Control System Toolbox Release Notes

There were no significant updates to the Control System Toolbox (version 6.2.1) for Releases 14 SP3.

Major Bug Fixes

To view major bug fixes made in R14SP3 for the Control System Toolbox, use the Bug Reports interface on the MathWorks Web site.

Note If you are not already logged in to Access Login, when you link to the Bug Reports interface (see below), you will be prompted to log in or create an Access Login account.

After you are logged in, use this Bug Fixes link. You will see the bug report for the Control System Toolbox. The report is sorted with fixed bugs listed first, and then open bugs.

If you are viewing these release notes in PDF form on the MathWorks Web site, you can refer to the HTML form of the release notes on the MathWorks Web site and use the link provided.

Printing the Release Notes

If you would like to print the Release Notes, you can link to a PDF version.

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Control System Toolbox 6.2 Release Notes

New Features

This section summarizes the new features and enhancements introduced in the Control System Toolbox 6.2.

New Command-Line API for Customizing Plots

The Control System Toolbox now provides a command-line API for customizing units, labels, limits, and other plot options. You can now change default plot options before generating a plot, or modify plot properties after creation.

For a detailed description of the commands, see the online Control System Toolbox documentation.

New SISO Design Constraint Types

You can now create

- Single piecewise linear constraints for root-locus and Bode plots
- Gain/phase exclusion regions for Nichols plots

Design constraints are displayed as shaded regions.

New Bode and Nichols Plot Options

When editing Bode and Nichols plots, you can now

- Manually set the lower limit of the magnitude
- Adjust the phase offsets by multiples of 360 degrees to facilitate comparing multiple responses

New Commands for Model Approximation and Order Reduction

New commands have been added for model approximation and order reduction:

- `hsvd` computes and plots the Hankel singular values.
- `balred` computes low-order approximations using a numerically-stable, balancing-free algorithm. You can perform multiple order reductions with a single command.

Major Bug Fixes

The Control System Toolbox Version 6.2 includes important bug fixes made since Version 6.1. You can see a list of major 6.2 bug fixes on the MathWorks Web site.

If you are viewing these release notes in PDF form on the MathWorks Web site, please refer to the HTML form of the release notes on the MathWorks Web site and use the link provided.

Known Software and Documentation Problems

The MathWorks Web site includes a list of known software and documentation problems in Version 6.2.

If you are viewing these release notes in PDF form on the MathWorks Web site, please refer to the HTML form of the release notes on the MathWorks Web site and use the link provided.

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Control System Toolbox 6.1 Release Notes

Major Bug Fixes

The Control System Toolbox 6.1 includes several bug fixes made since Version 6.0. You can see a list of the particularly important Version 6.0 bug fixes.

If you are viewing these Release Notes in PDF form, please refer to the HTML form of the Release Notes, using either the Help browser or the MathWorks Web site and use the link provided.

Platform Limitations for HP

Preference and Property Editors

The Toolbox Preferences Editor and Response Property Editor are not supported on HP platforms. The LTI Viewer Preferences Editor is supported with a reduced set of features (no tools to set preferences for grids, fonts, colors, or phase wrapping).

SISO Design Tool

The following features are not supported for the SISO Design Tool on HP platforms:

- Preference and property editing
- Compensator format editing
- Storing and retrieving compensators
- Design constraints

In addition, the SISO Tool Export window has fewer export options.

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Control System Toolbox 6.0 Release Notes

New Features

This section summarizes the new features and enhancements introduced in the Control System Toolbox 6.0.

If you are upgrading from a release earlier than Release 13.0, then you should see "New Features" on page 4-2 in the Control System Toolbox 5.2 Release Notes.

Linearization Tools Moved to Simulink Control Design

The LTI Viewer interface with the Simulink linearization tools has been moved to Simulink Control Design. The `slview` command now launches the Linear Analysis Tool in Simulink Control Design.

Enhanced Numerical Algorithms

The numerical engine has been overhauled to leverage the state-of-the-art LAPACK and SLICOT libraries, resulting in faster and more accurate computations. This upgrade benefits the following areas:

- Computation of system zeros (zero, ss to tf or zpk conversions)
- Lyapunov and Riccati solvers (`lyap`, `dlyap`, `care`, `dare`)
- Model order reduction (`balreal` and `modred`)

and also introduces several new foundation algorithms, including

- Square-root solvers for stable Lyapunov equations (`lyapchol` and `dlyapchol`)
- Block diagonalization algorithm (`bdschur`)
- Commands for reordering eigenvalues in Schur decompositions (`ordschur` and `ordqz`). These commands are part of MATLAB.

Improved Support for Model Order Reduction

The support for model order reduction has been significantly improved:

- `balreal` now leverages the new square-root Lyapunov solvers for greater robustness, accuracy, and performance.

- Reduction of unstable or marginally stable systems is now supported.

New Commands for Modal Decompositions

New commands have been added for additive modal decompositions:

- `stabsep` separates the stable and unstable modes of a system.
- `modsep` performs modal decompositions into N arbitrary regions.

Major Bug Fixes

The Control System Toolbox 6.0 includes several bug fixes made since Version 5.2. You can see a list of the particularly important Version 6.0 bug fixes.

If you are viewing these release notes in PDF form, please refer to the HTML form of the release notes, using either the Help browser or the MathWorks Web site, and use the link provided.

In addition, the following bugs were fixed:

- Fixed issues with frequency unit conversions in LTI Viewer
- `allmargin` issues for some discrete models with poles near z=1
- `sigma` plot was empty for MIMO system with zero gain between some I/O pairs.
- Fixed issues with `rlocus` command applied to improper systems.

Platform Limitations for HP

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Control System Toolbox 5.2 Release Notes

New Features

This section summarizes the new features and enhancements introduced in the Control System Toolbox 5.2.

If you are upgrading from a release earlier than Release 12.1, then you should see "New Features" on page 5-2 in the Control System Toolbox 5.1 Release Notes.

Response Plots

New features for response plots include

- Normalization of time plots for easy trend comparison
- Driving input signal shown in linear simulation (`lsim`) plots
- Standard zooming for all response plots
- A **Full View** right-click menu
- Ability to toggle magnitude and phase visibility in Bode plots
- In Bode plots, a modified phase correction algorithm that produces consistent phase at `w=Inf` and is robust to perturbations of the pole/zero structure at the origin
- Showing only positive frequencies in Nyquist plots
- A new function, `iopzmap`, that plots the transfer poles and zeros for each I/O pair in a MIMO system

LTI Viewer

The LTI Viewer no longer restricts importing models with unequal numbers of inputs and/or an unequal numbers of outputs. You can import any combination of LTI models into the viewer.

The zoom property in the LTI Viewer right-click menu has been removed. You can access this functionality from the new toolbar.

The import and export dialog boxes are now easier to use.

The LTI Viewer now seamlessly imports SISO models from the System Identification Toolbox. The noise model is automatically discarded and the `IDMODEL` is converted to ZPK format.

SISO Design Tool

The following are new features in the SISO Design Tool.

Additional Feedback Structures

The SISO Design Tool has support for two new feedback structures:

- Feedforward configuration
- Cascade configuration with filter **F** in the minor loop

All the usual functionality (e.g., graphical tuning of **F** and **G**) is available in the new feedback structures.

Analysis Menu

The SISO Design Tool contains a new **Analysis** menu that raises **Loop Responses** under **Tools** to the top level. New plots available from this menu are

- Input disturbance rejection
- Output disturbance rejection

Real-Time Updating of Linked LTI Viewers

LTI Viewers that are linked to the SISO Design Tool update response plots in real-time during mouse-driven compensator tuning. This is the default behavior. To deactivate this feature, clear the **Real-Time Update** check box in the linked LTI Viewer. In this case, plots update only when you release your mouse.

Import of System Identification Toolbox Models

The SISO Design Tool now seamlessly imports SISO models from the System Identification Toolbox. The noise model is automatically discarded and the `IDMODEL` is converted to ZPK format.

Reworked Store and Retrieve Windows

A new window, the **Design Archive**, combines both store and retrieve functions within a single, more intuitive GUI.

Nichols Plots

You can now trace the frequency by placing your mouse cursor over the Nichols contour.

Enhancements to the c2d Function

The `c2d` function has a new impulse-invariant discretization method that guarantees matching continuous and discrete responses for pulse inputs.

Major Bug Fixes

The Control System Toolbox 5.2 includes several bug fixes made since Version 5.1. This section describes important Version 5.2 bug fixes.

allmargin

The `allmargin` function converts ZPK models to TF format only when there is an algebraic loop in your system. This change ensures that the SISO Design Tool can correctly diagnose closed-loop stability (open loop is always in ZPK format).

dlinmod

The `dlinmod` function now correctly linearizes all multirate discrete or hybrid (continuous and discrete) Simulink models when using Jacobian-based linearization.

place

Formerly, bad edge cases in the orthogonalization loop caused a divide by zero in the `place` function. This is no longer the case.

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Control System Toolbox 5.1 Release Notes

New Features

This section introduces the new features and enhancements added in the Control System Toolbox 5.1 since the Control System Toolbox 5.0 (Release 12.0).

For information about Control System Toolbox features that are incorporated from Version 5.0, see "New Features" on page 6-2 in the Control System Toolbox 5.0 Release Notes.

SISO Design Tool Enhancements

Enhancements to the SISO Design Tool include the following:

- Save/load session — You can now save the state of the SISO Design Tool before exiting and restore it at a later time.
- Graphical design constraints — You can use a new set of design constraints that you move and shape with the mouse or specify by typing their parameter values. For example, the design constraints for root locus include damping ratios, settling time, natural frequency, and percent overshoot.
- Interactive open-loop Nichols plot — You can use a new view to graphically tune the parameters of the feedback compensator. The open-loop Nichols plot contains the same functionality as the open-loop Bode diagram and root locus.
- Interactive Prefilter Design view — You can now interactively shape the prefilter compensator. Both interactive graphics and a right-click menu are available.
- New compensator format — You can display compensator transfer functions in the natural frequency format, which is of the form

  $$dcgain \times \frac{(1 + s/\omega_{z1})}{(1 + s/\omega_{p1})} \ldots$$

  where ω_{z1},ω_{z2}, ... and ω_{p1}, ω_{p2}, ..., are the natural frequencies of the zeros and poles, respectively.

For detailed examples of how to use the SISO Design Tool, see "Designing Compensators" in *Getting Started with the Control System Toolbox*.

Algorithmic Enhancements

Enhancements to controls algorithms include

- M-circle grid for Nyquist plots
- A new function, `bandwidth`, that calculates the bandwidth of SISO systems
- LTI models with complex data — You can now specify transfer functions or state-space models with complex coefficients. Most commands work on such models, *except* for the following:
  - Time response commands
  - `rlocus`
  - `margin`, `allmargin`
- New LTI method `conj` for use with LTI models with complex data (works for TF, ZPK, SS objects)

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Control System Toolbox 5.0 Release Notes

New Features

This section introduces the new features and enhancements added in the Control System Toolbox 5.0 since the Control System Toolbox 4.2.1 (Release 11.0).

SISO Design Tool

The SISO Design Tool is a new visual interface that greatly simplifies the design of compensators for single-input, single-output (SISO) linear systems. Using editable root locus and Bode diagram views, you can graphically adjust the compensator gain, poles, and zeros, while monitoring the closed-loop responses and stability margins.

Other features include storing intermediate designs, discretizing the compensator, and visualizing design constraints.

For detailed examples of how to use the SISO Design Tool, see “Designing Compensators” in the Getting Started with the Control System Toolbox documentation.

LTI Viewer

Enhancements to the LTI Viewer include

- Data markers for scanning data off response plots and annotating plots with critical response values
- Adaptive S and Z grids for pole/zero and root locus plots
- Sharper Nyquist and Nichols plots with less user intervention
- Option to display all crossover frequencies for gain and phase margins

For detailed examples of how to use the LTI Viewer, see “Analyzing Models” in Getting Started with the Control System Toolbox.

Property and Preference Editors

You can use new Property and Preference Editors to set plot options such as titles, fonts, units, and grids. You can set toolbox preferences to persist from session to session, or set tool preferences for instances of the LTI Viewer and SISO Design Tool during a single session. You can also customize individual response plots using the Property Editor.

For a discussion of how to set properties and preferences, see Customization in the Control System Toolbox online help.

Algorithmic Enhancements

Enhancements to controls algorithms include

- A new function, `allmargin`, for computing all crossover frequencies and corresponding gain margins, phase margins, and delay margins
- A new algorithm for computing stability margins of SISO systems, including systems with delays
- An enhanced root locus plotting algorithm

New Demo Suite

The Control System Toolbox demos have been upgraded and considerably expanded. The new demo suite includes basic “getting started” tutorials, interactive demos, web-based GUI demos, and an extensive set of case studies covering dc motors, op amplifiers, disk drives, aircraft autopilots, heat exchangers, and steel rolling mills.

Documentation

The Control System Toolbox documentation has been thoroughly revamped and now includes the following:

- A new Getting Started with the Control System Toolbox manual, which introduces the main features of the toolbox through extended examples. The focus of this book is on basic control engineering tasks, including building models, analyzing model responses, and designing compensators. The examples presented use the LTI Viewer and SISO Design Tool extensively.

- Online documentation, including a complete function reference and a set of design case studies that demonstrate the advanced capabilities of the Control System Toolbox.