Signal Processing Toolbox Release Notes

The "Signal Processing Toolbox 6.0 Release Notes" on page 1-1 describe the changes introduced in the latest version of the Signal Processing Toolbox. The following topics are discussed in these Release Notes:

- "New Features" on page 1-2
- "Major Bug Fixes" on page 1-8
- "Platform Limitations" on page 1-9
- "Upgrading from an Earlier Release" on page 1-10
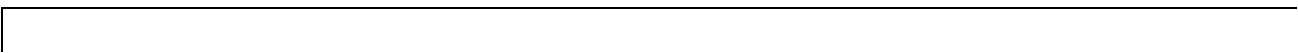- "Known Software and Documentation Problems" on page 1-11

If you are upgrading from a release earlier than Release 12.1, you should also see:

- "Signal Processing Toolbox 5.1 Release Notes" on page 2-1
- "Signal Processing Toolbox 5.0 Release Notes" on page 3-1

If you are upgrading from a release prior to Release 11.1, see the Release 11.1 New Features Guide. Note that is a PDF document.

Printing the Release Notes

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

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Signal Processing Toolbox 6.0 Release Notes

New Features

This section summarizes the new features and enhancements introduced in the Signal Processing Toolbox.

If you are upgrading from a release earlier than Release 12.1, then you should see "Upgrading from an Earlier Release" on page 1-10.

This section is organized into the following subsections:

- "Digital Filter Objects" on page 1-2
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Digital Filter Objects

The Signal Processing Toolbox 6.0 adds a new way of creating, viewing, and modifying discrete-time filters using objects. With the new discrete-time filter object, `dfilt`, you can use object-oriented programming, such as calling constructors to create specific types of filter objects, using `get` to view the filter properties, and using `set` to change filter properties. See the `dfilt` reference page for detailed information on this new object.

Some advantages of using `dfilt` objects instead of vectors of coefficients `[b,a]` are:

- The filter's structure is part of the object.

- The `filter` function can be run on any structure without converting to transfer function form.

- The filter is contained in a single object instead of two vectors. This simplifies passing the filter to another function or GUI.

- `freqz`, `grpdelay`, `impz`, `phasez`, `stepz`, and `zplane` are now overloaded methods. If you pass a `dfilt` to any of them or if you do not specify any outputs, the filter response is displayed in the Filter Visualization Tool (`fvtool`), where you can access other filter analyses. If you pass filter coefficients to them, the figure is displayed in a default figure window.

- You can change a filter's characteristics quickly and easily by changing one or more of its properties.

- You can double-click on a `dfilt` object in the MATLAB Workspace Browser to display the Property Inspector.

- You can highlight a `dfilt` and right-click in the MATLAB Workspace Browser to launch the Filter Visualization Tool.

Window Design and Analysis Tool

The new Window Design and Analysis Tool (`wintool`) is a GUI that provides an easy way to design and compare spectral windows. All of the windows provided in the Signal Toolbox are available in `wintool`. You start `wintool` from the MATLAB command line. See the `wintool` reference page for more information.

Window Visualization Tool

A new tool for viewing windows, `wvtool`, has been added.

Window Objects

A new way of creating, viewing, and modifying windows using objects has been added. The new window object, `sigwin`, uses object-oriented programming. See "Digital Filter Objects" above for advantages of using objects. See the `sigwin` reference page for detailed information on this new object.

Window Function

Using the window function without specifying an input now launches the Window Design and Analysis Tool (wintool).

New Windows

Two new window functions have been added:

- parzenwin computes a Parzen window. This window is also known as a de la Vallé-Poussin window.
- flattopwin computes a Flat Top window.

Gaussian Filter Function

The new function, firgauss designs an FIR Gaussian digital filter.

New Analysis Functions

Three new analysis functions have been added:

- phasedelay - computes the phase delay response of a filter
- phasez - computes the digital phase response of a filter
- zerophase - computes the zero-phase response of a filter. (Previously, this function, using a different syntax, was in the Filter Design Toolbox.)

Improvements to grpdelay

The grpdelay function has been updated to be more accurate for IIR filters with poles/zeros very close to the unit circle. This improvement is also reflected in the Group Delay plot in FDATool and FVTool.

stepz Function

stepz, which is also available as an overloaded dfilt method, is now available from the MATLAB command line. Previously, it was available only in fdatool.

digitrevorder Function

A new function, digitrevorder, allows you to pre-order a vector of filter coefficients.

FDATool Enhancements

- New panel control buttons have been added on the lower left side (in a sidebar) to change the panel from Design Filter to Import Filter. If the Filter Design Toolbox is installed, Set Quantization Parameters and Transform Filter control buttons are also included. If the DSP Blockset is installed, a Realize Model control button is included to create a subsystem filter block in a Simulink model.

- You can specify additional filter design options in the Design panel. These options previously were only available from the command line.

- The Filter Visualization Tool (`fvtool`), which is launched with the Full View Analysis toolbar button or **Analysis->Full View Analysis,** can be linked so that it stays synchronized with FDATool. For more information, see the FVTool Enhancements section below.

- The following menu items have been added or updated

  - **File->Export** exports vectors of filter coefficients or a `dfilt` filter object to the workspace, a text file, or a MAT file.

  - **File->Export to SPTool** exports the current filter to SPTool.

  - **Edit->Undo** now undoes single actions, one at a time. Undo will also undo the design or importing of a filter.

  - **Edit->Redo** redoes the last action.

  - **Edit->Convert Structure** launches a dialog box for converting the underlying filter structure. This dialog box is also available from a context menu (by right-clicking) in the **Current Filter Information** frame.

  - **Edit->Convert to Second Order Sections** launches a dialog box for converting the filter to Second Order Sections. This dialog box is also available from a context menu (by right-clicking) in the **Current Filter Information** frame. (The fields in this dialog box previously were part of the **Convert Structure** dialog box.)

  - **Edit->Convert to Single Section** converts a second order sections filter back to a single section. This option is also available from a context menu (by right-clicking) in the **Current Filter Information** frame.

    The **Convert to Second Order Sections** dialog box now limits scaling to Direct form II structures only.

  - **Analysis->Analysis Parameters** sets analysis-specific parameters for the filter responses. You can also access this from the context menu. You can

now save your preferred **Analysis Parameters** by clicking **Save as Default** in the **Analysis Parameters** dialog box.

- **Analysis->Sampling Frequency** sets the sampling frequency for the current filter.

- The **Filter** menu has been removed. You can access all items previously on this menu from the sidebar and **Edit** menu.

• Context menus, which you access by right-clicking, are included for setting the units, changing the display, setting the sampling frequency, or accessing the Analysis Parameters on the response plots and labels.

• The Pole/Zero Plot can now display the number of poles /zeros in cases where multiple poles/zeros occur at a single point.

• A new filter design method—**Maximally flat**—has been added. Other new methods have also been added in the Filter Design Toolbox,

• To perform zero-phase analysis, right-click on the *y*-axis label of a Magnitude plot to display the context menu and select **Zero-Phase**, or select it in the **Analysis Parameters** dialog box. To display the corresponding phase plot, select **Continuous Phase** from the Phase context menu.

• Data markers have been enhanced so they are now movable.

• The Current Filter Information frame has been updated. The Convert Structure button has been removed. To convert a structure, select **Convert Structure** from the right-click context menu or from the **Edit** menu.

FVTool Enhancements

• FVTool can be synchronized with FDATool with the **Activate FDAToolLink** toolbar button. When activated, any changes made to the filter in FDATool are immediately reflected in FVTool.

• **File->FDAToolLink** sets the mode for FDAToolLink. **Replace current filter** removes the filter in FVTool and replaces it with the new FDATool filter. **Add new filter** adds the FDATool filter to the current filter in FVTool so that multiple filters can be displayed and compared. You can also set the mode using the **Set Link mode** toolbar button.

• The **Edit** and **Insert** menus have been customized to FVTool and irrelevant menu items have been removed.

- A new **Tools** menu, which includes edit plot and zoom options, has been added.
- If the Filter Design Toolbox is installed, a new analysis method, Noise Loading Method, has been added to the **Analysis** menu. Refer to the Filter Design Toolbox documentation for more information.

- Context menus, which you access by right-clicking, are included for setting the units, changing the display, or accessing the Analysis Parameters on the response plots and labels.
- You can now save your preferred **Analysis Parameters** by clicking **Save as Default** in the **Analysis Parameters** dialog box.

- You can name the filter and specify the filter's sampling frequency with **Sampling Frequency** on the **Analysis** menu or by selecting **Sampling Frequency** from the context menu. If you have more than one filter, you can specify a different name and sampling frequency for each filter.

- To perform zero-phase analysis, right-click on the *y*-axis label of a Magnitude plot to display the context menu and select **Zero-Phase**, or select it in the **Analysis Parameters** dialog box. To display the corresponding phase plot, select **Continuous Phase** from the Phase context menu.

Demos

You can now launch the Window Visualization Tool (`wvtool`) from the Vector Transition demo (`windtrandemo`) to view the selected window.

A new Spectral Estimation demo (`psddemo`) has been added.

A new digital filter object demo (`dfiltdemo`) has been added.

The spectrogram demo (`specgramdemo`) has been enhanced with additional audio playback and visualization options.

Major Bug Fixes

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

FDATool — 800 x 600 Resolution

On all platforms, FDATool requires a screen resolution of at least 800 x 600.

Upgrading from an Earlier Release

This section describes the upgrade issues involved in moving from the Signal Processing Toolbox 5.1 to Version 6.0.

Obsolete Function

`freqzplot` is now an obsolete function. Although it is included in Release 13 for backward compatibility, it might be removed in a future release. Functions that previously used `freqzplot` now use `fvtool` to display plots.

Known Software and Documentation Problems

You can see a list of known software and documentation problems in Version 6.0. 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.

Signal Processing Toolbox 5.1 Release Notes

New Features

This section introduces the new features added in the Signal Processing Toolbox 5.1 since the Signal Processing Toolbox 5.0 (Release 12.0). Enhancements are described in the next section.

For information about Signal Processing Toolbox features that are incorporated from recent releases, see "New Features" on page 3-2 in the Signal Processing Toolbox 5.0 Release Notes.
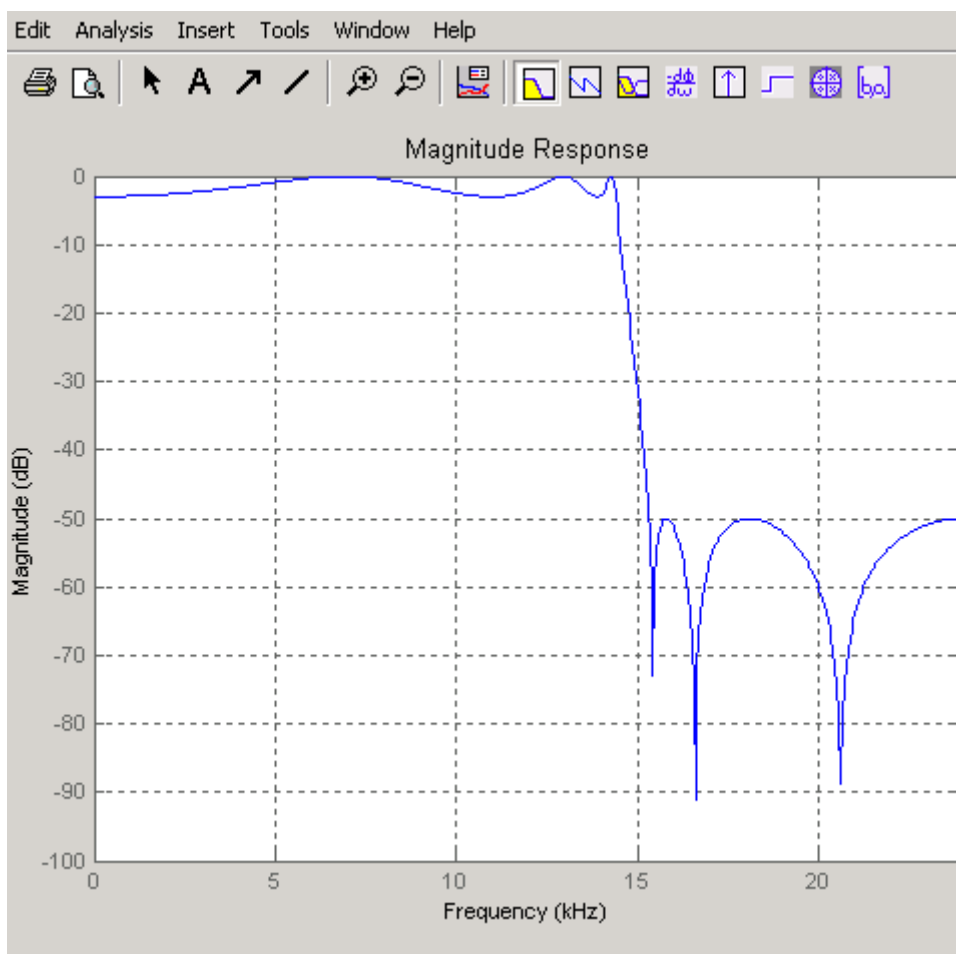
The Signal Processing Toolbox 5.1 provides a number of new features and enhancements, and a completely new facility for analyzing filters, the Filter Visualization Tool.

This section is organized into the following subsections:

- "Filter Visualization Tool" on page 2-2
- "New Windows" on page 2-3
- "bitrevorder" on page 2-4
- "downsample/upsample" on page 2-4
- "filternorm" on page 2-4
- "goertzel" on page 2-4
- "New Signal Demo" on page 2-4

Filter Visualization Tool

The new Filter Visualization Tool (`fvtool`) groups all the filter analysis functions, such as magnitude, phase, impulse response, etc., into a single window where you can easily switch between analyses, add annotations, and print your filter response.

Edit   Analysis   Insert   Tools   Window   Help

Magnitude Response

New Windows

Six new window functions and a general window function have been added to the Signal Processing Toolbox. One window has been renamed. The new windows are:

- Bartlett-Hann (`barthannwin`)
- Blackman-Harris (`blackmanharris`)

- Bohman (`bohmanwin`)
- Gaussian (`gausswin`)
- Nuttall's Blackman-Harris (`nuttallwin`)
- Tukey (tapered cosine) (`tukeywin`)

The general `window` function is an alternate way to specify any Signal Processing Toolbox window.

The rectangular (`boxcar`) window function has been renamed `rectwin`. For compatibility, `boxcar` will continue to work in this release.

bitrevorder
The new `bitrevorder` function returns input data in bit-reversed order.

downsample/upsample
The new `downsample` and `upsample` functions decrease and increase the sampling rate of a signal, respectively.

filternorm
The new `filternorm` function computes the 2-norm or inf-norm of a digital filter.

goertzel
The new `goertzel` function implements the Goertzel algorithm, which is an alternate method of computing the DFT.

New Signal Demo
A new demo, Vector Transition Processing Using Spectral Windows, has been added. This demo is interactive and demonstrates how to smooth the transition between two vectors by using various spectral windows.

Enhancements

This section describes the Signal Processing Toolbox enhancements and is organized into the following subsections:

FDATool Enhancements

The following items have been added to the FDATool.

- The new Filter Visualization (`fvtool`) can be launched from **Analysis->Full View Analysis**.
- Print Preview is now an icon on the toolbar and it launches the MATLAB standard print preview.
- Clicking on any point on a filter plot line adds a data marker, which displays information about the current point.
- New windows are included in **Method->FIR->Window** and in the Window option in the Window Specifications pane.
- The ability to export filter coefficients to a C-header file (**File->Create Header File**) is included.
- The raised cosine (`firrcos`) filter method is a new option in the Method menu and in the Design Filter pane.
- A plug-in for Code Compose Studio™ IDE to provide the ability to download coefficients from FDATool to the Developer's Kit for TI DSP is included.
- FDATool is integrated with DSP Blockset and is accessible from the Digital Filter Design block.

SPTool Enhancement

You can print preview and print your filter design in the SPTool Filter Viewer and Filter Designer.

Enhanced Functions

The following functions have been enhanced in the Signal Processing Toolbox 5.1.

Function	Enhancement
buffer	Takes all MATLAB data types in addition to double-precision data
chirp	Allows you to specify the shape (concave or convex) of a quadratic chirp operation
eqtflength	Returns the numerator and denominator orders in addition to the numerator and denominator
lpc	Outputs a vector of prediction error variances in addition to the linear prediction filter coefficients
medfilt1	Allows you to specify the matrix dimension along which the filter operates
sgolayfilt	Allows you to specify the matrix dimension along which the filter operates, and it returns row output for row input. This is consistent with filter

Major Bug Fixes

The Signal Processing Toolbox 5.1 includes several bug fixes, including the following:

- In FDATool Magnitude and Phase plot, zoom now works properly.
- In FDATool, the highpass FIR design method for Least Squares and Equiripple cases now uses the weights correctly when you use the **Specify Order** option.

Bug Fixes Incorporated from Release 12.0

The Signal Processing Toolbox 5.1 includes several bug fixes that were made in Release 12.0.

Known Software Problem

FDATool and FVTool Pole/Zero Plot

In the FDATool analysis window, pole-zero plots do not display more than one root at a given point and data markers cannot be displayed for these points.

FDATool and FVTool Magnitude and Phase Plot

In the Magnitude and Phase plot, you can use data markers only on the phase curve.

Signal Processing Toolbox 5.0 Release Notes

New Features

This section introduces the new features and enhancements added in the Signal Processing Toolbox 5.0 since the Signal Processing Toolbox 4.3 (Release 11.1).

The Signal Processing Toolbox 5.0 provides a number of important enhancements, and a completely new facility for designing and analyzing filters, the Filter Design & Analysis Tool (FDATool).

This section is organized into the following subsections:

- "Filter Design & Analysis Tool (FDATool)" on page 3-3
- "SPTool" on page 3-4
- "Spectrogram Demo" on page 3-5
- "Automatic Order Adjustment in FIR Filter Functions" on page 3-5
- "grpdelay" on page 3-6
- "hilbert" on page 3-6
- "lpc" on page 3-6
- "xcorr" on page 3-6

Filter Design & Analysis Tool (FDATool)

The Filter Design & Analysis Tool provides a simple and intuitive graphical interface to most of the Signal Processing Toolbox's digital filter design functions.
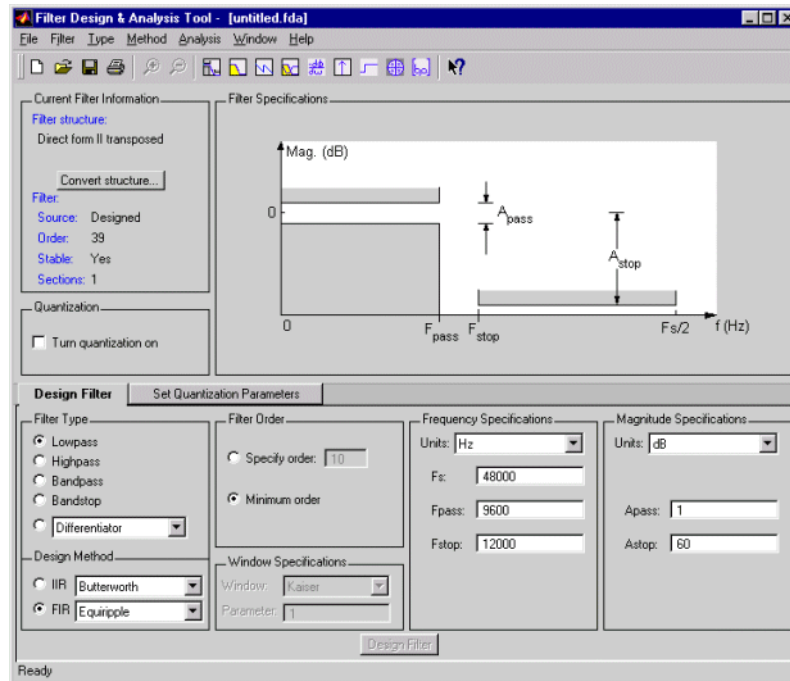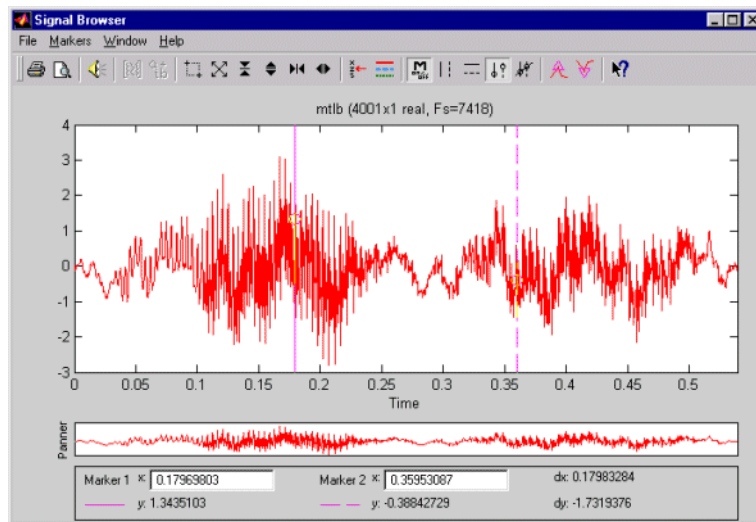

To start the tool, type `fdatool` at the MATLAB command line.

## **SPTool**

SPTool has received a number of enhancements:

• The Signal Browser can now play a selected portion of a signal.

• The markers (rulers) have been enhanced in all component tools (Signal Browser, Filter Viewer, Filter Designer, and Spectrum Viewer).

• The toolbars have been enhanced in all component tools. (The new Signal Browser interface is shown below.)

To start the tool, type sptool at the MATLAB command line.

Spectrogram Demo

The Spectrogram Demo (`specgramdemo(y,Fs)`) is a new demo that displays a spectrogram, a time plot, and a frequency slice of an input signal, *y*, assuming a sample rate of *Fs* Hz.
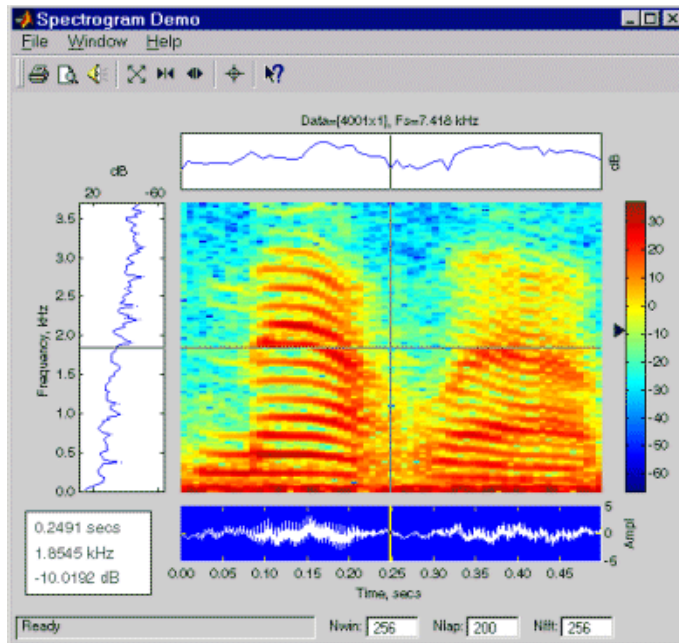
Automatic Order Adjustment in FIR Filter Functions

Most of the FIR filter functions (`fir1`, `fir2`, `firls`, `remez`, `fircls`, `fircls1`) now automatically increase the order of linear phase filters by 1 when necessary to meet the design specifications. For example, a Type II (odd order, symmetric) linear phase filter must have a zero at π radians. If a gain other than zero is instead specified at π radians in any of the above mentioned functions, the function adds 1 to the filter order and proceeds to design the higher order filter.

A warning message is produced in the command window whenever a function automatically changes the filter order.

grpdelay

The grpdelay function now returns more accurate results for IIR filters.

hilbert

The hilbert function no longer zero-pads sequences that have a non-power-of-two length, so the transforms are now exact.

lpc

The lpc function can now return an estimate of the prediction error variance (power) as a second output.

xcorr

The xcorr function can now efficiently compute the cross-correlation and autocorrelation of large vectors.

Major Bug Fixes

The Signal Processing Toolbox includes several bug fixes, including the following descriptions (online only) of particularly important bug fixes.

Upgrading from an Earlier Release

This section describes the upgrade issues involved in moving from the Signal Processing Toolbox 4.3 (Release 11.1) to the Signal Processing Toolbox 5.0.

Changes to remez

In the Signal Processing Toolbox 5.0, the `remez` function no longer supports the `'m'` option that previously executed an M-file variant of the function.