SIGNAL PROCESSING TOOLSET FOR LABVIEW™ AND LABWINDOWS™/CVI™ RELEASE NOTES

Version 7.0

These release notes introduce you to the Signal Processing Toolset for LabVIEW and LabWindows/CVI and contain information about system requirements, installation, new features, modified features, improvements to the toolset, upgrade issues, and known issues.

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LabVIEW

This section contains information about the Signal Processing Toolset for LabVIEW.

System Requirements

The Signal Processing Toolset for LabVIEW requires the following minimum system configuration:

- LabVIEW 6.1 or later Full Development System or Professional Development System
- Windows 2000/NT/XP/Me/98
- 80 MB free disk space

Installation

Before installing Signal Processing Toolset 7.0, ensure your system meets the following conditions:

- LabVIEW 6.1 or later is installed on your system.
- LabVIEW is not running.
- No earlier versions of the Signal Processing Toolset, including beta releases, are installed on your system.

(Windows 98) Insert the Signal Processing Toolset installation CD and follow the instructions that appear on your screen.

(Windows 2000/NT/XP/Me) Complete the following steps to install the Signal Processing Toolset for LabVIEW.

1. Log on as an administrator or as a user with administrator privileges.
2. Insert the Signal Processing Toolset installation CD and follow the instructions that appear on your screen.

New Features

Signal Processing Toolset 7.0 contains the following new features:

- Easy-to-use versions of the joint time-frequency analysis (JTFA), super-resolution spectral analysis (SRSA), and wavelet analysis VIs that support the waveform data type
- Advanced JTFA VIs that use the refnum data type to reduce memory consumption
- Additional examples to help you get started using the Signal Processing Toolset
- Support for LabVIEW RT
- New VIs for JTFA and wavelet analysis

Table 1 lists the new palettes and VIs in Signal Processing Toolset 7.0. Refer to the *Signal Processing Toolset Help* for more information about individual palettes and VIs.

Table 1. New Palettes and VIs in Signal Processing Toolset 7.0

Palette/VI Name	Description
Easy Level JTFA palette **Easy Level SRSA** palette **Easy Level JTFA** palette	Contain VIs that support the waveform data type, have simpler parameter settings as compared to the advanced VIs, and support engineering units.
Refnum JTFA palette	Contains VIs that use the refnum data type to pass data, which reduces memory consumption.
Wavelet Packet palette	Contains VIs used to perform wavelet packet analysis.
2D Discrete Wavelet Transform VI	Computes the 2D discrete wavelet transform.
Arbitrary Path Decomposition VI	Performs bandpass filtering using cascaded lowpass and highpass decimation filters.

Table 1. New Palettes and VIs in Signal Processing Toolset 7.0 (Continued)

Palette/VI Name	Description
Arbitrary Path Reconstruction VI	Reconstructs a signal using the arbitrary path filtering results from the Arbitrary Path Decomposition VI.
Fast MIF VI	Computes the mean instantaneous frequency (MIF) for a signal using the Gabor-expansion-based method.
Inverse 2D Discrete Wavelet Transform VI	Reconstructs a 2D image using the results from the 2D Discrete Wavelet Transform VI.
Online STFT VI	Is the online version of the STFT VI.
Online STFT Spectrogram VI	Is the online version of the STFT Spectrogram VI.
Optimal Path VI	Finds the optimal filtering path for wavelet analysis and performs filtering on that path.
Time Varying Filter VI	Performs time varying filtering using the Gabor-expansion-based method. The time varying filter is suitable for transient signals whose frequency evolves over time.

Modified Features

Adaptive Gaussian Chirplet Decomposition Replaces Adaptive Gabor Expansion

The adaptive Gaussian chirplet decomposition algorithm replaces the adaptive Gabor expansion algorithm. Adaptive Gabor expansion decomposes a signal $s(t)$ using the following equation.

$$s(t) = \sum_k A_k h_k(t),$$

where

$$h_k(t) = \sqrt[4]{\frac{\alpha_k}{\pi}} \exp\left\{-\frac{\alpha_k}{2}(t-t_k)^2 + j\omega_k(t-t_k)\right\}.$$

Adaptive Gaussian chirplet decomposition decomposes a signal $s(t)$ using the following equation.

$$s(t) = \sum_k A_k h_k(t),$$

where

$$h_k(t) = \sqrt[4]{\frac{\alpha_k}{\pi}} \exp\left\{ -\frac{\alpha_k}{2}(t - t_k)^2 + j(\omega_k(t - t_k) + \frac{\beta_k}{2}(t - t_k)^2) \right\}.$$

In Signal Processing Toolset 6.0, the Adaptive Spectrogram, Adaptive Gabor Transform, and Adaptive Gabor Expansion VIs used the adaptive Gabor expansion algorithm. The preceding three VIs are replaced in Signal Processing Toolset 7.0 by the Adaptive Spectrogram Ex, Adaptive Transform, and Adaptive Expansion VIs, all of which use the adaptive Gaussian chirplet decomposition algorithm. National Instruments recommends that you use the new Adaptive Spectrogram Ex, Adaptive Transform, and Adaptive Expansion VIs. Refer to the *Upgrade Issues* section for information about using version 6.0 VIs with Signal Processing Toolset 7.0.

Parameters of Existing VIs Changed

Table 2 lists the VIs whose parameters have changed in Signal Processing Toolset 7.0. Refer to the *Signal Processing Toolset Help* for information about individual VIs.

Table 2. VIs Whose Parameters Have Changed in Signal Processing Toolset 7.0

Version 6.0 VI Name	Version 7.0 VI Name
Adaptive Gabor Expansion	Adaptive Expansion
Adaptive Gabor Transform	Adaptive Transform
Adaptive Spectrogram	Adaptive Spectrogram Ex
Arbitrary Path	Arbitrary Path Decomposition
Continuous Wavelet Transform	Continuous Wavelet Transform Ex
De-noise	De-noise Ex
Detrend	Detrend Ex
Discrete Gabor Transform	Discrete Gabor Transform Ex

Table 2. VIs Whose Parameters Have Changed in Signal Processing Toolset 7.0 (Continued)

Version 6.0 VI Name	Version 7.0 VI Name
Discrete Wavelet Transform	Discrete Wavelet Transform Ex
Fast Gabor Spectrogram	Fast Gabor Spectrogram Ex
Inverse Discrete Wavelet Transform	Inverse Discrete Wavelet Transform Ex
MDL	MDL Ex

First and Second Derivative Extension Methods Replaced by Periodic and Spline

Periodic and spline replace first derivative and second derivative as choices for the **extension** parameter in the JTFA and wavelet analysis VIs. If your applications built with Signal Processing Toolset 6.0 require the first or second derivative extension method, call the `spt6_extension.vi` located in `Program Files\National Instruments\LabVIEW x\vi.lib\Addons\Adv Sig Processing\Misc.llb`, where *x* denotes the version number of LabVIEW. You can use the `spt6_extension.vi` to compute the first and second derivative extension.

`spt6_extension.vi` has the outputs **Initial Condition Out** and **Final Condition Out**. You can select the user defined **extension** method in the version 7.0 VIs and use **Initial Condition Out** and **Final Condition Out** from `spt6_extension.vi` as the **Initial Condition** and **Final Condition** inputs to the version 7.0 VIs, as shown in Figure 1.

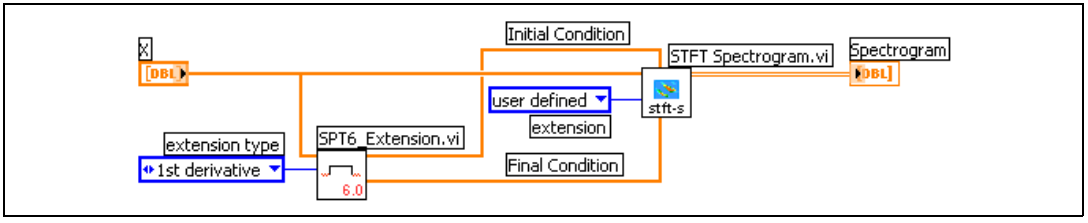

Figure 1. Implementing the First Derivative Extension in Signal Processing Toolset 7.0

num of freq bins Parameter of the STFT Spectrogram (real) VI

In version 6.0, the **number of frequency bins** parameter of the STFT Spectrogram (real) VI specified the column size of the output spectrogram.

Figure 2 shows the block diagram of a VI using the STFT Spectrogram (real) VI from version 6.0.

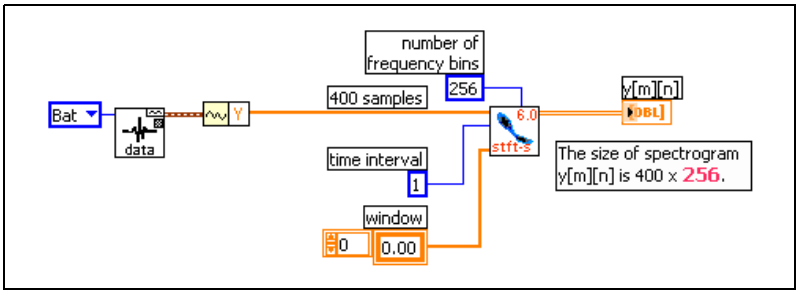

Figure 2. number of frequency bins Parameter in Signal Processing Toolset 6.0

In Figure 2, the column size of the spectrogram y[m][n] equals the value of the **number of frequency bins** parameter.

In Signal Processing Toolset 7.0, the **num of freq bins** parameter of the STFT Spectrogram (real) VI specifies the number of frequency bins to observe the input signal in the joint time-frequency domain in terms of a normalized frequency range of the time-frequency representation from DC to 1.0.

Figure 3 shows the block diagram of a VI using the STFT Spectrogram (real) VI from version 7.0.

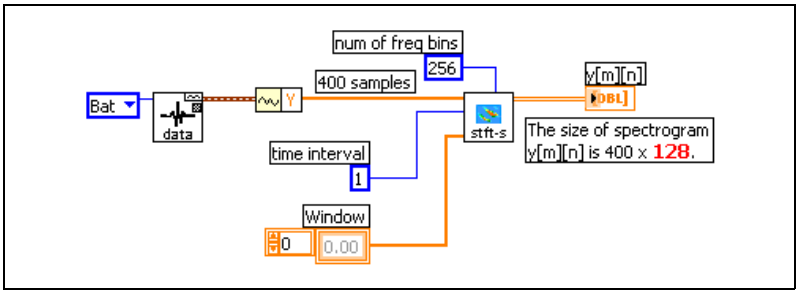

Figure 3. num of freq bins Parameter in Signal Processing Toolset 7.0

In Figure 3, the column size of the spectrogram y[m][n] equals **num of freq bins**/2.

Online JTFA Application

The Online JTFA application has been removed from the NI SPT Start-Up application.

Error Codes

Signal Processing Toolset 7.0 contains a new set of error codes. Refer to the *Signal Processing Toolset Help* for information about the error codes.

Improvements

JTFA Algorithms

Performance of the JTFA VIs has improved from 2 to approximately 10 times, as compared to previous versions of the Signal Processing Toolset, due to optimization of the algorithms used.

Memory Allocation of the JTFA VIs

The memory allocation of the JTFA VIs has improved. In Signal Processing Toolset 7.0, the JTFA VIs can process signals with up to 1 M data samples.

Usability

Signal Processing Toolset 7.0 contains easy-to-use versions of the JTFA, SRSA, and wavelet analysis VIs. Version 7.0 also contains customized controls to display your analysis results as spectrograms, scalograms, and gray-scale images. Refer to the *Signal Processing Toolset Help* for information about individual VIs and controls.

Upgrade Issues

Version 6.0 VIs

The version 6.0 VIs listed in Table 2 are still in the Signal Processing Toolset 7.0 libraries (`.llb` files) but do not appear on the version 7.0 palettes. You can still run the version 6.0 VIs listed in Table 2 in Signal Processing Toolset 7.0. However, National Instruments recommends you use the new version 7.0 VIs listed in Table 2 in place of the version 6.0 VIs.

Adaptive Spectrogram and Adaptive Gabor Transform VIs

If you are using the Adaptive Spectrogram and Adaptive Gabor Transform VIs, the results you obtain with Signal Processing Toolset 7.0 might be different from your version 6.0 results. The reason for the difference in results between version 7.0 and version 6.0 is that adaptive transform results can change because of different implementations of the algorithm. In version 7.0, the implementation of the adaptive transform algorithm is optimized by using the new adaptive Gaussian chirplet decomposition algorithm. Refer to the *Modified Features* section for information about the adaptive Gaussian chirplet decomposition algorithm.

Note The amount of difference between results obtained with version 6.0 and version 7.0 depends on the signal-to-noise ratio. If the signal under analysis is buried under noise and the signal-to-noise ratio is small, the results you obtain with the version 7.0 Adaptive Spectrogram Ex and Adaptive Transform VIs might be different from the results you obtained with the version 6.0 Adaptive Spectrogram and Adaptive Gabor Transform VIs. When the signal-to-noise ratio is large, the results from version 7.0 and version 6.0 are very close.

Known Issues

The following issues are known to exist in Signal Processing Toolset 7.0:

- The NI SPT Start-Up application is not supported for LabVIEW RT.
- The Time Varying Filter VI, the Easy Time Varying Filter VI, and `Time Varying Filter Example.vi` are not executable in LabVIEW RT.

LabWindows/CVI

This section contains information about the Signal Processing Toolset for LabWindows/CVI.

System Requirements

The Signal Processing Toolset for LabWindows/CVI requires the following minimum system configuration:

- LabWindows/CVI 6.0 or later
- Windows 2000/NT/XP/Me/98
- 80 MB free disk space

Installation

Before installing Signal Processing Toolset 7.0, ensure your system meets the following conditions:

- LabWindows/CVI 6.0 or later is installed on your system.
- LabWindows/CVI is not running.
- No earlier versions of the Signal Processing Toolset, including beta releases, are installed on your system.

(Windows 98) Insert the Signal Processing Toolset installation CD and follow the instructions that appear on your screen.

(Windows 2000/NT/XP/Me) Complete the following steps to install the Signal Processing Toolset for LabWindows/CVI.

1. Log on as an administrator or as a user with administrator privileges.
2. Insert the Signal Processing Toolset installation CD and follow the instructions that appear on your screen.

New Features

Signal Processing Toolset 7.0 contains the following new features:

- Additional examples to help you get started using the Signal Processing Toolset
- New functions for JTFA and wavelet analysis

Refer to the *Signal Processing Toolset for LabWindows/CVI Help* for more information about individual functions.

New JTFA Functions

- SptCxAdaptiveExpansion
- SptCxAdaptiveSpectrogram
- SptCxAdaptiveTransform
- SptCxFastGaborSpectrogramEx
- SptCxReassignedSTFTSp
- SptFastMeanInstFreq
- SptGetEasyGaborSpDimSize
- SptGetOptimalDualWinLen
- SptRealAdaptiveExpansion
- SptRealAdaptiveSpectrogram
- SptRealAdaptiveTransform

- SptRealFastGaborSpectrogramEx
- SptRealReassignedSTFTSp

New Wavelet Analysis Functions

- SptArbPathDecomposition
- SptArbPathReconstruction
- SptConWaveletTransformEx

New Wavelet Packet Functions

- SptWPCreateHandle
- SptWPDecomposition1D
- SptWPDisposeHandle
- SptWPGetTerminalNodeLen
- SptWPGetTreeStrLen
- SptWPIndexToNode
- SptWPJoin1D
- SptWPOptimalNode
- SptWPReadEntropy
- SptWPReadTerminalNode
- SptWPReadTreeStr
- SptWPReconstruction1D
- SptWPSplit1D
- SptWPWriteTerminalNode

Modified Features

Parameters of Existing Functions Changed

Table 3 lists the functions whose parameters have changed in Signal Processing Toolset 7.0. Refer to the *Signal Processing Toolset for LabWindows/CVI Help* for information about individual functions.

Table 3. Functions Whose Parameters Have Changed in Signal Processing Toolset 7.0

Version 6.0 Function Name	Version 7.0 Function Name
SptArbitraryPath	SptArbPathDecomposition
SptConWaveletTransform	SptConWaveletTransformEx
SptRealFastGaborSpectrogram	SptRealFastGaborSpectrogramEx

First and Second Derivative Extension Methods Replaced by Periodic and Spline

Periodic and spline replace first derivative and second derivative as choices for the **extension** parameter in the JTFA and wavelet analysis functions. The first derivative and second derivative extension methods are still supported in Signal Processing Toolset 7.0. However, the first derivative and second derivative extension methods are obsolete and not documented in version 7.0. The first derivative and second derivative extension methods might not be supported in the next release of the Signal Processing Toolset.

num of freq bins Parameter of the SptRealSTFTSpectrogram Function

In version 6.0, the **winInfo->N** parameter of the SptRealSTFTSpectrogram function specified the column size of the output spectrogram. The column size of the output spectrogram equaled **winInfo->N**.

In Signal Processing Toolset 7.0, the **winInfo->N** parameter of the SptRealSTFTSpectrogram specifies the number of frequency bins to observe the input signal in the joint time-frequency domain in terms of a normalized frequency range of the time-frequency representation from DC to 1.0. In version 7.0, the column size of the output spectrogram equals (**winInfo->N**)/2.

Computing the Row Size of 2D Outputs

The equations used to compute the row size of the 2D output of the following functions have changed:

- SptRealSTFTSpectrogram
- SptCxSTFTSpectrogram
- SptRealSTFT
- SptCxSTFT
- SptRealFastGaborSpectrogram
- SptCxFastGaborSpectrogram

SptRealSTFTSpectrogram, SptCxSTFTSpectrogram, SptRealSTFT, and SptCxSTFT

In version 6.0, the row size of the 2D output of the SptRealSTFTSpectrogram, SptCxSTFTSpectrogram, SptRealSTFT, and SptCxSTFT functions was computed using the following equation.

row size = floor(**len/winInfo->dM**).

In Signal Processing Toolset 7.0, the row size of the 2D output of the SptRealSTFTSpectrogram, SptCxSTFTSpectrogram, SptRealSTFT, and SptCxSTFT functions is computed using the following equation.

row size = floor(**len/winInfo->dM**) + 1.

SptRealFastGaborSpectrogram and SptCxFastGaborSpectrogram

In version 6.0, the row sizes of the SptRealFastGaborSpectrogram and SptCxFastGaborSpectrogram functions were computed using the following equation.

row size = floor(floor(**len/analysisWinInfo->dM**) × **analysisWinInfo->dM/timeInterval**).

In Signal Processing Toolset 7.0, the row sizes of the SptRealFastGaborSpectrogram and SptCxFastGaborSpectrogram functions are computed using the following equation.

row size = floor(floor(**len/analysisWinInfo->dM** + 1) × **analysisWinInfo->dM/timeInterval**).

Error Codes

Signal Processing Toolset 7.0 contains a new set of error codes. Refer to the *Signal Processing Toolset for LabWindows/CVI Help* for information about the error codes.

Improvements

JTFA Algorithms

Performance of the JTFA functions has improved from 2 to approximately 10 times, as compared to previous versions of the Signal Processing Toolset, due to optimization of the algorithms used.

Memory Allocation of the JTFA Functions

The memory allocation of the JTFA functions has improved. In Signal Processing Toolset 7.0, the JTFA functions can process signals with up to 1 M data samples.

Usability

Signal Processing Toolset 7.0 has online function help, *Signal Processing Toolset for LabWindows/CVI Help*. Most of the functions have example code included in the online help. Refer to the *Signal Processing Toolset for LabWindows/CVI Help* for information about individual functions.

Upgrade Issues

Version 6.0 Functions

If your applications developed with version 6.0 use the functions listed in Table 3, National Instruments recommends that you use the corresponding version 7.0 functions.

Memory Allocation for 2D Outputs

If your applications developed with version 6.0 use functions listed in the *num of freq bins Parameter of the SptRealSTFTSpectrogram Function* and *Computing the Row Size of 2D Outputs* sections, you might need to change the size of the memory allocation for the 2D outputs. Refer to the *Signal Processing Toolset for LabWindows/CVI Help* for information about individual functions.