Isight New Features Overview

Releases 5.0, 5.5, and 5.6

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SIMULIA Regional Users Meeting

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Overview

Isight Releases

<table>
<thead>
<tr>
<th>Release</th>
<th>Status</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0:</td>
<td>Patch 5.0-2 released</td>
<td>January 2011 (August patch)</td>
</tr>
<tr>
<td>5.5:</td>
<td>Patch 5.5-2 in final stages</td>
<td>May 2011 (November patch)</td>
</tr>
<tr>
<td>5.6:</td>
<td>In final stages</td>
<td>November 2011</td>
</tr>
</tbody>
</table>

Feature Categories

- Model-Building
- Process Components/Plug-ins
- Application Components
- Execution and Postprocessing

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Isight New Features

Model-Building

5.0
- Create models completely from a script

5.5
- Model comparison tool
- Support for 4D arrays in the UI
- Support multiple versions in the Library

5.6
- Allow creation of parameters without default values
- Component configuration summary
- Property Editor re-organization
- Report of installed plug-ins, components and patches
Create Models Completely From a Script

Isight models can now be built entirely through scripting

- Some user applications best implemented by building a model dynamically on-the-fly.

Language is Dynamic Java or Jython
Model Comparison Tool

Since very subtle changes to models can significantly affect the results, a new model comparison tool is being provided to easily find differences between models.

Same model – different results. What changed?

This tool easily finds exactly what changed.
Model Comparison Tool

Tool can be accessed in various ways

From the Tools menu in the Gateway

As a standalone tool (comparemodels.bat/.sh)

In “batch” mode with a report to standard output
Model Comparison Tool

- Tree displays location in model
- Differences numbered
- Buttons allow selection of models from disk, Library, or Job Database

Icon indicates type of change (add, delete, or change)

Detail message about difference displayed in table and lower panel

Model A: Model tridentfunction from C:\Documents and Settings\sw5\My Documents\tridentfunction.zmf
Model B: Model trigfunc from C:\Documents and Settings\sw5\My Documents\trigfunc.zmf

<table>
<thead>
<tr>
<th>Model Element</th>
<th>#</th>
<th>Overview</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Removed</td>
<td>23</td>
<td>Removed parameter c</td>
<td></td>
</tr>
<tr>
<td>Target Changed</td>
<td>24</td>
<td>Removed the target of 1.32.</td>
<td></td>
</tr>
<tr>
<td>Objective Type Changed</td>
<td>25</td>
<td>Objective changed from target to minimize.</td>
<td></td>
</tr>
<tr>
<td>Parameter Value Changed</td>
<td>26</td>
<td>The value changed from -10 to 25.</td>
<td></td>
</tr>
<tr>
<td>Lower Bound Changed</td>
<td>27</td>
<td>Lower bound changed from -10 to 20.</td>
<td></td>
</tr>
<tr>
<td>Upper Bound Changed</td>
<td>28</td>
<td>Upper bound changed from 10 to 30.</td>
<td></td>
</tr>
<tr>
<td>Calculator Expression Changed</td>
<td>29</td>
<td>Expression in calculator changed from:</td>
<td>Expression in calculator changed from: &lt;br&gt; &lt;br&gt;#option AllowExceptionalValue &lt;br&gt; &lt;br&gt;γ = ((c * x^3) + (d * x^2) + e * x + f)/x</td>
</tr>
<tr>
<td>Component Added</td>
<td>30</td>
<td>Component Task 1 added.</td>
<td></td>
</tr>
</tbody>
</table>
Model Comparison Tool

Second tab displays summary of model contents

Third tab displays output in text form (same as command line output)
Component Configuration Summary

Quick summary of selected component configuration available in main window, avoiding need to open the editor simply to view main configuration settings.
Isight New Features

Process Components/Plug-ins

5.0
- DOE: Box-Behnken, Fractional Factorial Pointer2 Enhancements
  - Individual optimization technique control
  - Select and drive optimizers by name
- Noise Analysis
- Approximations: Elliptical Basis Functions (EBF)

5.5
- Custom exploration strategy (sequence or scripting)
- Optimization: MISQP algorithm
- Approximations: Sequential sampling for error reduction
- Easy native code integration for Optimization and Approximation techniques

5.6
- Six Sigma component
  - New Reliability Analysis technique: Importance Sampling
  - Expose tolerance variables - random variable standard dev. as design variable in optimization
- DOE component: Ability to add a manual point in a DOE matrix; User-Defined matrix
- Taguchi component: Design Matrix Previewer (detect control/noise adjustment overlap)
Noise Analysis

- Baseline Mesh – Increasing Span Can Decrease Deflection and Stress (inaccurate)

Displacement higher at lower span

Noise Level = 0.64

Noise Level = 1.0
Noise Analysis Component

Applying the new Noise Analysis component to this can detect this situation.
Noise Analysis Component

Noise level calculated as fraction of the time the slope changes sign.

Execution summary for component NoiseAnalysis

Started on Thu Apr 15 09:23:36 EDT 2010
Completed on Thu Apr 15 09:23:36 EDT 2010
Number of subflow evaluations: 10

Noise Results
This table lists the noise level of each output caused by each input.
Noise is defined as the fraction of the time the slope of the output versus input curve changes sign.

<table>
<thead>
<tr>
<th>Sources</th>
<th>Model 1_Part_1_Solid_ostrude_2_depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step_1_S_noise_max</td>
<td>0.5</td>
</tr>
<tr>
<td>Step_1_U_mag_max</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Significant noise detected. Noise in Abaqus model outputs may be reduced through better element selection or through mesh refinement. Please see examples/models/components/noiseanalysis for more details.
Abaqus/CAE Expert Meshing

Modify model to reduce noisiness of stress calculation

Original Mesh

New Mesh
Noise Analysis Component

- Noise removed – model is now suitable for optimization studies
Custom Exploration Strategy

New strategy plug-in for Exploration Component

Create driver plans and assemble them into custom search strategies:

- Configure DOE, Monte Carlo, Optimization, SDI, and Six-Sigma Analysis plans
- Run drivers in sequence
- Run drivers within an arbitrary script
Custom Exploration Strategy

Script mode offers complete flexibility to impose any desired logic.

run plans

run single points

store a design

change the design

restore a design
Sequential Sampling for Isight Approximations

A new option has been added to automatically add sampling points to the approximation until an acceptable level of accuracy is achieved.

A new page in the Approximation wizard for configuring sequential sampling options.
Easy Native Code Integration

- A greatly simplified way of integrating native code algorithms for Optimization and Approximations

- Communication between Isight and the executable program is via writing and reading files (avoids writing Java wrapper using Isight API)

- Reduced performance – price for the ease of integration
  - Not noticeable in optimization with real life simulation codes (> several seconds)
  - May be noticeable in approximation graphs, but not runtime execution
Easy Native Code Integration

SDK Generator enhanced to support the new method of Optimization and Approximation plug-in development

New option to call external executable directly (instead of creating a Java wrapper)

Template file provides the basic structure for the program to follow

A simple way to publish the native code program to the Library directly
Importance Sampling for Reliability

Importance sampling is a special type of Monte-Carlo where we sample only in “interesting” regions.

Technically, we use a distribution that is different from the original distribution and then compensate for this disparity.

Isight computes the Most Probable Point (MPP) of failure and samples around the MPP.

- In contrast, the standard Monte-Carlo technique samples around the mean value point (MVP).

\[
g(X) = 0 \quad \text{Failure Surface}
\]

\[
g(U) = 0 \quad \text{Failure Region}
\]

\[
g(U) < 0 \quad \text{Safe Region}
\]

\[
g(U) > 0 \quad \text{Failure Region}
\]

\[
I(X) = 1 \quad \text{except FORM}
\]

\[
I(X) = 1 \quad \text{but FORM}(X) = 0
\]

\[
\text{Monte Carlo samples around MPP}
\]

\[
\text{FORM}
\]
Adding Runs to a DOE Design Matrix

Runs can be added directly in the DOE Design Matrix table wherever DOE is used (DOE component, Taguchi, Six Sigma, Approximations, etc.)

- Missing values highlighted
- Convenient menu items to:
  1) Paste runs from clipboard
  2) Remove multiple added runs
- Type new values directly into table
- Validation error reported if all runs do not have values for each factor
Taguchi Matrix Previewer

Undesirable overlap in experiment values when a factor is both noise and control

Control Run 1: 79 (+/- 1.5)
Control Run 2: 80 (+/- 1.5)

This overlap is not always obvious before execution without reviewing the full experiment (individual control, noise matrices not enough)
Taguchi Matrix Previewer

New tab in Taguchi Editor emphasizes the problem

- Offending factor column(s) highlighted
- Warning message indicates overlap
- Component validation warning displayed in Gateway
Isight New Features

Application Components

5.0
- MATLAB: capture and present MATLAB log
- Eclipse Isight Developer plug-in
- PBS/Torque Grid Plug-in

5.5
- Dymola component
- Development:
  - Full component templates (including UI) for Isight Developer (Eclipse plug-in)
Isight New Features

Application Components

5.6

OS Command enhancements:
- Ability to surrender component concurrency ticket
- User-defined environment variables

Abaqus Component enhancements:
- New approach to calculating Max/Min to mitigate noise
- Ability to handle multiple CAE cases
- Allow variable substitution in Abaqus component grid scripts
- Ability to extract tensor components and invariants

Data Matching component enhancements:
- Support for multi-target curves to multi-simulation curves
- Relative error calculation
- Custom function support

XML component (now released)
- Keyword search capability
- Array Support

Component Central re-organization
Isight Developer Eclipse Plug-in

- Open SDK
- “Isight Developer” – Integrated Development Environment (IDE)
  - Plug-in to Eclipse
  - Simplifies the process of building components
  - Debugging tool
  - Syntax checker

Component Templates
  - Provide the common source code

These tools are used by SIMULIA R&D to create components and are also available to any Isight user.
Isight Developer: Templates

Isight Developer provides templates to offer the source code for common UI presentation and execution behavior:

- “Command with File I/O” - Provides Input, Execution (command), and Output configuration with a name-value parser
- “Parameter Tree and Table” - Provides a tree/table mechanism for presenting and defining parameters with an XML parser
OS Command - User-Defined Environment Variables

Environment Variables can now be defined and used for a specific OS Command instance (including within Simcode)

Note: String substitution (e.g. \{var x\}, \{user\}, etc.) is supported and is resolved at runtime when the environment variables are set before the command executes
Isight uses “concurrency tickets” to keep track of components that are running and presumably using CPU cycles to limit the load on the machine. In some cases, the component is not actually using the CPU of that machine during execution, such as when a grid plug-in is used to execute on a different machine. Previously, the concurrency ticket was surrendered only when a grid plug-in was used (allowing the machine to accept more work). A new advanced option is added to OSCommand to give up the concurrency ticket while running the command and reacquire it after command completion.
Abaqus Component – Support for Multiple CAE Cases

If multiple .odb files are detected, the user can now choose to parse all of them to create output parameters per job.

Parameter names prefixed with job name
XML Parser Component

The XML Parser component is now shipped as a standard component and a few enhancements have been added.

Search for keywords

Parse the xml for arrays
Component Central Reorganization

SIMULIA Component Central website (http://components.simulia.com) provides:

- Information on components for Isight
- Delivery mechanism for independently released components
- Links to websites of third party software products
- Ability to view demonstration videos
- Marketing materials
- Developer materials

Component Central has been updated and reorganized according to the Isight 5.6 packaging.
Component Central Reorganization

Categories are now Basic, Pro, Add-on, and Free

Consistent naming convention established for downloadable files
Component Central Reorganization

“Applications” and “Algorithms” Grids added to home page for quick access
Component Central Reorganization

Quick access to Component Central provided in Gateway

Launches browser and opens Component Central home page
Isight New Features

Execution and Post-Processing

5.0
- Trend lines in graphs
- Subflow prologue/epilogue
- Store subflow parameter history in process component output array

5.5
- Filter points by distance from targets
- Graph enhancements
  - Plot data from multiple jobs on a single chart
  - Customization options and units on charts
- New graph types: Step chart, carpet plots, constraint overlay graphs
- Taguchi postprocessing enhancements
  - Control, Noise, Signal numbers in history table
  - Main Effects Viewer (MEV)
    - User specified values in table
    - Save and reload confirmation runs
Isight New Features

Execution and Post-Processing

5.6
- Direct access to runtime directories post-execution
- Constraint overlay plot in Approximation Viewer contour plots
- DOE ANOVA enhancements (support for mixed level designs)
- Add best level and worst level, baseline point selection in Taguchi Dynamic Response Graph
Trend Lines for 2D Scatter Plots

Trend lines are now displayed (optionally) on the 2D scatter plots (individual plots and grid of plots)
Subflow Prologues and Epilogues

Epilogue includes *subflow run grading*:
- E.g. react to changes in feasibility
Improved Post-Execution File and Directory Management

- Improved access to saved runtime directories

Direct access to runtime directories which were kept in Runtime Gateway Parameters and History tabs.
Filter by Distance

New feature in the Runtime Gateway to allow filtering based on distance from a target and sort the history based on it.

The Euclidian distance is calculated by normalizing all parameters to \([0, 1]\) using the maximum and minimum values from the history.

Set the targets for filtering

Set the number of rows to display (Setting to 0 shows all rows)
Constraint Overlay Graphs

A new contour graph has been added with constraints and scatter points overlaid on top of it.

Tooltips on points display parameter and constraint values.
Constraint Overlay Graphs

The Display Properties Editor allows for interactive configuration options:

- Show/hide data points
- Select which constraints to show
- Show isolines with values
Constraint Overlay Graphs

A 3D version of the graph displays the surface with 2D projection.

Additional options to show isolines on the surface or even hide the surface completely for better view of the projection.
Enhanced Overlay Constraint Graphs in Approximation Viewer

Floor projection is added and constraint violations shown

Constraint boundaries can be shown/hidden

Constraints can be relaxed to do quick trade-off studies
THANK YOU