

New Features in LS-OPT Version 3.0

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Overview

- **Overview of features in 3.0**
- **Main features**
 - Parameter identification
 - Stochastic fields
 - Improved Visualization
- **Outlook**
 - LS-OPT 3.1
 - LS-PM: Process Manager

Overview of features Version 3.0 (4th Quarter 2005)

- **LS-OPT for Windows**
 - Incorporates new Application Program Interface to speed up development/facilitate porting
- **Parameter Identification (beta available)**
 - Automated use of test results to calibrate materials/systems
 - Response Surface-based
 - Handles "continuous" test curves
- **Stochastic fields**
 - Geometry
 - Shell thickness
- **Improved visualization of stochastic results**
 - Extended LS-PREPOST visualization of design sensitivities and importance of design variables

Overview of features

Version 3.0

▪ Dyna d3plot interface

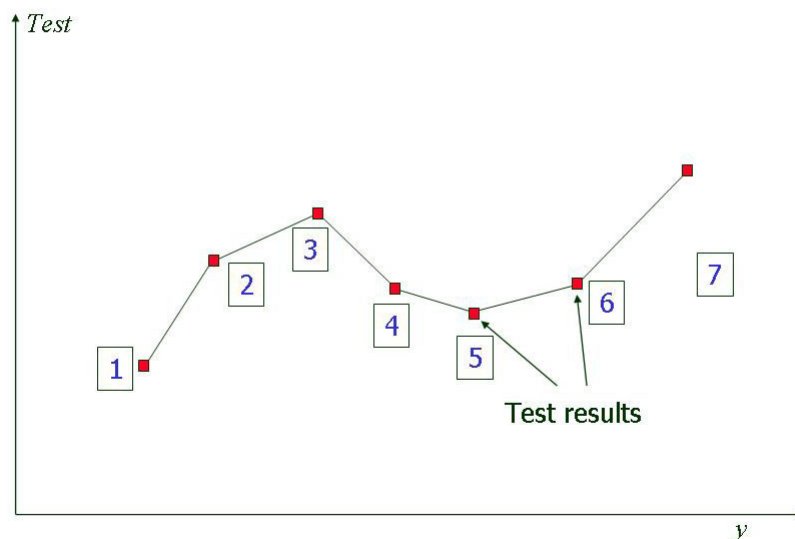
- LS-TAURUS interface is retired
- d3plot binary read directly by LSOPT
- Additional d3plot capabilities
 - extract results for an *element* or a *node*
 - in addition to the maximum/minimum over a part.
- Improved diagnostics

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Parameter Identification

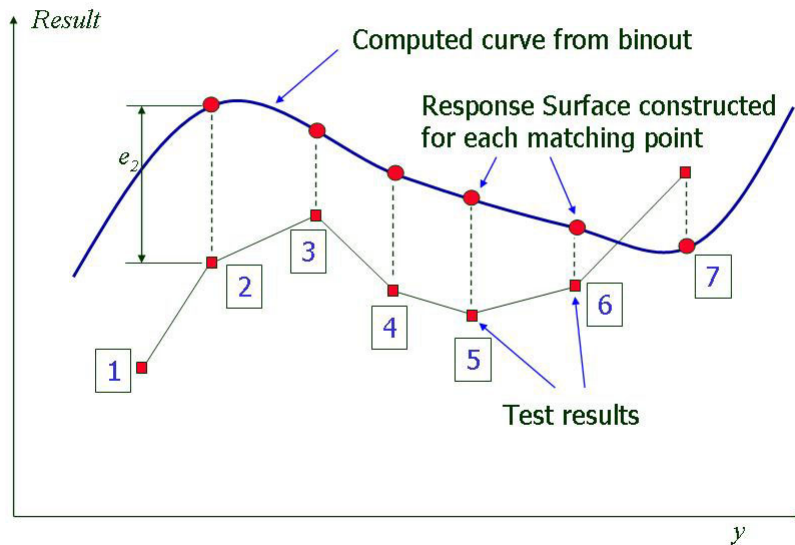
Test Points



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Parameter Identification Test Points + Computed Curve



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Parameter Identification Mean Squared Error

Weight (Importance of error)

Response Surface Value

Test Value

Residual

$$\frac{1}{P} \sum_{p=1}^P W_i \left(\frac{F_i(\mathbf{x}) - G_i}{s_i} \right)^2 = \frac{1}{P} \sum_{p=1}^P W_i \left(\frac{e_i(\mathbf{x})}{s_i} \right)^2$$

Number of points

Residual Scale factor (Normalization of error)

Variables (material or system constants)

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Parameter identification

Relevant commands

- **Get test data**

```
History 'testname' file "testfilename"
```

- **Construct crossplot**

```
History 'curvename' {Crossplot (
    history_x_name, history_y_name,
    [numpoints, begin, end] )}
```

Dyna
time-histories

- **Construct error norm of curve mismatch**

```
Composite 'name' {MeanSqErr (
    testname, curvename,
    [numpoints, begin, end,
    weighting_type, scaling_type,
    weighting_value, scaling_value,
    weighting_curve, scaling_curve] )}
```

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MeanSqErr

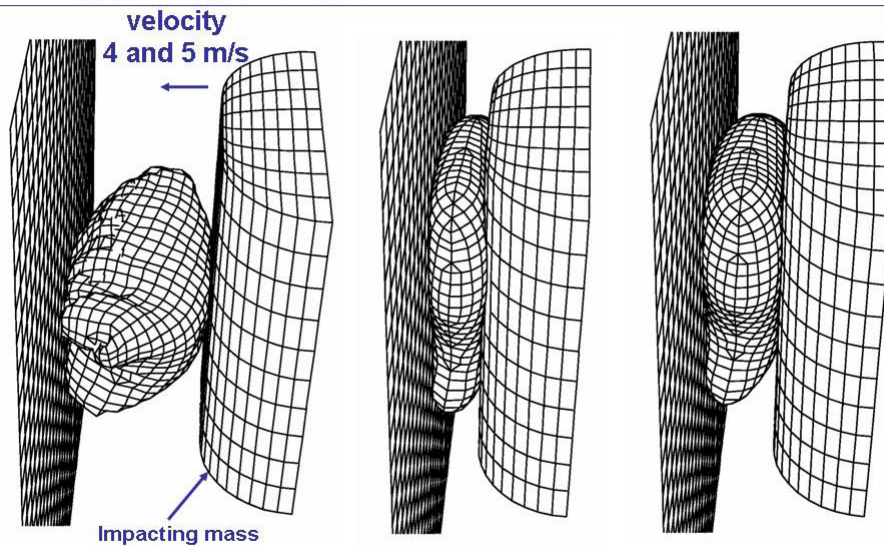
Command arguments

Argument name	Description	Symbol	LS-OPT Type	Default
<i>Test_curve</i>	Test Curve name	$G(y)$	History	-
<i>Computed_curve</i>	Computed curve name	$F(x,y)$	History	-
<i>Num_regression_points</i>	Number of regression points	P	Int	If < 2 or not specified: number of points in Test curve.
<i>Start_point</i>	y-Position of first regression point	y_1	Float	y-Position of first test point
<i>End_point</i>	y-Position of last regression point	y_P	Float	y-Position of last test point
<i>Weight_type</i>	Weighting type	-	Reserved option name: UNITWEIGHT, WEIGHTVALUE, PROPWEIGHT, FILEWEIGHT	UNITWEIGHT
<i>Scale_type</i>	Scaling type	-	Reserved option name: UNITSCALE, SCALEVALUE, PROPSCALE, MAXISCALE, FILESCALE	MAXISCALE
<i>Weight_value</i>	Weight value	W	Float	1
<i>Scale_value</i>	Scale value	s	Float	1
<i>Weight_curve</i>	Weights as a function of y	$W(y)$	History	Weight.compositename
<i>Scale_curve</i>	Scale factors as a function of y	$S(y)$	History	Scale.compositename

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Airbag System Identification



Courtesy of DaimlerChrysler, Germany

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Airbag Problem formulation

- **Goal:** Determine Leakage vs. pressure curve for airbag
- **Given:** 2 physical experiments (4m/s & 5m/s impact velocity)
 - Measure acceleration
 - integrate to find velocity and displacement
 - use scaling to normalize quantities
- **Method:** Minimize *Mean Squared Error*
- **Subject to monotonicity constraints**

$$x_{k+1} > x_k, \quad k = 1, 2, \dots, m$$

- **Choose a flat starting design for leakage coefficient**

$$[6, 6, 6, \dots, 6] * 1e-8$$

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Airbag Selected Commands

```

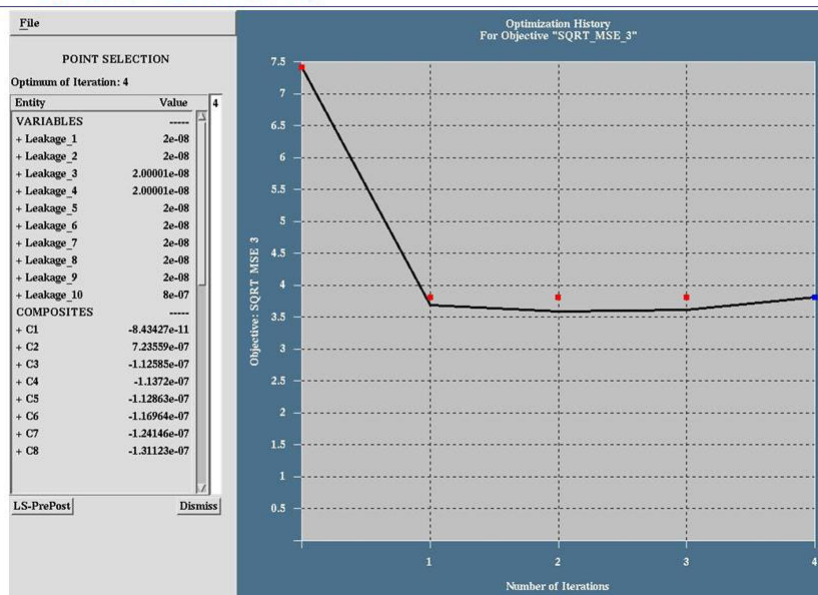
composite 'MSE_Acc_4' {MeanSqErr ( Test_acc_4,
  Acc_4mps_sc, 20 ,,,, SCALEVALUE,, 100 )}
composite 'MSE_Acc_5' {MeanSqErr ( Test_acc_5,
  Acc_5mps_sc, 20 ,,,, SCALEVALUE,, 100 )}
composite 'MSE_Vel_4' {MeanSqErr ( Test_vel_4,
  Vel_4mps_sc, 20 ,,,, SCALEVALUE,, 1 )}
composite 'MSE_Vel_5' {MeanSqErr ( Test_vel_5,
  Vel_5mps_sc, 20 ,,,, SCALEVALUE,, 1 )}
composite 'MSE_Dis_4' {MeanSqErr ( Test_dis_4,
  Dis_4mps_sc, 20 ,,,, SCALEVALUE,, 100 )}
composite 'MSE_Dis_5' {MeanSqErr ( Test_dis_5,
  Dis_5mps_sc, 20 ,,,, SCALEVALUE,, 100 )}
composite 'MSE_TOTAL' {MSE_Acc_4 + MSE_Acc_5 +
  MSE_Vel_4 + MSE_Vel_5 + MSE_Dis_4 + MSE_Dis_5}

```

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Airbag Optimization History



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Stochastic fields

Overview

- **A stochastic field allows a property (e.g. shell thickness) to vary over a part.**
- **Entities**
 - Nodal locations
 - Shell thicknesses
- **Methods**
 - Harmonic Fields
 - Import DYNA displacements or eigen mode
- **LS-DYNA keywords added for stochastic fields**

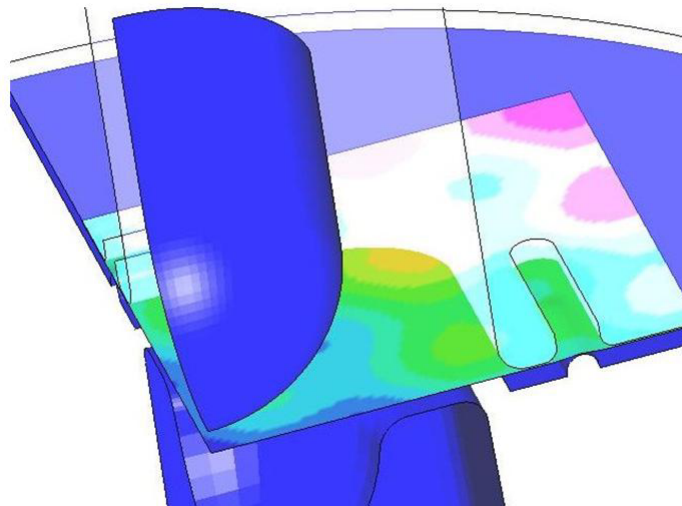
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Stochastic fields

Thickness

- **Harmonic functions (sine expansion)**

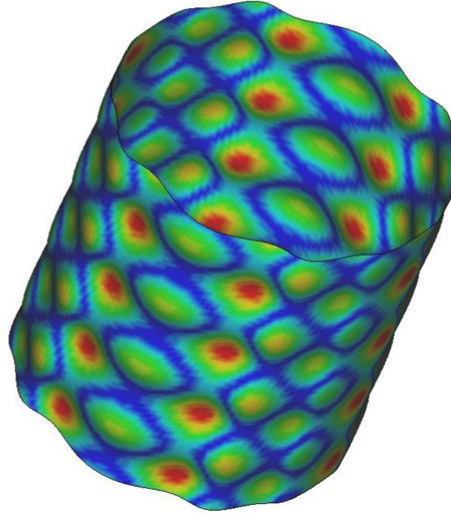


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Stochastic fields Geometry

- **Import LS-DYNA displacement or eigen modes**



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Stochastics Improved visualization

Creates LS-PREPOST plots

- **Speed improvements (×10 faster)**
- **Any LS-PREPOST response e.g FLD**
- **Stochastic contribution of a variable**
 - Variation of the response due to the variation of the variable.
- **Most important variable**
 - Greatest effect on the response variation.
- **Expanded history plotting**

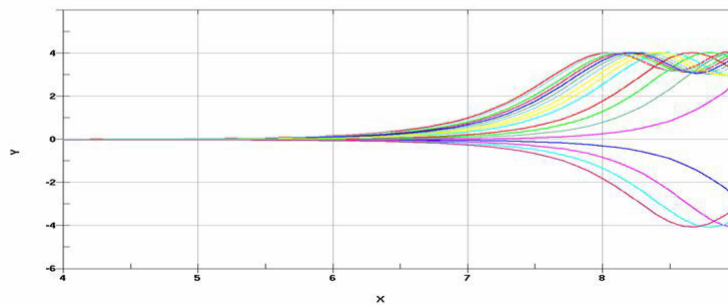
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Improved visualization for multiple runs

Automatic display of histories

- **Collect all LS-DYNA histories generated in a Monte Carlo analysis and display in LS-PREPOST**
- **In addition to the current history statistics capability**



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Outlook

Version 3.1

- **Discrete Optimization**
 - Define fixed sets for variables
 - Discrete materials
- **3-D visualization of response surfaces**
 - OpenGL interface
- **Pre-processing features through LS-PREPOST**
 - History/Response panel. E.g. pick nodes/elements from FE model
- **GUI features for expressions and special functions, e.g. parameter identification, integration, ...**

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Process Manager (LSPM) Multi-Stage Analysis (2006)

- **Goals**

- Seamless analysis of a multi-stage process using LSDYNA
- Emphasis on reliability: file handling, restart, recovery, post-processing
- Integration with LSPP: Shares LSPP database
- Extension of the LSOPT queuing features
- LS-OPT integration: Run as LSOPT job, parameter control, extract data

- **Features**

- Specify DYNA versions, revisions, options
- Database handling: recovery, compression, deletion, copying
- Reads LSPP database
- Job scheduling
- Transmission of files to remote nodes
- Special job wrapper functions: retrieves data files, monitors progress, recovers database "on call", emails diagnostics, completion, statistics

- **Post-processing**

- Seamlessly done through database recovery

