

# **Model-Based Calibration Toolbox Release Notes**

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## Summary by Version

This table provides quick access to what's new in each version. For clarification, see “About Release Notes” on page 1.

Version (Release)	New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
<b>Latest Version V3.3 (R2007b)</b>	Yes Details	No	Bug Reports Includes fixes	Printable Release Notes: PDF  Current product documentation
V3.2 (R2007a)	Yes Details	No	Bug Reports Includes fixes	No
V3.1 (R2006b)	Yes Details	No	Bug Reports Includes fixes	No
V3.0.1 (R2006a)	No	No	Bug Reports at Web site	No
V3.0 (R14SP3+)	Yes Details	Yes Summary	Bug Reports at Web site	No
V2.1.1 (R14+)	No	No	Fixed bugs	No
V2.1 (R14)	Yes Details	No	Fixed bugs	No
V2.0 (R13+)	Yes Details	No	No bug fixes	V2.0 product documentation

### About Release Notes

Use release notes when upgrading to a newer version to learn about new features and changes, and the potential impact on your existing files and practices. Release notes are also beneficial if you use or support multiple versions.

If you are not upgrading from the most recent previous version, review release notes for all interim versions, not just for the version you are installing. For

example, when upgrading from V1.0 to V1.2, review the New Features and Changes, Version Compatibility Considerations, and Bug Reports for V1.1 and V1.2.

## New Features and Changes

These include

- New functionality
- Changes to existing functionality
- Changes to system requirements (complete system requirements for the current version are at the MathWorks Web site)
- Any version compatibility considerations associated with each new feature or change

## Version Compatibility Considerations

When a new feature or change introduces a reported incompatibility between versions, its description includes a **Compatibility Considerations** subsection that details the impact. For a list of all new features and changes that have reported compatibility impact, see the “Compatibility Summary for Model-Based Calibration Toolbox” on page 21.

Compatibility issues that are reported after the product has been released are added to Bug Reports at the MathWorks Web site. Because bug fixes can sometimes result in incompatibilities, also review fixed bugs in Bug Reports for any compatibility impact.

## Fixed Bugs and Known Problems

MathWorks Bug Reports is a user-searchable database of known problems, workarounds, and fixes. The MathWorks updates the Bug Reports database as new problems and resolutions become known, so check it as needed for the latest information.

Access Bug Reports at the MathWorks Web site using your MathWorks Account. If you are not logged in to your MathWorks Account when you link to Bug Reports, you are prompted to log in or create an account. You then can view bug fixes and known problems for R14SP2 and more recent releases.

The Bug Reports database was introduced for R14SP2 and does not include information for prior releases. You can access a list of bug fixes made in prior versions via the links in the summary table.

## **Related Documentation at Web Site**

**Printable Release Notes (PDF).** You can print release notes from the PDF version, located at the MathWorks Web site. The PDF version does not support links to other documents or to the Web site, such as to Bug Reports. Use the browser-based version of release notes for access to all information.

**Product Documentation.** At the MathWorks Web site, you can access complete product documentation for the current version and some previous versions, as noted in the summary table.



## Version 3.3 (R2007b) Model-Based Calibration Toolbox

This table summarizes what's new in V3.3 (R2007b):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	No	Bug Reports Includes fixes	Printable Release Notes: PDF  Current product documentation

New features and changes introduced in this version are:

- Command-line definition of inputs for test plans and models.  
See `modelinput` in the Model-Based Calibration Toolbox Reference documentation, and for examples see “Command-Line Examples” in the Getting Started with Model-Based Calibration Toolbox documentation.
- Extended command-line functionality for creating, editing, and fitting local models.

See `LocalModel Properties` in the Model-Based Calibration Toolbox Reference documentation, and for examples, see “Command-Line Examples” in the Getting Started with Model-Based Calibration Toolbox documentation.

- Enhanced defaults and previews for space-filling designs, including performance increases, design property improvements, and improved handling of constrained design points. The new defaults are faster to compute and provide symmetrical designs with better space-filling properties. The default **Selection criteria** is now Minimize RMS variation from CDF, and **Enforce Symmetrical Points** is now selected by default.

The number of constrained design points are now displayed in the Design Browser preview, where you can iterate design generation until the desired number of constrained points is achieved. The preview design is now identical to the final design.

See “Setting Up a Space-Filling Design” in the Model-Based Calibration Toolbox Model Browser User’s Guide documentation.

- Enhanced optimization set up and analysis, including support for boundary constraint definition in the optimization wizard, ability to rename objectives and constraints, and improved display of table gradient constraints.

You can now use a right-click shortcut to convert an existing constraint to a boundary model constraint without opening the Constraint Editor. Table gradient constraint output is simplified in the Optimization Output Table and Constraint Summary table to aid analysis, and these constraints are faster to display.

See “Overview of Objectives and Constraints” in the Model-Based Calibration Toolbox CAGE User’s Guide documentation.

- New process suggestions for analyzing optimization results, with advice for detecting problems and improving results.

See “Analyzing Point-by-Point Optimization Output” in the Model-Based Calibration Toolbox CAGE User’s Guide documentation.

## Version 3.2 (R2007a) Model-Based Calibration Toolbox

This table summarizes what's new in V3.2 (R2007a):

<b>New Features and Changes</b>	<b>Version Compatibility Considerations</b>	<b>Fixed Bugs and Known Problems</b>	<b>Related Documentation at Web Site</b>
Yes Details below	No	Bug Reports Includes fixes	Printable Release Notes: PDF  Current product documentation

New features and changes introduced in this version are:

- Extended command-line API to setup models for use as standalone objects or as part of MBC projects. See DIVCP Example.
- New tools to assist in the assessment and use of optimization results for producing optimal lookup tables. See “Using Acceptable Solutions”.
- Use distributed computing to speed up multiple run optimizations (requires Distributed Computing Toolbox). See “Distributed Computing in Optimization”.
- Use Genetic Algorithms and Pattern Search to find globally optimal solutions (requires Genetic Algorithms and Direct Search Toolbox). See Choose Optimization Algorithm.

## Version 3.1 (R2006b) Model-Based Calibration Toolbox

This table summarizes what's new in V3.1 (R2006b):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	No	Bug Reports Includes fixes	No

New features and changes introduced in this version are organized by these topics:

- “Optimization Enhancements” on page 8
- “Modeling Enhancements” on page 9

### Optimization Enhancements

- Gradient constraints for controlling table smoothness in optimization-based and feature-based table filling
- Contour plot view for optimization results
- Point-by-point variable bounds for finer control of optimization problems
- Ability to enable and disable optimization constraints for “what if” studies
- Support for starting optimizations from the results of a previous run
  - Solve related “what if” problems faster
  - Refine calibration results by tweaking algorithm settings
- Enhanced user interface for comparing the results of different calibration optimization problems

## **Modeling Enhancements**

- Improved integration of validation metrics within the model selection process
- Enhanced local modeling at each operating point (a complementary approach to building a single, global model)
- Ability to alter variable ranges and refit models automatically

## **Version 3.0.1 (R2006a) Model-Based Calibration Toolbox**

This table summarizes what's new in V3.0.1 (R2006a):

<b>New Features and Changes</b>	<b>Version Compatibility Considerations</b>	<b>Fixed Bugs and Known Problems</b>	<b>Related Documentation at Web Site</b>
No	No	Bug Reports at Web site	No

## Version 3.0 (R14SP3+) Model-Based Calibration Toolbox

This table summarizes what's new in V3.0 (R14SP3+):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	Yes—Details labeled as <b>Compatibility Considerations</b> , below. See also Summary.	Bug Reports at Web site	No

New features and changes introduced in this version are:

- “Command-Line Interface to the Model-Based Calibration Toolbox” on page 11
- “Improved CAGE Setup” on page 12
- “Optimization” on page 12
- “Calibration Tool Interface” on page 13
- “Boundary Modeling” on page 13
- “Feature Filling” on page 13
- “Surface Viewer Movie” on page 13

### Command-Line Interface to the Model-Based Calibration Toolbox

The command-line interface to the Model-Based Calibration Toolbox enables the modeling process to be automated using MATLAB® commands. In this way, you can simplify the modeling process for technicians and engineers who might not have extensive background and training in this area. You can also access modeling functionality from test bed automation tools.

## Improved CAGE Setup

The CAGE Import Tool allows easier reusability of CAGE sessions. You can use the CAGE Import Tool to import models, data sets, optimizations and features from any Model-Based Calibration Toolbox project file produced in CAGE or the Model Browser (.mat or .cag). This feature can greatly simplify the application of proven feature filling and optimization processes to new engine variants.

## Optimization

Optimization in CAGE has had major updates:

- Significant speed improvements
- New optimization parameters that help avoid local minima by specifying multiple start points, and running only from feasible start points
- Automatic scaling of objective and constraint values improves numerical stability of algorithms
- Enhanced table filling from optimization results now allows more flexible filling methods: you can exclude infeasible solutions, choose whether to extrapolate, use selected solutions, and apply custom fill algorithms
- Enhanced API for user-defined optimization scripts
- Improved results visualization for drive-cycle optimizations and multiobjective optimizations
- Improved constraint display for non-model constraints (1-D and 2-D tables, ellipsoid, etc.)

## Compatibility Considerations

Some existing user-defined optimization scripts may require a call to the function `setRunInterfaceVersion` to fix incompatibilities. You can also do this in the CAGE Browser GUI in the Optimization Parameters dialog.

If you want to use the new `foptcon` optimization parameters (multiple start points and run only from feasible start points) with existing optimizations, you must use the menu item **Optimization > Reset Parameters**.



## **Calibration Tool Interface**

New links to standard industry tools allow import and export of calibrations directly from/to ATI Vision (via a live link or .mat files) and ETAS INCA (via .dcm files).

## **Boundary Modeling**

You can model boundaries using convex hulls. You can create boundary models for subsets of inputs, which simplifies the boundary identification process for complex engines. Improved visualization tools in the Boundary Editor help you construct accurate constraints. Boundary constraints can now be imported into the Design Editor and exported to Simulink®.

## **Feature Filling**

The Feature Fill Wizard uses new algorithms to fill and optimize table values with reference to a model. You can fill multiple tables simultaneously using the wizard, extending the range of calibration problems that CAGE can solve. You can impose gradient and smoothing penalties, and fill tables on a region-by-region basis.

## **Surface Viewer Movie**

The Surface Viewer now has a movie mode that is faster and easier to use, with an interactive progress bar.

## Version 2.1.1 (R14+) Model-Based Calibration Toolbox

This table summarizes what's new in V2.1.1 (R14+):

<b>New Features and Changes</b>	<b>Version Compatibility Considerations</b>	<b>Fixed Bugs and Known Problems</b>	<b>Related Documentation at Web Site</b>
No	No	Fixed bugs	No

## Version 2.1 (R14) Model-Based Calibration Toolbox

This table summarizes what's new in V2.1 (R14):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	No	Fixed bugs	No

New features and changes introduced in this version are organized by these topics:

- “CAGE New Features” on page 15
- “Model Browser New Features” on page 16

### CAGE New Features

There is new functionality in CAGE tradeoff views, model views, tables, data sets and features.

### Tradeoff Enhancements

- There is improved zooming on graphs
- You can now remove tables
- There is much more information in the table display
- Enhanced multimodel import interface
- You can set inputs to table values

### Optimization Enhancements

- New streamlined filling of calibration tables using optimization results
- You can now perform mixed point and sum optimizations

## **Tables Functionality**

- Simplified table creation -- you can select size, initial value and inputs all at once, and normalizers are automatically initialized across variables; so there is no longer any need to go to the Calibration Manager or initialize normalizers (except in features)
- You can convert tables directly to models
- New table arithmetic tool allows you to perform operations on whole tables or selected cells
- New extrapolation mask creation options in tables (from boundary models and Prediction Error)
- The Tables view is now one of the Data Objects and no longer a Process (this used to be called Manual Calibration)

## **Models Enhancements**

- You can now import models from multiple files simultaneously
- Boundary models are enabled in the Surface Viewer and Models View
- You can use the new Model Properties dialog to view information such as the model type, definition, inputs, availability of Prediction Error Variance and constraints, creation date, user name, and toolbox version
- There is improved zooming on the model connections graph

## **Data Sets and Features Enhancements**

- Data sets are significantly faster for larger datasets
- You can now copy feature strategies to the clipboard

## **Model Browser New Features**

There is new functionality in the Data and Design Editors and modeling interfaces.

## Data Editor Enhancements

- You can now select and remove outliers in the Data Editor plots
- You can apply test notes to help you identify and sort problem data for analysis in the Data Editor
- You can select noted tests to view them in other plots and tables
- There is a new improved interface for importing data from the Workspace

## Design Editor Enhancements

- You can display the number of overlapping design points in the projection graphs
- You can round columns of the design

## Modeling Enhancements

- Now you can export models directly to CAGE
- You can clip using boundary models in the Prediction Error Variance viewer
- It is now easier to build exported Simulink models in Real-Time Workshop -- to build your exported models, you no longer need to copy all .c and .h files from mbc/mbcstimulink to the directory where you are building the Simulink models.

## Version 2.0 (R13+) Model-Based Calibration Toolbox

This table summarizes what's new in V2.0 (R13+):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	No	No bug fixes	V2.0 product documentation

New features and changes introduced in this version are organized by these topics:

- “CAGE New Features” on page 18
- “Model Browser New Features” on page 19

### CAGE New Features

- Optimization capability for base map calibration in CAGE. For example you could maximize fuel economy at a single point or over a drive cycle within emissions requirements, using Fuel and NoX models. You can perform multi-objective optimizations, such as minimizing fuel consumption while maximizing torque within emissions constraints. You can also incorporate your own algorithms in provided templates.
- Automatic fill of Tradeoff, using the optimization scripts.
- Significantly faster CAGE evaluation.
- Support for more blocks in CAGE strategy parsing -- all standard Simulink lookup tables and the relational operator block.
- Considerable usability improvements in the new Surface Viewer in CAGE.
- Use of boundary models in CAGE (in the response surface viewer and optimization views).
- Improved multi-model tradeoff (one model for all sites, greatly reducing file size).

## Model Browser New Features

- Boundary modelling for understanding complex operating envelopes using nonparametric surfaces.
- Stepwise improvements in terms of speed and large data set handling. Automatic stepwise is available for RBF models and prune as a stepwise option for all linear models.
- More efficient fitting and handling of large data sets (size ~ 1000 to 10000 points).
- New and improved Data Editor with increased functionality. There are new viewing options similar to the Design Editor so you can view your data in many ways simultaneously. You can now access the Data Editor to view and export your modeling data from all nodes in the model tree. For example, this allows you to extract the value of MBT from all your local models and export them to the workspace. The Data Editor retains a memory of view settings.
- User-defined and transient models available as one-stage models.
- New Tree Regression methods for fitting RBF's.
- Local Multi-Models for site specific models. You can fit a variety of different models to each test and choose criteria to automatically select the best fit for each.
- Ability to fit the same model to all tests using Local Average Fit. This allows you to fit global models to your data while also being able to view the fit to each test individually.
- Much improved data selection and matching to designs.
- New enhancements to design augmentation. You can easily use the data matching functions to add all your data to a design as fixed points, in order to augment the design and collect more data.
- Flexible summary statistics for models and you can use these criteria to automatically select best models, in addition to using them as diagnostic statistics when comparing models.
- Memory of settings for a test plan retained by response surface, cross-section view, and validation data.

- Ability to display boundary models in Model Browser response surface viewer and cross-section viewer.



## Compatibility Summary for Model-Based Calibration Toolbox

This table summarizes new features and changes that might cause incompatibilities when you upgrade from an earlier version, or when you use files on multiple versions. Details are provided in the description of the new feature or change.

<b>Version (Release)</b>	<b>New Features and Changes with Version Compatibility Impact</b>
<b>Latest Version V3.3 (R2007b)</b>	None
V3.2 (R2007a)	None
V3.1 (R2006b)	None
V3.0.1 (R2006a)	None
V3.0 (R14SP3+)	See the <b>Compatibility Considerations</b> subheading for this new feature or change: “Optimization” on page 12
V2.1.1 (R14+)	None
V2.1 (R14)	None
V2.0 (R13+)	None