

# Time Series Analysis and Graphics Library 2.0 for Windows

from  
Digital Acoustics

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## Overview

Since 1993, Time Series Analysis and Graphics Library (TSAGL) has been the standard general-purpose signal processing, analysis and display package for GAUSS Programming Environment. It contains a host of basic and complex algorithms that allow the user to develop sophisticated programs for various signal processing, analysis and modeling tasks based upon individual requirements and specific needs. The algorithms are written in the form of GAUSS procedures. They can therefore be accessed quickly and easily from within the GAUSS environment.

You will find in the new version of TSAGL for Windows over 80 procedures to facilitate signal analysis, filtering, modeling, file input/output and signal display, manipulation and extraction using the Windows graphical interface capabilities. Many of the existing procedures have also been rewritten or improved. All procedures are gathered in five libraries. The following is a description of some of the features found in the TSAGL package. For a complete list of commands, please refer to the table on the next page.

## Standard Library

The TSAGL Standard Library consists of a suite of algorithms to manipulate and simulate signals in the time domain. These procedures make up the core of the package. Among the features present, one can list signal differentiation, integration and resampling. Algorithms that compute the auto-correlation, partial auto-correlation and cross-correlation series are available as well as procedures to generate synthetic signals for testing and simulation purposes. In addition, popular windowing functions for smoothing spectral estimates can be found in this library. Easy file name selection for reading and writing signals can also be performed using new procedures added to the Windows version of the package.

## Filter Library

Digital filtering of time series can be performed using various procedures supplied in the TSAGL Filter Library. For instance, standard Infinite Impulse Response (IIR) filters such as Butterworth, Bessel and Chebyshev are implemented along with Finite Impulse Response (FIR) lowpass, highpass, bandpass and bandstop filters. Procedures are also provided to carry out data filtering using moving average, smoothing, FIR and IIR type filters given the direct, cascade and parallel forms.

The Filter Library supports adaptive filtering of time and space series based on Hanning's CANC approach, allowing the user to simulate the ANC and ALE methods.

Deconvolution or inverse filtering of signals may be carried out with the aid of algorithms that implement the concept of least-

squares or Wiener filtering. Least-squares filtering procedures can serve as the building blocks in a program designed to tackle such problems as predictive deconvolution and forecasting. For example, these routines are called extensively by procedures in the Model Library to estimate the parameters of an ARMA process for spectral analysis purposes.

## Spectrum Library

The Spectrum Library consists of algorithms commonly used in the analysis of time series. Using the Fast Fourier Transform, the library provides procedures for estimating the frequency content of signals, cross-spectral density and coherence between two time series. If a model-based approach is required, auto-regressive and auto-regressive/moving-average spectra can be calculated easily with the SPECTRAR and SPECARMA procedures.

Echo detection, source waveform estimation and homomorphic deconvolution may be carried out via cepstral analysis using both real and complex cepstrum procedures found in this library.

## Model Library

The Model Library contains routines for parametric modeling of time series. The Burg and Least-Squares auto-regressive procedures are provided for estimating the parameters of an auto-regressive process. ARMA modeling can be performed, for spectral analysis purposes, through the use of several procedures such as PADE and PADEARMA which employ the Euclidean algorithm to obtain an estimate of the ARMA process' parameters.

A spline procedure has been added to allow easy and accurate interpolation of signals where required.

Waveform analysis curve fitting is supported to facilitate modeling where the data are noisy. This is especially useful when a priori knowledge of the underlying characteristics of the waveform is available.

## Graphics Library

Time and frequency domain signals are edited and displayed using entirely new procedures in the TSAGL Graphics Library. Editing signals can easily be performed with one mouse click. The extracted portion of the signal is displayed automatically and can be used for further analysis. A given time series may be edited on the graphics screen as many times as it is necessary until the desired segment is isolated and returned to the calling program. This version of the library can produce graphics on any display and output printer/plotter supported by the Windows Operating System.

# TSAGL Command Summary

Procedure	Description
align	aligns two or more signals.
autocor	computes auto-correlation series.
bandpass	generates non-recursive band-pass filter.
bandstop	generates non-recursive band-stop filter.
bartlett	generates Bartlett window.
bestfit	finds the best polynomial to fit data.
blackman	generates Blackman window.
brown	generates brown noise.
bsbdpass	generates 2nd order Bessel band-pass filter.
bsbdstop	generates 2nd order Bessel band-stop filter.
bshpass	generates 2nd order Bessel high-pass filter.
bslopass	generates 2nd order Bessel low-pass filter.
burg	computes coefficients of AR process.
bwbdpass	2nd order Butterworth band-pass filter.
bwbdstop	2nd order Butterworth band-stop filter.
bwhpass	2nd order Butterworth high-pass filter.
bwlopass	2nd order Butterworth low-pass filter.
canc	carries out data adaptive filtering.
cbbdpass	2nd order Chebyshev band-pass filter.
cbbdstop	2nd order Chebyshev band-stop filter.
cbhipass	2nd order Chebyshev high-pass filter.
cblopass	2nd order Chebyshev low-pass filter.
ciresp	impulse response of cascade-form filter.
coherenc	computes coherence of 2 real-valued series.
cplxceps	computes complex cepstrum.
crosscor	computes cross-correlation series.
crosspec	cross-spectrum of 2 real-valued time series.
decimate	decimates a time series.
derive	differentiates a time series.
diresp	impulse response of direct-form filter.
exponent	finds parameters of exponential function.
fft2	computes FFT on 2 series simultaneously.
firfilt	carries out non-recursive digital filtering.
genspline	generates the spline curve.
getfilename	selects filename for input/output.
goodness	calculates the goodness of fit.
graphics	activates/deactivates graphics mode.
hamming	generates Hamming window.
highpass	generates non-recursive high-pass filter.
iirfilt	carries out cascade-form IIR filtering.
iirspec	spectrum of cascade-form IIR filter.
iirdfilt	carries out direct-form IIR filtering.
iirpflt	carries out parallel-form IIR filtering.
iirspec	spectrum of parallel-form IIR filter.
ilsarma	computes coefficients of ARMA process.
integral	integrates a series.
interpol	interpolates a time series using the FFT.
iwavelet	computes the inverse of a wavelet.
kaiser	generates Kaiser window.
levinson	solves least-squares normal equations.
linefit	fits a straight line.
lnxlny	plots series using natural log coordinates.
logxlogy	plots series using base 10 log coordinates.
lowpass	generates non-recursive low-pass filter.
lsar	computes coefficients of AR process.

modexpo	finds coeff. of modified exp. function.
nilsarma	computes coefficients of ARMA process.
pade	approximates a polynomial by a ratio.
padearma	estimates coefficients of ARMA process.
pautocor	computes partial auto-correlation series.
piresp	impulse response of parallel-form filter.
polydiv	divides 2 polynomials.
polydvqr	returns quotient and remainder.
polyfit	generates coefficients of a polynomial curve.
powerfcn	finds parameters of the power function.
predict	computes coefficients of prediction filter.
realceps	computes real cepstrum.
resample	resamples series with a new sampling rate.
ricker	generates the Ricker wavelet.
shape	computes coefficients of shaping filter.
smooth	smooths signals using a moving-average filter.
specarma	power spectral density for ARMA process.
spectrar	power spectral density for AR process.
spectrum	power and phase spectra using FFT.
spline	generates the coefficients of spline curve.
spike	computes the optimum spike position.
synsig	builds a synthetic signal using sine function.
tapered	generates tapered window.
uniform	generates uniform window.
vonhann	generates vonhann window.
xmodexpo	finds parameters of exponential function.
xy	plots series using cartesian coordinates.
xydb	plots series with dependent axis in decibels.

## Summary

Time Series Analysis and Graphics Library is designed to be versatile and easily accessible. The fact that it is written in the form of GAUSS procedures allows one to develop custom-tailored programs. It is therefore an excellent research and development tool for anyone involved in the field of signal processing and analysis. The manual provides detailed information and examples about the use of every procedure along with a discussion on technically related topics organized in 8 chapters. TSAGL is available for the GAUSS for Windows from Aptech Systems, Inc.

### Contact Aptech or your local dealer for pricing and information

See our web-site for the Dealer nearest you:  
[www.Aptech.com/s2\\_dist.html](http://www.Aptech.com/s2_dist.html)

**Aptech Systems, Inc.**  
**23804 SE Kent-Kangley Road**  
**Maple Valley, WA 98038 USA**

**Phone: (425) 432-7855 ♦ FAX:(425) 432-7832**

**Email: [info@Aptech.com](mailto:info@Aptech.com) ♦ URL:  
[www.Aptech.com](http://www.Aptech.com)**

