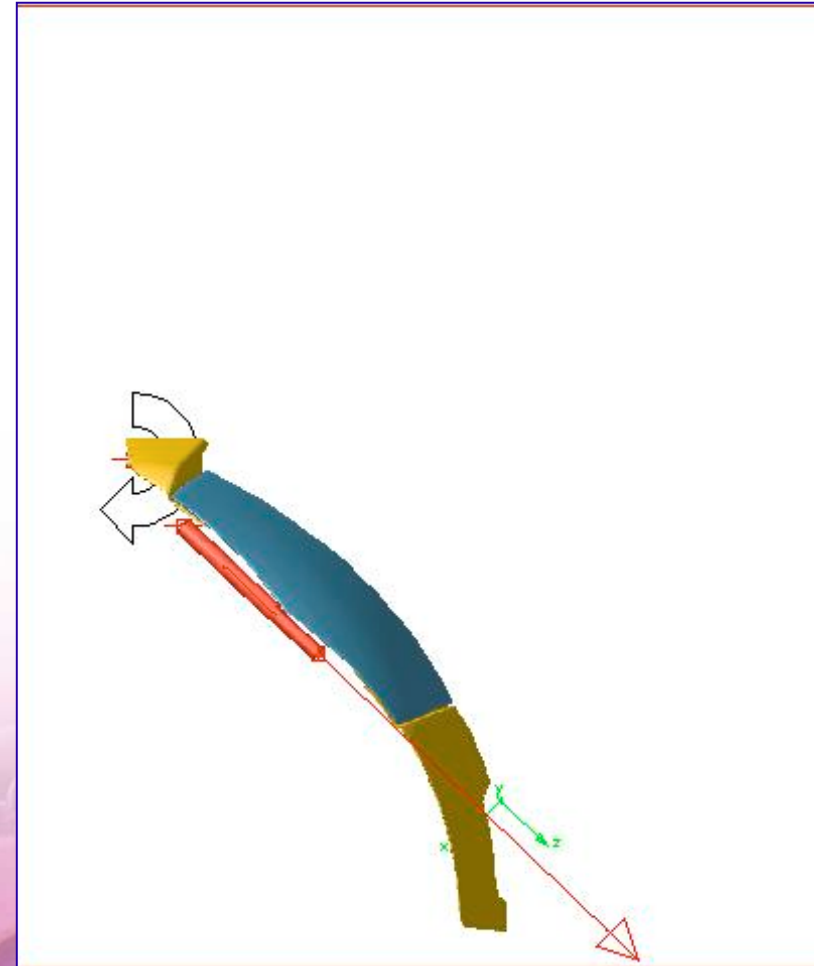
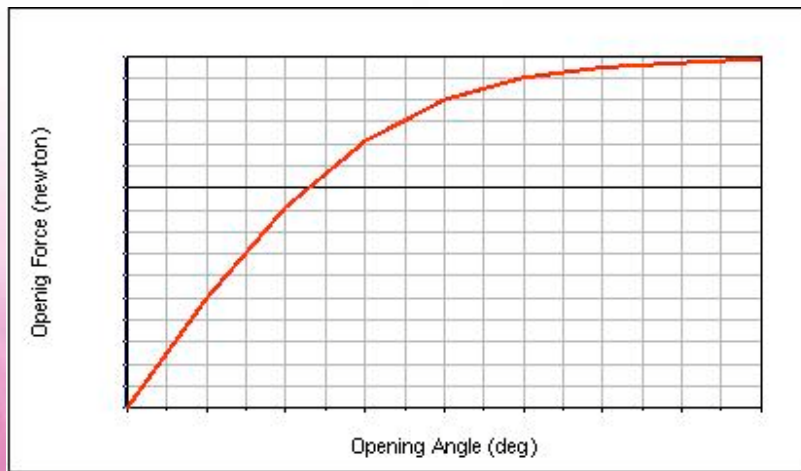


# Door Handling

- **During door manipulation**
  - Customers can feel different steps (due to catch mechanism)
  - Different equilibrium position

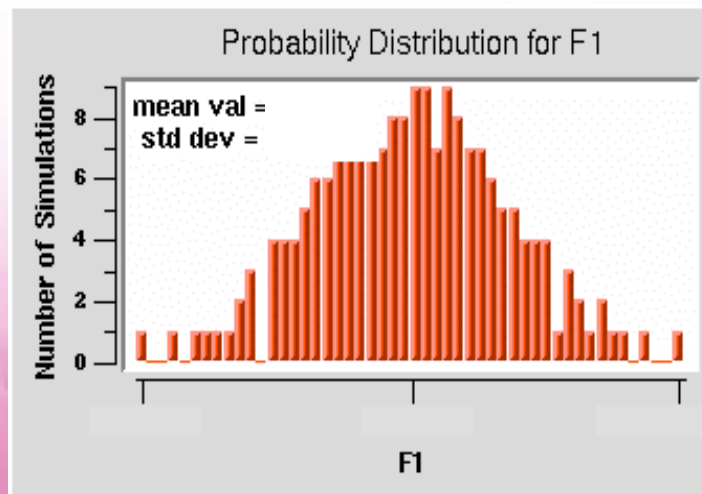


# Successfully Back Door Simulation



# The Further step!

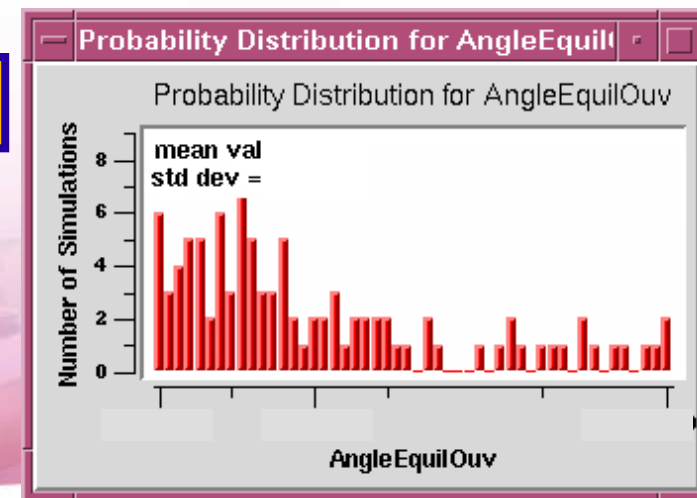
- **Low CPU time simulations**
  - Adapted to parametric studies
- **Generation of parametric studies in ADAMS**
  - Design Of Experiment (DOE)
  - Optimisation
  - Robustness Analysis



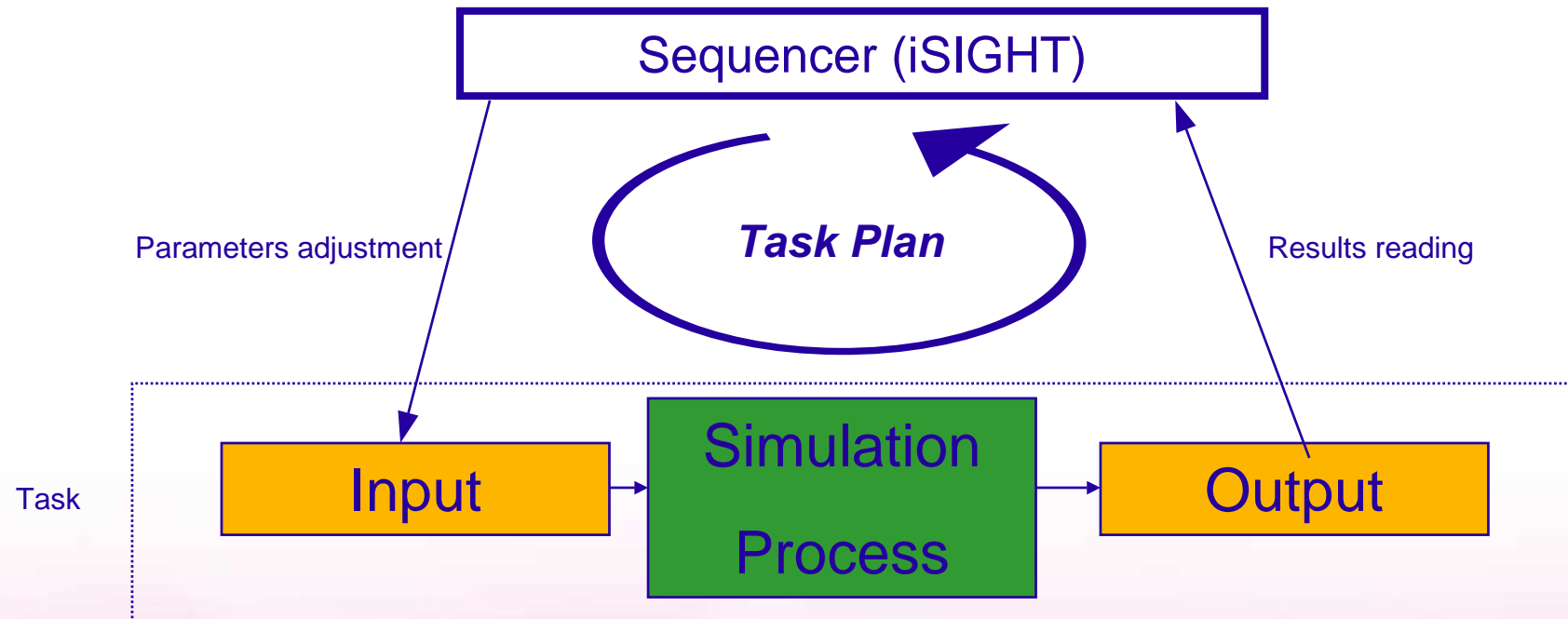
*Monte Carlo*



$IT = 8\sigma$



# iSIGHT : Automatic Simulation Sequencer



- **iSIGHT automates sequencing of Simulation Process guided by a Task Plan (Optimisation, Design Of Experiment...)**
- **Task = 1 or more simulation process ↗ 1 or more Subtasks**



# ISIGHT/ADAMS

- **Coupling iSIGHT/ADAMS**
  - Simulation process = ADAMS Simulation
  - Coupling of iSIGHT and ADAMS first validated
- **ISIGHT/ADAMS = PSA solution**
  - MDI France developed iSIGHT/ADAMS under PSA PEUGEOT CITROËN Specifications
- **Requirements**
  - Parameters are DESIGN VARIABLES
  - Criteria (output) are COMPUTED MEASURES
  - Simulation is an Aview commands simulation script
    - *Standard ADAMS Commands*

# Optimisation pre-processing

## Parameters

- **iSIGHT/ADAMS :**
  - Scan model
  - Visualize parameters of the model
- **One Panel to specify :**
  - Parameters
  - Initial Value
  - Range of variation

LISTE DES PARAMETRES iSight POUR LE MODELE : .man\_stat

Factor activation	Min	<	Init	>	Max
<input type="checkbox"/> anglemax		non	92.0	non	
<input type="checkbox"/> pas		non	0.5	non	
<input type="checkbox"/> massevolet		non	17.0	non	
<input type="checkbox"/> lyy		non	1.0E+06	non	
<input type="checkbox"/> XCdG		non	2792.27	non	
<input type="checkbox"/> YCdG		non	7.51	non	
<input type="checkbox"/> ZCdG		non	851.66	non	
<input type="checkbox"/> assiette		non	0.81	non	
<input type="checkbox"/> Treferece		non	293.15	non	
<input type="checkbox"/> Tmanipulation		non	293.15	non	
<input checked="" type="checkbox"/> F1od	350	<	369.0	>	380
<input checked="" type="checkbox"/> F2od	400	<	458.0	>	500
<input type="checkbox"/> F3od		non	417.0	non	
<input type="checkbox"/> F4od		non	500.0	non	
<input checked="" type="checkbox"/> Frd	40	<	46.0	>	50
<input type="checkbox"/> deltaS		non	10.0	non	
<input type="checkbox"/> Tmanipulationfroid		non	253.15	non	
<input type="checkbox"/> Tmanipulationchaud		non	353.15	non	
<input type="checkbox"/> Tmanipulationambient		non	293.15	non	
<input type="checkbox"/> Xrotulevoletd		non	2750.0	non	
<input type="checkbox"/> Yrotulevoletd		non	592.4	non	
<input type="checkbox"/> Zrotulevoletd		non	860.0	non	
<input type="checkbox"/> Xrotulestrd		non	2530.0	non	
<input type="checkbox"/> Yrotulestrd		non	523.7	non	

SUIVANT

# Optimisation pre-processing

## Constraints / Objective/ Outputs / Properties

- **iSIGHT/ADAMS :**
  - Visualize criterions of the model
- **One Panel to specify :**
  - Objective(s)
  - Constraint(s)
  - Output(s)
- **Study properties :**
  - Name
  - Simulation script
  - Diff. Step Size
  - Number of iterations
- **« Start »**
  - ADAMS write formatted files
- **Study ready to be executed**

LISTE DES CRITERES iSight POUR LE MODELE : .man\_stat\_volet

Obj	ObWg	ObSc	LoWg	LoSc	Lower	<	Response activation	<	Upper	UpSc	UpWg
non	1.0	1.0	1.0	1.0	10	<input checked="" type="checkbox"/>	COMPFOuv	<	70	1.0	1.0
non	1.0	1.0	1.0	1.0	10	<	COMPFFerm	<	60	1.0	1.0
max	1.0	1.0	1.0	1.0		non	COMPAouv	=	28	1.0	1.0
non	1.0	1.0	1.0	1.0	22	<	COMP Aferm	<	24	1.0	1.0
non	1.0	1.0	1.0	1.0		non	COMPAouv froid	non		1.0	1.0
non	1.0	1.0	1.0	1.0		non	COMPAouv chaud	non		1.0	1.0
non	1.0	1.0	1.0	1.0		non	COMPFOuv froid	non		1.0	1.0
non	1.0	1.0	1.0	1.0		non	COMPFOuv chaud	non		1.0	1.0
non	1.0	1.0	1.0	1.0		non	COMPFFerm froid	non		1.0	1.0
non	1.0	1.0	1.0	1.0		non	COMPFFerm chaud	non		1.0	1.0
non	1.0	1.0	1.0	1.0		non	COMP Aferm froid	non		1.0	1.0
non	1.0	1.0	1.0	1.0		non	COMP Aferm chaud	non		1.0	1.0

LANCEMENT DE TACHE iSight POUR LE MODELE : .ma

Job name: Optimization\_1

Simulation script: .man\_stat\_volet.Ouverture

Diff. step size: 0.01

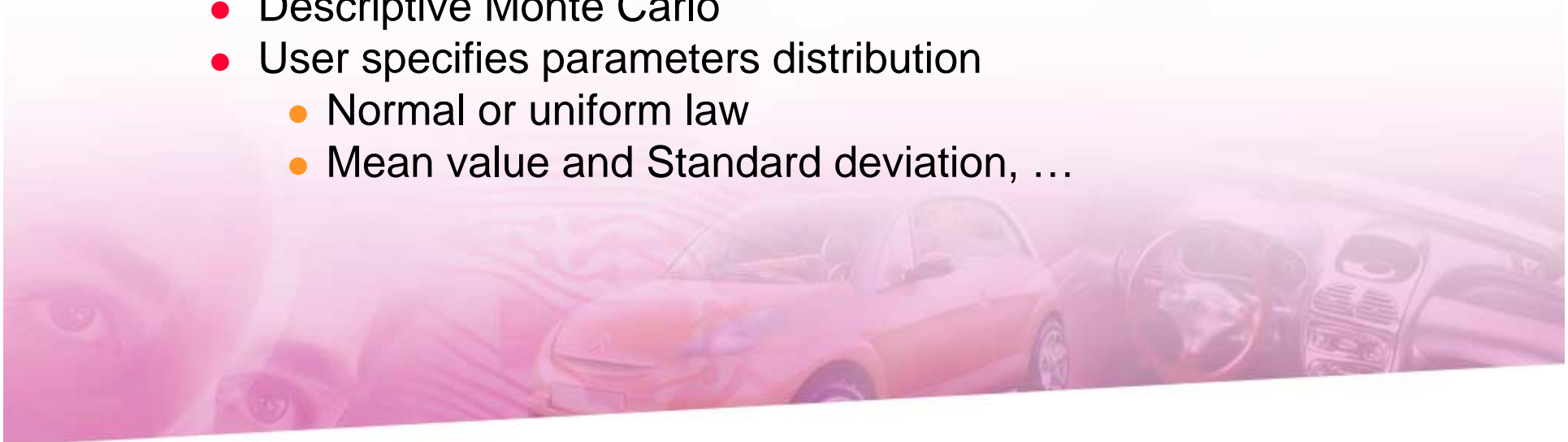
Number of iterations: 10

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# Others Applications

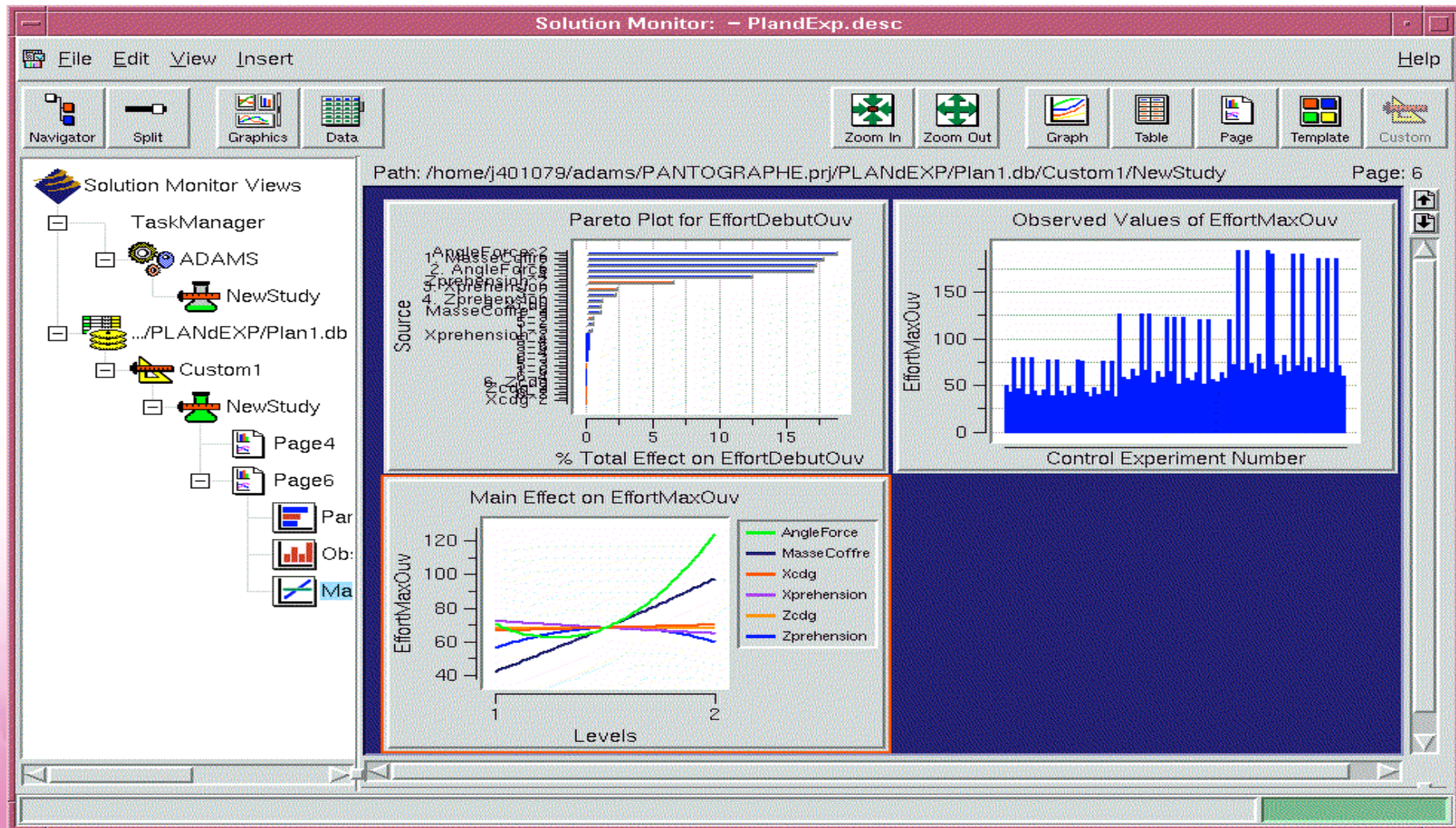
- **Design of Experiments**
  - DOE by Matrix File
  - User prepares its plan in a specialized tool
  - Post processing offers
    - Pareto, Main effects and Interaction graphs and tables, ...
  
- **Robustness Analysis**
  - Descriptive Monte Carlo
  - User specifies parameters distribution
    - Normal or uniform law
    - Mean value and Standard deviation, ...



# Automatic Study execution

- **iSIGHT/ADAMS write formatted files that contain**
  - Study's properties
  - Parameters information
  - Outputs information
  - Type of model (model's comment)
- **iSIGHT job for sequencing of simulations is automatically compiled by using**
  - Formatted files
  - Generic iSIGHT file
- **Compilation and Execution of the job is automatic for the user**

# Post-Processing



## Conclusion

- **iSIGHT/ADAMS is successfully used in vehicle development departments.**
- **Designers can now use statistics methods without be specialists.**

