Package 'astrochron'

July 20, 2014

Type Package

Title An R Package for Astrochronology

Version 0.3.1

Date 2014-07-19

Author Stephen Meyers

Maintainer Stephen Meyers <smeyers@geology.wisc.edu>

Description Astrochonologic testing, astronomical time scale development, time series analysis

Imports baseline, multitaper, fields

License GPL-3

NeedsCompilation yes

Repository CRAN

Date/Publication 2014-07-20 07:32:44

R topics documented:

`astrochron-package` *astrochron: An R Package for Astrochronology*

Description

'astrochron' is a suite of signal processing routines for astrochronology, including data series preparation, spectral analysis, time-frequency analysis, and astrochronologic testing.

Details

Package:	astrochron
Type:	Package
Version:	0.3.1
Date:	2014-07-19
License:	GPL-3

Note

Please note that this version of astrochron is undergoing BETA TESTING.

Development of 'astrochron' is partially supported by the U.S. National Science Foundation:

CAREER: Deciphering the Beat of a Timeless Rhythm - The Future of Astrochronology (EAR 1151438 to S. Meyers)

Collaborative Research: Evolution of the Climate Continuum- Late Paleogene to Present (OCE 1003603 to S. Meyers and L. Hinnov)

TO CITE PACKAGE 'astrochron' IN PUBLICATIONS, PLEASE USE:

Meyers, S.R. (2014), *astrochron: An R Package for Astrochronology (Version 0.3.1).*

Also cite the original research papers that document the relevant algorithms, as referenced on the help pages for specific functions.

Author(s)

Stephen Meyers

Maintainer: Stephen Meyers <smeyers@geology.wisc.edu>

Examples

```
### EXAMPLES OF SOME FUNCTIONS AVAILABLE IN 'astrochron':

### This demo will use a model [series are usually read using the function 'read'.]
data(modelA)

### Interpolate the model stratigraphic series to its median sampling interval
modelAInterp=linterp(modelA)

### Calculate MTM spectrum using 2pi Slepian tapers, include AR1 condfidence level estimates,
###  plot power with linear scale
mtm(modelAInterp,tbw=2,ar=TRUE,pl=2)

### Perform Evolutive Harmonic Analysis using 2pi Slepian tapers, a window of 8 meters,
###  pad to 1000 points, and output Harmonic F-test confidence level results
fCL=eha(modelAInterp,win=8,pad=1000,output=4)

### Extract Harmonic F-test spectrum at approximately 22 meters height
spec=extract(fCL,22)
### In this extracted spectrum, identify F-test peak maxima exceeding 90% confidence level
freqs=peak(spec,level=0.9)[2]
### Conduct ASM testing on these peaks
# set Rayleigh frequency in cycles/m
rayleigh=0.1245274
# set Nyquist frequency in cycles/m
nyquist=6.66597
# set orbital target in 1/ky
target=c(1/405.47,1/126.98,1/96.91,1/37.66,1/22.42,1/18.33)
# execute ASM
asm(freq=freqs,target=target,rayleigh=rayleigh,nyquist=nyquist,sedmin=0.5,sedmax=3,numsed=100,
    linLog=1,iter=100000,output=FALSE)

### Interactively track obliquity term in EHA harmonic F-test confidence level results
# freqs=trackFreq(fCL,fmin=1.2,fmax=2.4,threshold=0.8)

### Convert the spatial frequencies to sedimentation rates
# sedrate=freq2sedrate(freqs,period=37.66)

### Convert the sedimentation rate curve to a time-space map
# time=sedrate2time(sedrate)

### Tune the stratigraphic series using the time-space map
# modelATuned=tune(modelAInterp,time)

### Interpolate the tuned series
# modelATunedInterp=linterp(modelATuned)
```

```
### Perform Evolutive Harmonic Analysis on the tuned series
# eha(modelATunedInterp)
```

---

anchorTime *Anchor a floating astrochronology to a radioisotopic age*

Description

Anchor a floating astrochronology to a radioisotopic age. The floating astrochronology is centered on a given ('floating') time datum and assigned the 'anchored' age.

Usage

```
anchorTime(dat,time,age,timeDir=1,flipOut=F,verbose=T,genplot=T)
```

Arguments

dat	Stratigraphic series. First column should be location (e.g., depth), second column should be data value.
time	'Floating' time datum to center record on. Units should be ka.
age	Radioisotopic age (or othwerwise) for anchoring at floating 'time' datum. Units should be ka.
timeDir	Direction of 'floating' time in input record; 1 = elapsed time towards present; 2 = elapsed time away from present
flipOut	Flip the output (sort so the ages are presented in decreasing order)? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

---

ar1 *Generate AR(1) model*

Description

Generate an AR(1) model

Usage

```
ar1(npts=1024,dt=1,mean=0,sdev=1,rho=0.9,genplot,verbose)
```

Arguments

npts	number of time series data points
dt	sampling interval
mean	mean value for Gaussian deviates
sdev	standard deviation for Gaussian deviates
rho	AR(1) coefficient
genplot	generate summary plots (T or F)
verbose	verbose output (T or F)

Examples

```
# generate an AR1 series with 500 points, sampling interval of 5 ka, and rho of 0.8
ar1(npts=500,dt=5,rho=0.8)
```

---

ar1etp *AR(1) + ETP simulation Routine*

Description

Simulate a combined AR(1) + ETP signal, plot spectrum and confidence levels

Usage

```
ar1etp(etpdat=NULL,iter=100,rho=0.9,ARvar=1,sig=90,tbw=2,padfac=5,ftest=F,fmax=0.1,
       speed=0.5,pl=2,output=F,graphfile=0)
```

Arguments

etpdat	Eccentricity, tilt, precession astronmical series. First column = time, second column = ETP. If not entered, will use default series.
iter	Number of simulations.
rho	AR(1) coefficient.
ARvar	Multiplicative factor for AR1 noise (1= eqivalent to ETP variance).
sig	Demarcate what confidence level (percent) on plots?
tbw	MTM time-bandwidth product.
padfac	Padding factor.
ftest	Include MTM harmonic f-test results? (T or F)
fmax	Maximum frequency for plotting.
speed	Set the amount of time to pause before plotting new graph, in seconds.
pl	Plot log power (1) or linear power (2)?
output	Output modeled time series? (T or F). If selected, only one simulation performed.
graphfile	Output a pdf or jpg image of each plot? 0 = no, 1 = pdf, 2 = jpeg. If yes, there will be no output to screen. Individual graphic files will be produced for each simluation, for assembling into a movie.

arcsinT *Arcsine Transformation of Stratigraphic Series*

Description

Arcsine transformation of stratigraphic series

Usage

```
arcsinT(dat,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for arcsine transformation. First column should be location (e.g., depth), second column should be data value for transformation.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

demean, detrend, divTrend, logT, prewhiteAR, and prewhiteAR1

armaGen *Generate Autoregressive Moving-average Model*

Description

Generate an Autoregressive Moving-average time series model

Usage

```
armaGen(npts=1024,dt=1,m=0,std=1,rhos=c(0.9),thetas=c(0),genplot=T,verbose=T)
```

Arguments

npts	Number of time series data points.
dt	Sampling interval.
m	Mean value of final time series.
std	Standard deviation of final time series.
rhos	Vector of AR coefficients for each order.
thetas	Vector of MA coefficients for each order.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

asm *Average Spectral Misfit*

Description

Calculate Average Spectral Misfit with Monte Carlo spectra simulations, as updated in Meyers et al. (2012).

Usage

```
asm(freq,target,fper=NULL,rayleigh,nyquist,sedmin=1,sedmax=5,numsed=50,
    linLog=1,iter=100000,output=F,genplot=T)
```

Arguments

freq	A vector of candidate astronomical cycles observed in your data spectrum (cycles/m). Maximum allowed is 500.
target	A vector of astronomical frequencies to evaluate (1/ka). These must be in order of increasing frequency (e.g., e1,e2,e3,o1,o2,p1,p2). Maximum allowed is 50 frequencies.
fper	A vector of uncertainties on each target frequency (1/ka). Values should be from 0-1, representing uncertainty as a percent of each target frequency. The order of the uncertainties must follow that of the target vector. By default, no uncertainty is assigned.
rayleigh	Rayleigh frequency (cycles/m).
nyquist	Nyquist frequency (cycles/m).
sedmin	Minimum sedimentation rate for investigation (cm/ka).
sedmax	Maximum sedimentation rate for investigation (cm/ka).
numsed	Number of sedimentation rates to investigate in ASM optimization grid. Maximum allowed is 500.
linLog	Use linear or logarithmic scaling for sedimentation rate grid spacing? (0=linear, 1=log)
iter	Number of Monte Carlo simulations for significance testing. Maximum allowed is 100,000.
output	Return output as a new data frame? (T or F)
genplot	Generate summary plots? (T or F)

Details

This function will caculate the Average Spectral Misfit between a data spectrum and astronomical target spectrum, following Meyers and Sageman (2007), and the improvements of Meyers et al. (2012).

Value

A data frame containing: Sedimentation rate (cm/ka), ASM (cycles/ka), Null hypothesis significance level (0-100 percent), Number of astronomical terms fit.

References

S.R. Meyers and B.B. Sageman, 2007, *Quantification of Deep-Time Orbital Forcing by Average Spectral Misfit*: American Journal of Science, v. 307, p. 773-792.

S.R. Meyers, B.B. Sageman and M.A. Arthur, 2012, *Obliquity forcing of organic matter accumulation during Oceanic Anoxic Event 2*: Paleoceanography, 27, PA3212, doi:10.1029/2012PA002286.

See Also

eAsm

Examples

```
## these frequencies are from modelA (type '?astrochron' for more information). Units are cycles/m
freq <- c(0.1599833,0.5332776,1.5998329,2.6797201,3.2796575,3.8795948,5.5194235,6.5459830)
freq <- data.frame(freq)

## Rayleigh frequency in cycles/m
rayleigh <- 0.1245274

## Nyquist frequency in cycles/m
nyquist <- 6.66597

## orbital target in 1/ky. Predicted periods for 94 Ma (see Meyers et al., 2012)
target <- c(1/405.47,1/126.98,1/96.91,1/37.66,1/22.42,1/18.33)

## percent uncertainty in orbital target
fper=c(0.023,0.046,0.042,0.008,0.035,0.004)

asm(freq=freq,target=target,fper=fper,rayleigh=rayleigh,nyquist=nyquist,sedmin=0.5,sedmax=3,
    numsed=100,linLog=1,iter=100000,output=FALSE)
```

---

autoPlot *Automatically plot stratigraphic series, with smoothing if desired*

Description

Automatically plot and smooth specified stratigraphic data, versus location. Data are smoothed with a Gaussian kernel.

Usage

```
autoPlot(dat,cols=NULL,nrows=NULL,smooth=0,xgrid=1,output=F,verbose=T)
```

Arguments

dat	Your data frame; first column should be location identifier (e.g., depth).
cols	A vector that identifies the columns to extract (first column automatically extracted).
nrows	Number of rows in figure.
smooth	Width (temporal or spatial dimension) for smoothing with a Gaussian kernel (0 = no smoothing); the Gaussian kernel is scaled so that its quartiles (viewed as probability densities, that is, containing 50 percent of the area) are at +/- 25 percent of this value.
xgrid	For kernal smoothing: (1) evaluate on ORIGINAL sample grid, or (2) evaluate on EVENLY SPACED grid covering range.
output	Output data frame of smoothed values? (T or F)
verbose	verbose output (T or F)

---

bandpass *Bandpass Filter Stratigraphic Series*

Description

Bandpass filter stratigraphic series using rectangular, Gaussian or tapered cosine window

Usage

```
bandpass(dat,padfac=2,flow=NULL,fhigh=NULL,win=0,alpha=3,p=0.25,demean=T,
         detrend=F,xmin=0,xmax=Nyq,addmean=T,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for bandpass filtering. First column should be location (e.g., depth), second column should be data value.
padfac	Pad with zeros to (padfac*npts) points, where npts is the original number of data points.
flow	Lowest frequency to bandpass.
fhigh	Highest frequency to bandpass.
win	Window type for bandpass filter: 0 = rectangular , 1= Gaussian, 2= Cosine-tapered window.
alpha	Gaussian window parameter: alpha is 1/stdev, a measure of the width of the Dirichlet kernel. Choose alpha >= 2.5.
p	Cosine-tapered window parameter: p is the percent of the data series tapered (choose 0-1).
demean	Remove mean from data series? (T or F)
detrend	Remove linear trend from data series? (T or F)

xmin	Smallest frequency for plotting.
xmax	Largest frequency for plotting.
addmean	Add mean value to bandpass result? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

Value

bandpassed stratigraphic series.

See Also

lowpass, noKernel, noLow, prewhiteAR, and prewhiteAR1

Examples

```
# generate example series with 3 precession terms and noise
ex <- cycles(noisevar=.0004,dt=5)
# bandpass precession terms using cosine-tapered window
res_ex <- bandpass(ex,flow=0.038,fhigh=0.057,win=2,p=.4)
```

---

bergerPeriods *Obliquity and Precession Periods of Berger et al. (1992)*

Description

Determine the predicted precession and obliquity periods based on Berger et al. (1992). Values are determined by piecewise linear interpolation.

Usage

```
bergerPeriods(age,genplot=T)
```

Arguments

age	Age (millions of years before present)
genplot	Generate summary plots? (T or F)

References

A. Berger, M.F. Loutre, and J. Laskar, 1992, *Stability of the Astronomical Frequencies Over the Earth's History for Paleoclimate Studies*: Science, v. 255, p. 560-566.

cb *Combine Multiple Vectors*

Description

Take any number of input vectors, bind the columns together, and return as a data.frame

Usage

```
cb(a,b)
```

Arguments

a	first input vector OR a data frame with >1 column.
b	second input vector OR if a is a data frame with > 1 column, a list of columns to bind.

Examples

```
# example dataset
x<-rnorm(100)
dim(x)<-c(10,10)
x<-data.frame(x)

# bind two columns
cb(x[1],x[5])

# bind five columns
cb(x,c(1,2,4,7,9))
```

clipIt *Create non-linear response by clipping stratigraphic series*

Description

Create non-linear response by clipping stratigraphic series below a threshold value. Alternatively, mute response below a threshold value using a contant divisor. Both approaches will enhance power in modulator (e.g., eccentricity) and diminish power the carrier (e.g., precession).

Usage

```
clipIt(dat,thresh=NULL,clipval=NULL,clipdiv=NULL,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series. First column should be location (e.g., depth), second column should be data value.
thresh	Clip below what theshold value? By default will clip at mean value.
clipval	What number should be assigned to the clipped values? By default, the value of thresh is used.
clipdiv	Clip using what divisor? A typical value is 2. By default, clipdiv is unity.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

---

constantSedrate *Apply a constant sedimentation rate model to transform a spatial series to temporal series*

Description

Apply a constant sedimentation rate model to transform a spatial series to temporal series.

Usage

```
constantSedrate(dat,sedrate,begin=0,timeDir=1,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series. First column should be location (e.g., depth), second column should be data value.
sedrate	Sedimentation rate, in same spatial units as dat.
begin	Time value to assign to first datum.
timeDir	Direction of floating time in tuned record: 1 = elapsed time increases with depth/height; -1 = elapsed time decreases with depth/height)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

cosTaper *Apply Cosine Taper to Stratigraphic Series*

Description

Apply a "percent-tapered" cosine taper (a.k.a. Tukey window) to a stratigraphic series.

Usage

```
cosTaper(dat,p=.25,rms=T,demean=T,detrend=F,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for tapering. First column should be location (e.g., depth), second column should be data value. If no data is identified, will output a 256 point taper to evaluate the spectral properties of the window.
p	Cosine-tapered window parameter: p is the percent of the data series tapered (choose 0-1). When p=1, this is equivalent to a Hann taper.
rms	Normalize taper to RMS=1 to preserve power for white process? (T or F)
demean	Remove mean from data series? (T or F)
detrend	Remove linear trend from data series? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

dpssTaper, gausTaper, and hannTaper

cycles *Generate Harmonic Model*

Description

Make a time series with specified harmonic components and noise

Usage

```
cycles(freqs=NULL,phase=NULL,amp=NULL,start=0,end=499,dt=1,noisevar=0,genplot=T,verbose=T)
```

Arguments

freqs	Vector with frequencies to model ('linear' frequencies).
phase	Vector with phases for each frequency (phase in radians). Phases are subtracted.
amp	Vector with amplitudes for each frequency.
start	First time/depth/height for output.
end	Last time/depth/height for output.
dt	Sampling interval.
noisevar	Variance of additive Gaussian noise.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

Value

modeled time series.

Examples

```
## test signal on pg 38 of Choudhury, Shah, and Thornhill (2008)
freqs=c(0.12,0.18,0.30,0.42)
phase=c(-pi/3,-pi/12,-pi/4,-3*pi/8)
amp=c(1,1,1,1)

cycles(freqs,phase,amp,start=0,end=4095,dt=1,noisevar=0.2)
```

---

delPts *Interactively Delete Points in Plot*

Description

Interactively delete points in x,y plot.

Usage

```
delPts(dat,ptsize=1,xmin=NULL,xmax=NULL,ymin=NULL,ymax=NULL,plotype=1)
```

Arguments

dat	Data frame with two columns
ptsize	Size of plotted points.
xmin	Minimum x-value (column 1) to plot
xmax	Maximum x-value (column 1) to plot
ymin	Minimum y-value (column 2) to plot
ymax	Maximum y-value (column 2) to plot
plotype	Type of plot to generate: 1= points and lines, 2 = points, 3 = lines

See Also

idPts, iso, trim and trimAT

---

demean *Remove Mean Value from Stratigraphic Series*

Description

Remove mean value from stratigraphic series

Usage

```
demean(dat,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for mean removal. First column should be location (e.g., depth), second column should be data value.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

arcsinT, detrend, divTrend, logT, prewhiteAR, and prewhiteAR1

---

detrend *Subtract Linear Trend from Stratigraphic Series*

Description

Remove linear trend from stratigraphic series

Usage

```
detrend(dat,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for linear detrending. First column should be location (e.g., depth), second column should be data value.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

arcsinT, demean, divTrend, logT, prewhiteAR, and prewhiteAR1

divTrend *Divide by Linear Trend in Stratigraphic Series*

Description

Divide data series value by linear trend observed in stratigraphic series

Usage

```
divTrend(dat,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for div-trending. First column should be location (e.g., depth), second column should be data value.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

arcsinT, demean, detrend, logT, prewhiteAR, and prewhiteAR1

dpssTaper *Apply DPSS Taper to Stratigraphic Series*

Description

Apply a single Discrete Prolate Spheroidal Sequence (DPSS) taper to a stratigraphic series

Usage

```
dpssTaper(dat,tbw=1,num=1,rms=T,demean=T,detrend=F,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for tapering. First column should be location (e.g., depth), second column should be data value. If no data is identified, will output a 256 point taper to evaluate the spectral properties of the window.
tbw	Time-bandwidth product for the DPSS
num	Which one of the DPSS would you like to use?
rms	Normalize taper to RMS=1 to preserve power for white process? (T or F)
demean	Remove mean from data series? (T or F)
detrend	Remove linear trend from data series? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

cosTaper, gausTaper, and hannTaper

---

eAsm *EXPERIMENTAL: Evolutive Average Spectral Misfit*

Description

EXPERIMENTAL: Calculate Evolutive Average Spectral Misfit with Monte Carlo spectra simulations, as updated in Meyers et al. (2012).

Usage

```
eAsm(spec,siglevel=0.9,target,fper=NULL,rayleigh,nyquist,sedmin=1,sedmax=5,numsed=50,
     linLog=1,iter=100000,ydir=1,output=4,genplot=F)
```

Arguments

spec	Time-frequency spectral results to evaluate. Must have the following format: column 1=frequency; remaining columns (2 to n)=probability; titles for columns 2 to n must be the location (depth or height). Note that this format is ouput by function eha.
siglevel	Threshold level for filtering peaks.
target	A vector of astronomical frequencies to evaluate (1/ka). These must be in order of increasing frequency (e.g., e1,e2,e3,o1,o2,p1,p2). Maximum allowed is 50 frequencies.
fper	A vector of uncertainties on each target frequency (1/ka). Values should be from 0-1, representing uncertainty as a percent of each target frequency. The order of the uncertainties must follow that of the target vector. By default, no uncertainty is assigned.
rayleigh	Rayleigh frequency (cycles/m).
nyquist	Nyquist frequency (cycles/m).
sedmin	Minimum sedimentation rate for investigation (cm/ka).
sedmax	Maximum sedimentation rate for investigation (cm/ka).
numsed	Number of sedimentation rates to investigate in ASM optimization grid. Maximum allowed is 500.
linLog	Use linear or logarithmic scaling for sedimentation rate grid spacing? (0=linear, 1=log)
iter	Number of Monte Carlo simulations for significance testing. Maximum allowed is 100,000.
ydir	Direction for y-axis in plots (depth or height). -1 = values increase downwards (slower plotting!), 1 = values increase upwards.
output	Return output as a new data frame? (0 = nothing, 1 = Ho-SL, 2 = ASM, 3 = # astronomical terms, 4 = everything)
genplot	Generate summary plots? (T or F)

Details

Please see function asm for details.

References

S.R. Meyers and B.B. Sageman, 2007, *Quantification of Deep-Time Orbital Forcing by Average Spectral Misfit*: American Journal of Science, v. 307, p. 773-792.

S.R. Meyers, 2012, *Seeing Red in Cyclic Stratigraphy: Spectral Noise Estimation for Astrochronology*: Paleoceanography, 27, PA3228, doi:10.1029/2012PA002307.

S.R. Meyers, B.B. Sageman and M.A. Arthur, 2012, *Obliquity forcing of organic matter accumulation during Oceanic Anoxic Event 2*: Paleoceanography, 27, PA3212, doi:10.1029/2012PA002286.

See Also

asm, eAsmTrack and eha

Examples

```
# use modelA as an example
data(modelA)

# interpolate to even sampling interval
modelAInterp=linterp(modelA)

# perform EHA analysis, save harmonic F-test confidence level results to 'spec'
spec=eha(modelAInterp,win=8,step=2,pad=1000,output=4)

# perform Evolutive Average Spectral Misfit analysis, save results to 'res'
res=eAsm(spec,target=c(1/405.47,1/126.98,1/96.91,1/37.66,1/22.42,1/18.33),rayleigh=0.1245274,
        nyquist=6.66597,sedmin=0.5,sedmax=3,numsed=100,siglevel=0.8,iter=10000,output=4)

# identify minimum Ho-SL in each record and plot
pl(1)
eAsmTrack(res[1],threshold=0.05)

# extract Ho-SL result at 18.23 m
HoSL18.23=extract(res[1],get=18.23,pl=1)

# extract ASM result at 18.23 m
asm18.23=extract(res[2],get=18.23,pl=0)
```

---

eAsmTrack — *EXPERIMENTAL: Track ASM Null Hypothesis significance level minima in eASM results*

Description

EXPERIMENTAL: Track ASM Null Hypothesis significance level minima in eASM results.

Usage

```
eAsmTrack(res,threshold=.5,ydir=-1,genplot=T,verbose=T)
```

Arguments

res	eAsm results. Must have the following format: column 1=sedimentation rate; remaining columns (2 to n)=Ho-SL; titles for columns 2 to n must be the location (depth or height). Note that this format is ouput by function eAsm.
threshold	Threshold Ho-SL value for analysis and plotting.
ydir	Direction for y-axis in plots (depth or height). -1 = values increase downwards (slower plotting!), 1 = values increase upwards.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

Details

Please see function eAsm for details.

---

eha *Evolutive Harmonic Analysis*

Description

Evolutive Harmonic Analysis using the Thomson Multitaper Method

Usage

```
eha(dat,tbw=2,pad,fmin,fmax,step,win,demean=T,detrend=T,siglevel=0.90,
    sigID=F,ydir=1,output=0,pl=1,xlab,ylab,genplot=2,verbose=T)
```

Arguments

dat	Stratigraphic series to analyze. First column should be location (e.g., depth), second column should be data value.
tbw	MTM time-bandwidth product (<=10)
pad	Pad with zeros to how many points? Must not factor into a prime number >23. Maximum number of points is 200,000.
fmin	Smallest frequency for analysis and plotting.
fmax	Largest frequency for analysis and plotting.
step	Step size for EHA window, in units of space or time.
win	Window size for EHA, in units of space or time.
demean	Remove mean from data series? (T or F)
detrend	Remove linear trend from data series? (T or F)

siglevel	Significance level for peak identification/filtering (0-1)
sigID	Identify signficant frequencies on power, amplitude, and probabilty plots. Only applies when one spectrum is calculated. (T or F)
ydir	Direction for y-axis in EHA plots (depth,height,time). -1 = values increase downwards (slower plotting), 1 = values increase upwards
output	Return output as new data frame? 0=no; 1=all results; 2=power; 3=amplitude; 4=probability; 5=significant frequencies (only for one spectrum); 6=significant frequencies and their probabilities (only for one spectrum)
pl	Plot logarithm of spectral power (1) or linear spectral power (2)?
xlab	Label for x-axis. Default = "Frequency"
ylab	Label for y-axis. Default = "Location"
genplot	Plotting options. 0= no plots; 1= power, amplitude, f-test, probability; 2=data series, power, amplitude, probability; 3= data series, power, normalized amplitude, filtered (at siglevel) and normalized amplitude
verbose	Verbose output? (T or F)

See Also

extract, trackFreq and traceFreq

Examples

```
## as an example, evaluate the modelA
data(modelA)

## interpolate to even sampling interval of 0.075 m
ex1=linterp(modelA, dt=0.075)

## perform EHA with a time-bandwidth parameter of 2, using an 7.95 meter window, 0.15 m step,
## and pad to 1000 points
## set labels for plots (optional)
eha(ex1,tbw=2,win=7.95,step=0.15,pad=1000,xlab="Frequency (cycles/m)",ylab="Height (m)")

## for comparison generate spectrum for entire record, using time-bandwidth parameter of 3, and
## pad to 5000 points
## start by making a new plot
pl(1)
eha(ex1,tbw=3,win=38,pad=5000,xlab="Frequency (cycles/m)")
```

---

etp *Generate Eccentricity-Tilt-Precession Models*

Description

Calculate eccentricity-tilt-precession time series using solutions from Laskar et al. (2004, 2011)

Usage

```
etp(laskar,tmin=0,tmax=1000,dt=1,eWt=1,oWt=1,pWt=1,sol=5,esinw=F,standardize=T,genplot=T,
    verbose=T)
```

Arguments

laskar	Laskar et al. (2004, 2011) astronomical solutions.
tmin	Start time (ka before present, J2000) for ETP.
tmax	End time (ka before present, J2000) for ETP.
dt	Sample interval for ETP (ka). Minimum = 1 ka.
eWt	Relative weight applied to eccentricity solution.
oWt	Relative weight applied to obliquity solution.
pWt	Relative weight applied to precession solution.
sol	Eccentricity solution to use: 1= LA10a, 2= LA10b, 3= LA10c, 4= LA10d, 5= LA04.
esinw	Use esinw in ETP calculation? (T or F).
standardize	Standardize (subtract mean, divide by standard deviation) precession, obliquity and eccentricity series before applying weight and combining? (T or F)
genplot	Generate summary plots? (T or F).
verbose	Verbose output? (T or F).

Value

Eccentricity + tilt + precession.

References

Laskar, J., Robutel, P., Joutel, F., Gastineau, M., Correia, A.C.M., Levrard, B., 2004, *A long term numerical solution for the insolation quantities of the Earth*: Astron. Astrophys., Volume 428, 261-285.

Laskar, J., Fienga, A., Gastineau, M., Manche, H., 2011, *La2010: A new orbital solution for the long-term motion of the Earth*: Astron. Astrophys., Volume 532, A89.

---

extract *Extract record from EHA time-frequency output or eAsm output*

Description

Extract record from EHA time-frequency output or eAsm output: Use interactive graphical interface to identify record.

Usage

```
extract(spec,get=NULL,xmin=NULL,xmax=NULL,ymin=NULL,ymax=NULL,h=6,w=4,ydir=-1,pl=0,
        ncolors=100,genplot=T,verbose=T)
```

Arguments

spec	Time-frequency spectral results to evaluate, or alternatively, eAsm results to evaluate. For time-frequency results, must have the following format: column 1=frequency; remaining columns (2 to n)=power, amplitude or probability; titles for columns 2 to n must be the location (depth or height). Note that this format is ouput by function eha. For eAsm results, must have the following format: column 1=sedimentation rate; remaining columns (2 to n)=Ho-SL or ASM; titles for columns 2 to n must be the location (depth or height).
get	Record to extract (height/depth/time). If no value given, graphical interface is activated.
xmin	Minimum frequency or sedimentation rate for PLOTTING.
xmax	Maximum frequency or sedimentation rate for PLOTTING.
ymin	Minimum depth/height for PLOTTING.
ymax	Maximum depth/height for PLOTTING.
h	Height of plot in inches.
w	Width of plot in inches.
ydir	Direction for y-axis in plots (depth or height). -1 = values increase downwards (slower plotting!), 1 = values increase upwards.
pl	An option for the color plots (0=do nothing; 1=plot log of value [useful for plotting power], 2=normalize to maximum value [useful for plotting amplitude]).
ncolors	Number of colors to use in plot.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

eha

---

flip *Flip stratigraphic series*

Description

Flip the stratigraphic order of your data series (e.g., convert stratigraphic depth series to height series, relative to a defined datum.)

Usage

```
flip(dat,begin=0,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series. First column should be location (e.g., depth), second column should be data value.
begin	Depth/height value to assign to (new) first stratigraphic datum.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

---

freq2sedrate *Convert record of local spatial frequency (from EHA) to sedimentation rate curve*

Description

Convert record of local spatial frequency (from EHA) to sedimentation rate curve

Usage

```
freq2sedrate(freqs,period=NULL,ydir=1,genplot=T,verbose=T)
```

Arguments

freqs	Data frame containing depth/height in first column (meters) and spatial frequencies in second column (cycles/m)
period	Temporal period of spatial frequency (ka)
ydir	Direction for y-axis in plots (depth,height). -1 = values increase downwards (slower), 1 = values increase upwards
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

---

gausTaper *Apply Gaussian Taper to Stratigraphic Series*

Description

Apply a Gaussian taper to a stratigraphic series

Usage

```
gausTaper(dat,alpha=3,rms=T,demean=T,detrend=F,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for tapering. First column should be location (e.g., depth), second column should be data value. If no data is identified, will output a 256 point taper to evaluate the spectral properties of the window.
alpha	Gaussian window parameter: alpha is 1/stdev, a measure of the width of the Dirichlet kernel. Larger values decrease the width of data window, reduce discontinuities, and increase width of the transform. Choose alpha >= 2.5.
rms	Normalize taper to RMS=1 to preserve power for white process? (T or F)
demean	Remove mean from data series? (T or F)
detrend	Remove linear trend from data series? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

References

Harris, 1978, *On the use of windows for harmonic analysis with the discrete Fourier transform*: Proceedings of the IEEE, v. 66, p. 51-83.

See Also

cosTaper, dpssTaper, and hannTaper

---

getColor *Query R for color information*

Description

Query R for color information.

Usage

```
getColor(color)
```

Arguments

color	The name of the color you are interested in, in quotes.

hannTaper *Apply Hann Taper to Stratigraphic Series*

Description

Apply a Hann (Hanning) taper to a stratigraphic series

Usage

```
hannTaper(dat,rms=T,demean=T,detrend=F,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for tapering. First column should be location (e.g., depth), second column should be data value. If no data is identified, will output a 256 point taper to evaluate the spectral properties of the window.
rms	Normalize taper to RMS=1 to preserve power for white process? (T or F)
demean	Remove mean from data series? (T or F)
detrend	Remove linear trend from data series? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

cosTaper, dpssTaper, and gausTaper

headn *List Column Numbers for Each Variable*

Description

Execute 'head' function, with column numbers indicated for each variable. (useful for functions such as 'autopl')

Usage

```
headn(dat)
```

Arguments

dat	Your data frame.

`hilbert` *Hilbert Transform of Stratigraphic Series*

Description

Calculate instantaneous amplitude via Hilbert Transform of stratigraphic series

Usage

```
hilbert(dat,padfac=2,demean=T,detrend=F,output=T,outave=F,xmin,xmax,genplot=T,verbose=T)
```

Arguments

`dat`	Stratigraphic series to Hilbert Transform. First column should be location (e.g., depth), second column should be data value.
`padfac`	Pad with zeros to (padfac*npts) points, where npts is the original number of data points.
`demean`	Remove mean from data series? (T or F)
`detrend`	Remove linear trend from data series? (T or F)
`output`	Return results as new data frame? (T or F)
`outave`	Add mean value to instantaneous amplitude? (T or F)
`xmin`	Smallest frequency for plotting.
`xmax`	Largest frequency for plotting.
`genplot`	Generate summary plots? (T or F)
`verbose`	Verbose output? (T or F)

References

A.E. Barnes, 1992, *The calculation of instantaneous frequency and instantaneous bandwidth*: Geophysics, v. 57, p. 1520-1524.

Examples

```
# generate example series with 3 precession terms and noise
ex <- cycles(noisevar=.0004,dt=5)
# bandpass precession terms using cosine-tapered window
res_ex <- bandpass(ex,flow=0.038,fhigh=0.057,win=2,p=.4)
# hilbert transform
hil_ex <- hilbert(res_ex)
```

idPts *Interactively Identify Points in Plot*

Description

Interactively identify points in x,y plot.

Usage

```
idPts(dat1,dat2=NULL,ptsize=1,xmin=NULL,xmax=NULL,ymin=NULL,ymax=NULL,plotype=1,output=F,
      verbose=T)
```

Arguments

dat1	Data frame with one or two columns. If one column, dat2 must also be specified.
dat2	Data frame with one column.
ptsize	Size of plotted points.
xmin	Minimum x-value (column 1) to plot
xmax	Maximum x-value (column 1) to plot
ymin	Minimum y-value (column 2) to plot
ymax	Maximum y-value (column 2) to plot
plotype	Type of plot to generate: 1= points and lines, 2 = points, 3 = lines
output	Return identified points as a data frame? (T of F)
verbose	Verbose output? (T or F)

See Also

delPts, iso, trim and trimAT

iso *Isolate Data from a Specified Stratigraphic Interval*

Description

Isolate a section of a uni- or multi-variate stratigraphic data set for further analysis

Usage

```
iso(dat,xmin,xmax,col=2,genplot=T,verbose=T)
```

Arguments

dat	Data frame containing stratigraphic variable(s) of interest. First column must be location (e.g., depth).
xmin	Minimum depth/height/time for isolation. If xmin is not specified, it will be selected using a graphical interface.
xmax	Maximum depth/height/time for isolation. If xmax is not specified, it will be selected using a graphical interface.
col	If you are using the graphical interface to select xmin/xmax, which column would you like to plot? (default = 2).
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

delPts, idPts, trim and trimAT

---

linage *Tune stratigraphic series to an astronomical target using graphical interface*

Description

Tune stratigraphic series to an astronomical target using graphical interface similar to Analyseries 'Linage' routine (Paillard et al, 1996).

Usage

```
linage(dat,target,extrapolate=F,xmin=NULL,xmax=NULL,tmin=NULL,tmax=NULL,plotype=1,
       output=1,genplot=T)
```

Arguments

dat	Stratigraphic series for tuning, with two columns. First column is depth/height.
target	Astronomical tuning target series. First column is time.
extrapolate	Extrapolate sedimentation rates above and below 'tuned' interval? (T or F)
xmin	Minimum height/depth to plot.
xmax	Maximum height/depth to plot.
tmin	Minimum time value to plot.
tmax	Maximum time value to plot.
plotype	Type of plot to generate: 1= points and lines, 2 = points, 3 = lines
output	Return which of the following? 1 = tuned stratigraphic series; 2 = age control points; 3 = tuned stratigraphic series and age control points
genplot	Generate additional summary plots (tuned record, time-space map, sedimentation rates)? (T or F)

References

Paillard, D., L. Labeyrie and P. Yiou, 1996), *Macintosh program performs time-series analysis*: Eos Trans. AGU, v. 77, p. 379.

Examples

```
# generate example series with 3 precession terms and noise using function 'cycles'
# then convert from time to space using sedimentation rate that increases from 1 to 7 cm/ka
ex=sedRamp(cycles(start=1,end=400, dt=2,noisevar=.00005),srstart=0.01,srend=0.07)

# create astronomical target series
targ=cycles(start=1,end=400,dt=2)

## manually tune
#tuned=linage(ex,targ)

## should you need to flip the direction of the astronomical target series, use function 'cb':
#tuned=linage(ex,cb(targ[1]*-1,targ[2]))
```

`linterp` *Piecewise Linear Interpolation of Stratigraphic Series*

Description

Interpolate stratigraphic series onto a envenly sampled grid, using piecewise linear interpolation

Usage

```
linterp(dat,dt,start,genplot=T,verbose=T)
```

Arguments

`dat`	Stratigraphic series for piecewise linear interpolation. First column should be location (e.g., depth), second column should be data value.
`dt`	New sampling interval.
`start`	Start interpolating at what time/depth/height value? By default, the first value of the stratigraphic series will be used.
`genplot`	Generate summary plots? (T or F)
`verbose`	Verbose output? (T or F)

logT *Log Transformation of Stratigraphic Series*

Description

Log transformation of stratigraphic series.

Usage

```
logT(dat,c=0,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for log transformation. First column should be location (e.g., depth), second column should be data value for transformation.
c	Constant to add prior to log transformation. Default = 0.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

arcsinT, demean, detrend, divTrend, prewhiteAR, and prewhiteAR1

lowpass *Lowpass Filter Stratigraphic Series*

Description

Lowpass filter stratigraphic series using rectangular, Gaussian or tapered cosine window [cosine window is experimental]

Usage

```
lowpass(dat,padfac=2,fcut=NULL,win=0,demean=T,detrend=F,alpha=3,p=0.25,xmin=0,xmax=Nyq,
        addmean=T,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for lowpass filtering. First column should be location (e.g., depth), second column should be data value.
padfac	Pad with zeros to (padfac*npts) points, where npts is the original number of data points.
fcut	Cutoff frequency for lowpass filtering.

win	Window type for bandpass filter: 0 = rectangular , 1= Gaussian, 2= Cosine-tapered window.
demean	Remove mean from data series? (T or F)
detrend	Remove linear trend from data series? (T or F)
alpha	Gaussian window parameter: alpha is 1/stdev, a measure of the width of the Dirichlet kernal. Larger values decrease the width of data window, reduce discontinuities, and increase width of the transform. Choose alpha >= 2.5.
p	Cosine-tapered window parameter: p is the percent of the data series tapered (choose 0-1).
xmin	Smallest frequency for plotting.
xmax	Largest frequency for plotting.
addmean	Add mean value to bandpass result? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

bandpass, noKernel, noLow, prewhiteAR, and prewhiteAR1

---

lowspec *Robust Locally-Weighted Regression Spectral Background Estimation*

Description

LOWSPEC: Robust Locally-Weighted Regression Spectral Background Estimation

Usage

```
lowspec(dat,decimate=NULL,tbw=3,padfac=5,detrend=F,siglevel=0.9,xmin,xmax,
        setrho,lowspan,b_tun,output=0,sigID=T,pl=1,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for LOWSPEC. First column should be location (e.g., depth), second column should be data value.
decimate	Decimate statigraphic series to have this sampling interval (via piecewise linear interpolation). By default, no decimation is performed.
tbw	MTM time-bandwidth product (2 or 3 permitted)
padfac	Pad with zeros to (padfac*npts) points, where npts is the original number of data points.
detrend	Remove linear trend from data series? This detrending is performed following AR1 prewhitening. (T or F)
siglevel	Significance level for peak identification.

xmin	Smallest frequency for plotting.
xmax	Largest frequency for plotting.
setrho	Define AR1 coefficient if desired (otherwise calculated).
lowspan	Span for LOWESS smoothing of prewhitened signal, usually fixed to 1. If using value <1, method is overly conservative with reduced false positive rate.
b_tun	Robustness weight parameter for LOWSPEC.
output	What should be returned as a data frame? (0=nothing; 1=spectrum + CLs; 2=sig peaks; 3=PDF image)
sigID	Identify signficant frequencies on power and probabilty plots? (T or F)
pl	Plot logarithm of spectral power (1) or linear spectral power (2)?
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

Details

LOWSPEC is a 'robust' method for spectral background estimation, designed for the identification of potential astronomical signals that are imbedded in red noise (Meyers, 2012). The complete algoritm implemented here is as follows: (1) initial pre-whitening with AR1 filter (default) or other filter as appropriate (see function prewhiteAR), (2) power spectral estimation via the multitaper method (Thomson, 1982), (3) robust locally weighted estimation of the spectral background using the LOWESS-based (Cleveland, 1979) procedure of Ruckstuhl et al. (2001), (4) assignment of confidence levels using a Chi-square distribution.

Candidiate astronomical cycles are subsequently idenitified via isolation of those frequencies that achieve the required (e.g., 90 percent) LOWSPEC confidence level and MTM harmonic F test confidence level. Allowance is made for the smoothing inherent in the MTM power spectral estimate as compared to the MTM harmonic spectrum. That is, an F test peak is reported if it achieves the required MTM harmonic confidence level, while also achieving the required LOWSPEC confidence level within +/- half the power spectrum bandwidth resolution. One additional criterion is included to further reduce the false positive rate, a requirement that significant F tests must occur on a local power spectrum high, which is parameterized as occurring above the local LOWSPEC background estimate. See Meyers (2012) for futher information on the algorithm.

In this implementation, the 'robustness criterion' ('b' in EQ. 6 of Ruckstuhl et al., 2001) has been optimized for 2 and 3 pi DPSS, using a 'span' of 1. By default the robustness criterion will be estimated. Both 'b' and the 'span' can be expliclty set using parameters 'b_tun' and 'lowspan'. Note that it is permissible to decrease 'lowspan' from its default value, but this will result in an overly conservative false positive rate. However, it may be necessary to reduce 'lowspan' to provide an approporiate background fit for some stratigraphic data. Another option is to decimate the data series prior to spectral estimation.

Value

If option 1 is selected, a data frame containing the following is returned: Frequency, Prewhitened power, LOWSPEC background, LOWSPEC CL, F-test CL.

If option 2 is selected, the 'significant' frequencies are returned (as described above).

If option 3 is selected, the graphics are output to a PDF file.

References

W.S. Cleveland, 1979, *Locally weighted regression and smoothing scatterplots*: Journal of the American Statistical Association, v. 74, p. 829-836.

S.R. Meyers, 2012, *Seeing Red in Cyclic Stratigraphy: Spectral Noise Estimation for Astrochronology*: Paleoceanography, 27, PA3228, doi:10.1029/2012PA002307.

A.F. Ruckstuhl, M.P Jacobson, R.W. Field, and J.A. Dodd, 2001, *Baseline subtraction using robust local regression estimation*: Journal of Quantitative Spectroscopy & Radiative Transfer, v. 68, p. 179-193.

D.J. Thomson, 1982, *Spectrum estimation and harmonic analysis*: IEEE Proceedings, v. 70, p. 1055-1096.

See Also

spec.mtm, baseline, mtm, and periodogram

Examples

```
# generate example series with periods of 400 ka, 100 ka, 40 ka and 20 ka
ex = cycles(freqs=c(1/400,1/100,1/40,1/20),start=1,end=1000,dt=5)

# add AR1 noise
noise = ar1(npts=200,dt=5,sd=.5)
ex[2] = ex[2] + noise[2]

# LOWSPEC analysis
#lowspec(ex)
```

---

modelA *Example stratigraphic model series*

Description

Example stratigraphic model series.

Usage

```
modelA
```

Format

Height (meters), weight percent CaCO3

mtm *Multitaper Method Spectral Analysis*

Description

Multitaper Method (MTM) Spectral Analysis

Usage

```
mtm(dat,tbw=3,padfac=5,demean=T,detrend=F,siglevel=0.9,xmin,xmax,ar1=F,output=0,sigID=F,
    pl=1,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for MTM spectral analysis. First column should be location (e.g., depth), second column should be data value.
tbw	MTM time-bandwidth product.
padfac	Pad with zeros to (padfac*npts) points, where npts is the original number of data points.
demean	Remove mean from data series? (T or F)
detrend	Remove linear trend from data series? (T or F)
siglevel	Significance level for peak identification.
xmin	Smallest frequency for plotting.
xmax	Largest frequency for plotting.
ar1	Estimate conventional AR(1) noise spectrum and confidence levels? (T or F)
output	What should be returned as a data frame? (0=nothing; 1=spectrum + CLs; 2=sig peak freqs; 3=sig peak freqs + prob; 4=all)
sigID	Identify signficant frequencies on power and probabilty plots? (T or F)
pl	Plot logarithm of spectral power (1) or linear spectral power (2)?
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

References

Thomson, D. J., 1982, *Spectrum estimation and harmonic analysis*, Proc. IEEE, 70, 1055-1096, doi:10.1109/PROC.1982.12433.

See Also

spec.mtm, lowspec, and periodogram

Examples

```
# generate example series with periods of 400 ka, 100 ka, 40 ka and 20 ka
ex = cycles(freqs=c(1/400,1/100,1/40,1/20),start=1,end=1000,dt=5)

# add AR1 noise
noise = ar1(npts=200,dt=5,sd=.5)
ex[2] = ex[2] + noise[2]

# MTM spectral analysis, with conventional AR1 noise test
mtm(ex,ar1=TRUE)
```

---

noKernel *Remove Gaussian Kernel Smoother from Stratigraphic Series*

Description

Estimate trend and remove from stratigraphic series using a Gaussian kernel smoother

Usage

```
noKernel(dat,smooth=0.1,sort=F,output=1,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for smoothing. First column should be location (e.g., depth), second column should be data value.
smooth	Degree of smoothing with a Gaussian kernal (0 = no smoothing); for a value of 0.5, the kernel is scaled so that its quartiles (viewed as prob densities) are at +/- 25 percent of the data series length. Must be > 0.
sort	Sort data into increasing depth (required for ksmooth)? (T or F)
output	1= output residual values; 2= output Gaussian kernel smoother.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

bandpass, lowpass, noLow, prewhiteAR, and prewhiteAR1

noLow *Fit and Remove Lowess Smoother from Stratigraphic Series*

Description

Fit and remove lowess smoother from stratigraphic series

Usage

```
noLow(dat,smooth=.20,output=1,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for lowess smoother removal. First column should be location (e.g., depth), second column should be data value.
smooth	Lowess smoothing parameter.
output	1= output residual values; 2= output lowess fit
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

bandpass, lowpass, noKernel, prewhiteAR, and prewhiteAR1

pad *Pad Stratigraphic Series with Zeros*

Description

Pad Stratigraphic Series with Zeros ("zero padding")

Usage

```
pad(dat,zeros,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for mean removal. First column should be location (e.g., depth), second column should be data value.
zeros	Number of zeros to add on the end of the series. By default, the number of points will be doubled.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

peak *Identify maxima of peaks in series, filter at desired threshold value*

Description

Identify maxima of peaks in any 1D or 2D series, filter at desired threshold value.

Usage

```
peak(dat,level,genplot=T,verbose=T)
```

Arguments

dat	1 or 2 dimensional series. If 2 dimesions, first column should be location (e.g., depth), second column should be data value.
level	Threshold level for filtering peaks. By default all peak maxima reported.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

periodogram *Simple Periodogram*

Description

Calculate periodogram for stratigraphic series

Usage

```
periodogram(dat,padfac=2,demean=T,detrend=F,xmin=0,xmax=Nyq,pl=1,output=0,f0=F,genplot=T,
            verbose=T)
```

Arguments

dat	Stratigraphic series to analyze. First column should be location (e.g., depth), second column should be data value.
padfac	Pad with zeros to (padfac*npts) points, where npts is the original number of data points.
demean	Remove mean from data series? (T or F)
detrend	Remove linear trend from data series? (T or F)
xmin	Smallest frequency for plotting.
xmax	Largest frequency for plotting.
pl	Power spectrum plotting: 1 = log power, 2 = linear power

output	Return output as new data frame? (0= no; 1= frequency,amplitude,power,phase; 2= frequency,real coeff.,imag. coeff)
f0	Return results for the zero frequency? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

mtm and lowspec

Examples

```
# ***** PART 1: Demonstrate the impact of tapering
# generate example series with 10 periods: 100, 40, 29, 21, 19, 14, 10, 5, 4 and 3 ka.
ex=cycles(c(1/100,1/40,1/29,1/21,1/19,1/14,1/10,1/5,1/4,1/3),
   amp=c(1,.75,0.01,.5,.25,0.01,0.1,0.05,0.001,0.01))

# set zero padding amount for spectral analyses
# (pad= 1 results in no padding, pad = 2 will pad the series to two times its original length)
# start with pad = 1, then afterwards evaluate pad=2
pad=1

# calculate the periodogram with no tapering applied (a "rectangular window")
res=periodogram(ex,output=1,padfac=pad)

# save the frequency grid and the power for plotting
freq=res[1]
pwr_rect=res[3]

# now compare with results obtained after applying four different tapers: Hann, % cosine
# taper, DPSS with a time-bandwidth product of 1, and DPSS with a time-bandwidth product of 3
pwr_hann=periodogram(hannTaper(ex,demean=FALSE),output=1,padfac=pad)[3]
pwr_cos=periodogram(cosTaper(ex,p=.3,demean=FALSE),output=1,padfac=pad)[3]
pwr_dpss1=periodogram(dpssTaper(ex,tbw=1,demean=FALSE),output=1,padfac=pad)[3]
pwr_dpss3=periodogram(dpssTaper(ex,tbw=3,demean=FALSE),output=1,padfac=pad)[3]

# now plot the results
ymin=min(rbind (log(pwr_rect[,1]),log(pwr_hann[,1]),log(pwr_cos[,1]),log(pwr_dpss1[,1]),
     log(pwr_dpss3[,1]) ))

ymax=max(rbind (log(pwr_rect[,1]),log(pwr_hann[,1]),log(pwr_cos[,1]),log(pwr_dpss1[,1]),
     log(pwr_dpss3[,1]) ))

pl(2)
plot(freq[,1],log(pwr_rect[,1]),type="l",ylim=c(ymin,ymax),lwd=2,ylab="log(Power)",
   xlab="Frequency (cycles/ka)",main="Comparison of rectangle (black), cosine (blue)
   and Hann (orange) taper",cex.main=1)
lines(freq[,1],log(pwr_hann[,1]),col="orange",lwd=2)
lines(freq[,1],log(pwr_cos[,1]),col="blue")
points(c(1/100,1/40,1/29,1/21,1/19,1/14,1/10,1/5,1/4,1/3),rep(ymax,10),cex=.5,col="purple")
plot(freq[,1],log(pwr_rect[,1]),type="l",ylim=c(ymin,ymax),lwd=2,ylab="log(Power)",
```

```
     xlab="Frequency (cycles/ka)",
    main="Comparison of rectangle (black), 1pi DPSS (green) and 3pi DPSS (red) taper",cex.main=1)
lines(freq[,1],log(pwr_dpss1[,1]),col="green")
lines(freq[,1],log(pwr_dpss3[,1]),col="red",lwd=2)
points(c(1/100,1/40,1/29,1/21,1/19,1/14,1/10,1/5,1/4,1/3),rep(ymax,10),cex=.5,col="purple")


# ***** PART 2: Now add a very small amount of red noise to the series (with lag-1
# correlation = 0.5)
ex2=ex
ex2[2]=ex2[2]+ar1(rho=.5,dt=1,npts=500,sd=.005,genplot=FALSE)[2]

# compare the original series with the series+noise
pl(2)
plot(ex,type="l",lwd=2,lty=3,col="black",xlab="time (ka)",ylab="signal",
     main="signal (black dotted) and signal+noise (red)"); lines(ex2,col="red")
plot(ex[,1],ex2[,2]-ex[,2],xlab="time (ka)",ylab="difference",
     main="Difference between the two time series (very small!)")

# calculate the periodogram with no tapering applied (a "rectangular window")
res.2=periodogram(ex2,output=1,padfac=pad)

# save the frequency grid and the power for plotting
freq.2=res.2[1]
pwr_rect.2=res.2[3]

# now compare with results obtained after applying four different tapers: Hann, % cosine taper,
# DPSS with a time-bandwidth product of 1, and DPSS with a time-bandwidth product of 3
pwr_hann.2=periodogram(hannTaper(ex2,demean=FALSE),output=1,padfac=pad)[3]
pwr_cos.2=periodogram(cosTaper(ex2,p=.3,demean=FALSE),output=1,padfac=pad)[3]
pwr_dpss1.2=periodogram(dpssTaper(ex2,tbw=1,demean=FALSE),output=1,padfac=pad)[3]
pwr_dpss3.2=periodogram(dpssTaper(ex2,tbw=3,demean=FALSE),output=1,padfac=pad)[3]

# now plot the results
ymin=min(rbind (log(pwr_rect.2[,1]),log(pwr_hann.2[,1]),log(pwr_cos.2[,1]),log(pwr_dpss1.2[,1]),
     log(pwr_dpss3.2[,1]) ))
ymax=max(rbind (log(pwr_rect.2[,1]),log(pwr_hann.2[,1]),log(pwr_cos.2[,1]),log(pwr_dpss1.2[,1]),
    log(pwr_dpss3.2[,1]) ))

pl(2)
plot(freq.2[,1],log(pwr_rect.2[,1]),type="l",ylim=c(ymin,ymax),lwd=2,ylab="log(Power)",
     xlab="Frequency (cycles/ka)",
    main="Comparison of rectangle (black), 30 cosine (blue) and Hann (orange) taper",cex.main=1)
lines(freq.2[,1],log(pwr_hann.2[,1]),col="orange",lwd=2)
lines(freq.2[,1],log(pwr_cos.2[,1]),col="blue")
points(c(1/100,1/40,1/29,1/21,1/19,1/14,1/10,1/5,1/4,1/3),rep(ymax,10),cex=.5,col="purple")

plot(freq.2[,1],log(pwr_rect.2[,1]),type="l",ylim=c(ymin,ymax),lwd=2,ylab="log(Power)",
     xlab="Frequency (cycles/ka)",
    main="Comparison of rectangle (black), 1pi DPSS (green) and 3pi DPSS (red) taper",cex.main=1)
lines(freq.2[,1],log(pwr_dpss1.2[,1]),col="green")
lines(freq.2[,1],log(pwr_dpss3.2[,1]),col="red",lwd=2)
points(c(1/100,1/40,1/29,1/21,1/19,1/14,1/10,1/5,1/4,1/3),rep(ymax,10),cex=.5,col="purple")
```

pl *Set Up Plots*

Description

Open new device and set up for multiple plots, output to screen or PDF if desired.

Usage

```
pl(n,r,c,h,w,mar,file)
```

Arguments

n	Number of plots per page (1-25). When specified, this parameter takes precedence, and options r and c are ignored.
r	Number of rows of plots.
c	Number of columns of plots.
h	Height of new page (a.k.a. "device").
w	Width of new page (a.k.a. "device").
mar	A numerical vector of the form c(bottom, left, top, right) which gives the margin size specified in inches.
file	PDF file name, in quotes. If a file name is not designated, then the plot is output to the screen instead.

plotEha *Create color time-frequency plots from eha results*

Description

Create color time-frequency plots from eha results.

Usage

```
plotEha(spec,xmin=NULL,xmax=NULL,ymin=NULL,ymax=NULL,h=6,w=4,ydir=1,pl=0,norm=NULL,
       xaxis=c("Frequency (cycles/ka)"),yaxis=c("Time (ka)"),ncolors=100,colorscale=F,
         filetype=0,output=T,verbose=T)
```

Arguments

spec	Time-frequency spectral results to evaluate. Must have the following format: column 1=frequency; remaining columns (2 to n)=power, amplitude or probability; titles for columns 2 to n must be the location (depth or height). Note that this format is ouput by function eha.
xmin	Minimum frequency for PLOTTING.
xmax	Maximum frequency for PLOTTING.
ymin	Minimum depth/height for PLOTTING.
ymax	Maximum depth/height for PLOTTING.
h	Height of plot in inches.
w	Width of plot in inches.
ydir	Direction for y-axis in plots (depth or height). -1 = values increase downwards (slower plotting!), 1 = values increase upwards.
pl	An option for the color plots (0=do nothing; 1=plot log of value [useful for plotting power], 2=normalize to maximum value [useful for plotting amplitude], 3=use normalization provided in norm.
norm	Optional amplitude normalization divisor, consisting of a single column dataframe. This option is provided in case you'd like to normalize a set of EHA results using the same scheme (e.g., before and after removal of spectral lines).
xaxis	Label for x-axis.
yaxis	Label for y-axis.
ncolors	Number of colors to use in plot.
colorscale	Include a color scale in the plot? (T or F)
filetype	Generate .pdf, .jpeg or .png file? (0=no; 1=pdf; 2=jpeg; 3=png)
output	If amplitude is normalized (pl = 2), output normalization used? (T or F)
verbose	Verbose output? (T or F)

---

plS *Set default plotting parameters for vertical stratigraphic plots*

Description

Set default plotting parameters for vertical stratigraphic plots. This is ususally invoked after function pl.

Usage

```
plS(f=T,s=1)
```

Arguments

f	Are you plotting the first (leftmost) stratigraphic plot? (T or F)
s	Size of the symbols and text on plot. Default = 1

prewhiteAR *Prewhiten Stratigraphic Series with Autoregressive Filter, Order Selected by Akaike Information Criterion*

Description

Prewhiten stratigraphic series using autoregressive (AR) filter. Appropriate AR order can be automatically determined using the Akaike Information Criterion, or alternatively, the order may be predefined.

Usage

```
prewhiteAR(dat,order=0,method="mle",aic=T,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for prewhitening. First column should be location (e.g., depth), second column should be data value for prewhitening. Series must have uniform sampling interval.
order	AR order for prewhitening (if aic=F), or alternatively, the maximum AR order to investigate (if aic=T). If order is set to <=0, will evaluate up to maximum default order (this varies based on method).
method	Method for AR parameter estimation: ("yule-walker", "burg", "ols", "mle", "yw")
aic	Select model using AIC? if F, will use order. AIC is only strictly valid if method is "mle".
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

References

Akaike, H. (1974), *A new look at the statistical model identification*, IEEE Trans. Autom. Control, 19, 716-723, doi:10.1109/TAC.1974.1100705.

See Also

ar, arcsinT, bandpass, demean, detrend, divTrend, logT, lowpass, noKernel, and prewhiteAR1

prewhiteAR1 *Prewhiten Stratigraphic Series with AR1 filter, using 'Standard' or Unbiased Estimate of rho*

Description

Prewhiten stratigraphic series using autoregressive-1 (AR1) filter. Rho can be estimated using the 'standard' approach, or following a bias correction.

Usage

```
prewhiteAR1(dat,setrho=NULL,bias=F,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for prewhitening. First column should be location (e.g., depth), second column should be data value for prewhitening. Series must have uniform sampling interval.
setrho	Specified lag-1 correlation coefficient (rho). By default, rho is calculated.
bias	Calculate unbiased estimate of rho, as in Mudelsee (2010, eq. 2.45). (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

References

M. Mudelsee, 2010, *Climate Time Series Analysis: Classical Statistical and Bootstrap Methods*, 474 pp., Springer, Dordrecht, Netherlands.

See Also

arcsinT, bandpass, demean, detrend, divTrend, logT, lowpass, noKernel, and prewhiteAR

rankSeries *Create lithofacies rank series from bed thickness data*

Description

Create lithofacies rank series from bed thickness data.

Usage

```
rankSeries(dat,dt,genplot=T,verbose=T)
```

Arguments

dat	First column should be bed thickness, and second column should bed lithofacies rank.
dt	Sampling interval for piecewise linear interpolation.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

Examples

```
# generate example series with random bed thicknesses
exThick=rnorm(n=20,mean=10,sd=2)
# assign alternating rank of 1 and 2
rank=double(20)
rank[seq(from=1,to=19,by=2)] <- 1
rank[seq(from=2,to=20,by=2)] <- 2

# combine into a dataframe
ex=cb(exThick,rank)

# generate lithofacies rank series
rankSeries(ex)
```

---

read *Read Data from File*

Description

Read stratigraphic data series from a file, either tab-delimited or CSV. First column must contain location data (depth, height, time). The function will remove missing entries, sort by location, average duplicate values, and generate summary plots.

Usage

```
read(d=1,h="auto",srt=T,ave=T,genplot=T)
```

Arguments

d	What column delimiter is used? (0 = tab/.txt, 1 = comma/.csv). CSV is the default option, which interfaces well with EXCEL.
h	Does the data file have column titles/headers? ("yes", "no", "auto"). "auto" will auto detect column titles/headers, which must be single strings and start with a character.
srt	Sort data values by first column? (T or F)
ave	Average duplicate values? (T or F). Only applies if input file has 2 columns
genplot	generate summary plots (T or F).

Details

Missing values (in the file that you are reading from) should be indicated by 'NA'. If you have included characters in the column titles that are not permitted by R, they will be modified!

---

readMatrix *Read Data Matrix from File*

Description

Read data matrix from a file, either tab-delimited or CSV.

Usage

```
readMatrix(d=1,h="auto",output=1,genplot=T)
```

Arguments

d	What column delimiter is used? (0 = tab/.txt, 1 = comma/.csv). CSV is the default option, which interfaces well with EXCEL.
h	Does the data file have column titles/headers? ("yes", "no", "auto"). "auto" will auto detect column titles/headers, which must be single strings and start with a character.
output	Return data as: 1= matrix, 2=data frame
genplot	generate summary plots (T or F).

Details

Missing values (in the file that you are reading from) should be indicated by 'NA'. If you have included characters in the column titles that are not permitted by R, they will be modified!

---

repl0 *Replace Values < 0 with 0*

Description

Replace all variable values < 0 with 0. If first column is location ID (depth/height/time), it will not be processed. Any number of variables (columns) permitted.

Usage

```
repl0(dat,ID=T,genplot=T,verbose=T)
```

Arguments

dat	Data series to process. If location is included (e.g., depth), it should be in the first column.
ID	Is a location ID included in the first column? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

---

replEps *Replace Values <= 0 with Smallest Positive Value*

Description

Replace all variable values <= 0 with the smallest positive floating-point number (eps) that can be represented on machine. If first column is location ID (depth/height/time), it will not be processed. Any number of variables (columns) permitted.

Usage

```
replEps(dat,ID=T,genplot=T,verbose=T)
```

Arguments

dat	Data series to process. If location is included (e.g., depth), it should be in the first column.
ID	Is a location ID included in the first column? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

---

resample *Resample Stratigraphic Series*

Description

Resample a stratigraphic series using a new (variably sampled) time or space axis. Values are piecewise-linearly interpolated from original data.

Usage

```
resample(dat,xout,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for resampling. First column should be location (e.g., depth), second column should be data value.
xout	Vector of new sampling locations.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

---

s *Standardize variable in Stratigraphic Series*

Description

Standardize variable in Stratigraphic Series (subtract mean value and divide by standard deviation)

Usage

```
s(dat,genplot=F,verbose=T)
```

Arguments

dat	Stratigraphic series for standardization. First column should be location (e.g., depth), second column should be data value.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

---

sedRamp *Apply 'ramping' sedimentation rate model to convert time to stratigraphy*

Description

Apply a linearly increasing (or decreasing) sedimentation rate model to convert time to stratigraphy.

Usage

```
sedRamp(dat,srstart=0.01,srend=0.05,genplot=T,verbose=T)
```

Arguments

dat	Time series. First column should be time (in ka), second column should be data value.
srstart	Initial sedimentation rate (in m/ka).
srend	Final sedimentation rate (in m/ka).
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

Value

modeled stratigraphic series.

Examples

```
# generate example series with 3 precession terms using function 'cycles'
# then convert from time to space using sedimentation rate that increases from 1 to 7 cm/ka
ex=sedRamp(cycles(),srstart=0.01,srend=0.07)
```

---

sedrate2time *Integrate sedimentation rate curve to obtain time-space map*

Description

Integrate sedimentation rate curve to obtain time-space map.

Usage

```
sedrate2time(sedrates,timedir=1,genplot=T,verbose=T)
```

Arguments

sedrates	Data frame containing depth/height in first column (meters) and sedimentation rates in second column (cm/ka).
timedir	Floating time scale direction: 1= time increases with depth/height; 2= time decreases with depth/height.)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

---

sortNave *Remove Missing Entries, Sort Data, Average Duplicates*

Description

Sort and average duplicates in stratigraphic series, as performed in 'read' function.

Usage

```
sortNave(dat,sortDecr=F,ave=T,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for processing. First column should be location (e.g., depth), second column should be data value.
sortDecr	Sorting direction? (F=increasing, T=decreasing)
ave	Average duplicate values? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

---

strats *Summary Statistics for Stratigraphic Series*

Description

Summary statistics for stratigraphic series: sampling interval and proxy values.

Usage

```
strats(dat)
```

Arguments

dat	Stratigraphic series to evaluate. First column should be location (e.g., depth), second column should be data value.

---

tones *Calculate all possible difference and combinations tones*

Description

Determine all possible difference and combinations tones from a set of frequencies, and find the closest one to a specified frequency

Usage

```
tones(a=NULL,freqs=NULL,f=T)
```

Arguments

a	The frequency you seeking to match, in cycles/ka.
freqs	The vector of frequencies from which to calculate difference and combination tones, in cycles/ka.
f	Output results as frequencies (cycles/ka)? If false, will output results as periods (ka). (T or F)

traceFreq *Frequency-domain minimal tuning: Use interactive graphical interface to trace frequency drift*

Description

Frequency-domain minimal tuning: Use interactive graphical interface to trace frequency drift.

Usage

```
traceFreq(spec,color=2,h=6,w=4,ydir=1,xmin=NULL,xmax=NULL,ymin=NULL,ymax=NULL,ncolors=100,
          pl=1,ln=F)
```

Arguments

spec	Time-frequency spectral results to evaluate. Must have the following format: column 1=frequency; remaining columns (2 to n)=power, amplitude or probability; titles for columns 2 to n must be the location (depth or height). Note that this format is ouput by function eha.
color	Line color for tracing. 1 = transparent black; 2 = transparent white; 3 = transparent yellow
h	Height of plot in inches.
w	Width of plot in inches.
ydir	Direction for y-axis in plots (depth or height). -1 = values increase downwards (slower plotting!), 1 = values increase upwards.
xmin	Minimum spatial frequency to plot.
xmax	Maximum spatial frequency to plot.
ymin	Minimum depth/height to plot.
ymax	Maximum depth/height to plot.
ncolors	Number of colors to use in plot.
pl	How do you want to represent the spatial frequency path?: 1=lines and points; 2=lines; 3=points
ln	Plot natural log of spectral results? (T or F)

See Also

eha and trackFreq

Examples

```
# Generate example series with 3 terms using function 'cycles'.
# Then convert from time to space with sedimentation rate that increases from 1 to 5 cm/ka, using
# function 'sedramp'.
# Finally interpolate to median sampling interval using function 'linterp'.
dat=linterp(sedRamp(cycles(freqs=c(1/100,1/40,1/20),start=1,end=2500,dt=5)))

# EHA anlaysis, output amplitude results
out=eha(dat,output=3)

## Interactively track frequency drift
#freq=traceFreq(out)
```

---

trackFreq *Frequency-domain minimal tuning: Use interactive graphical interface and sorting to track frequency drift*

Description

Frequency-domain minimal tuning: Use interactive graphical interface and sorting algorithm to track frequency drift.

Usage

```
trackFreq(spec,threshold=NULL,pick=T,fmin=NULL,fmax=NULL,dmin=NULL,dmax=NULL,xmin=NULL,
        xmax=NULL,ymin=NULL,ymax=NULL,h=6,w=4,ydir=1,ncolors=100,genplot=T,verbose=T)
```

Arguments

spec	Time-frequency spectral results to evaluate. Must have the following format: column 1=frequency; remaining columns (2 to n)=power, amplitude or probability; titles for columns 2 to n must be the location (depth or height). Note that this format is ouput by function eha.
threshold	Threshold level for filtering peaks. By default all peak maxima reported.
pick	Pick the peaks of interest using a graphical interface? (T or F). Only activated if genplot=T.
fmin	Minimum frequency for analysis.
fmax	Maximum frequency for analysis.
dmin	Minimum depth/height for analysis. NOT ACTIVATED YET!
dmax	Maximum depth/height for analysis. NOT ACTIVATED YET!
xmin	Minimum frequency for PLOTTING.
xmax	Maximum frequency for PLOTTING.
ymin	Minimum depth/height for PLOTTING.
ymax	Maximum depth/height for PLOTTING.

h	Height of plot in inches.
w	Width of plot in inches.
ydir	Direction for y-axis in plots (depth or height). -1 = values increase downwards (slower plotting!), 1 = values increase upwards.
ncolors	Number of colors to use in plot.
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

eha and traceFreq

Examples

```
# Generate example series with 3 terms using function 'cycles'.
# Then convert from time to space with sedimentation rate that increases from 1 to 5 cm/ka, using
# function 'sedramp'.
# Finally interpolate to median sampling interval using function 'linterp'.
dat=linterp(sedRamp(cycles(freqs=c(1/100,1/40,1/20),start=1,end=2500,dt=5)))

# EHA anlaysis, output probability results
out=eha(dat,output=4)

## Isolate peaks with probability >= 0.9
#freq=trackFreq(out,0.9)
```

---

trim *Remove Outliers from Stratigraphic Series*

Description

Automatically remove outliers from stratigraphic series, using 'boxplot' algorithm.

Usage

```
trim(dat,c=1.5,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for outlier removal. First column should be location (e.g., depth), second column should be data value.
c	'c' defines the 'coef' variable for boxplot.stats. For more information: ?boxplot.stats
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

delPts, idPts, iso and trimAT

---

trimAT *Remove Outliers from Stratigraphic Series*

Description

Remove outliers from stratigraphic series, using specified threshold value.

Usage

```
trimAT(dat,thresh=0,dir=2,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for outlier removal. First column should be location (e.g., depth), second column should be data value.
thresh	Threshold value for outlier detection.
dir	Remove values (1) smaller than or (2) larger than this threshold?
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

See Also

delPts, idPts, iso and trim

---

tune *Tune Stratigraphic Series*

Description

Tune stratigraphic series from space to time, using specified control points

Usage

```
tune(dat,controlPts,extrapolate=F,genplot=T,verbose=T)
```

Arguments

dat	Stratigraphic series for tuning. First column should be location (e.g., depth), second column should be data value.
controlPts	Tuning control points. A data frame or matrix containing two columns: depth, time
extrapolate	Extrapolate sedimentation rates above and below 'tuned' interval? (T or F)
genplot	Generate summary plots? (T or F)
verbose	Verbose output? (T or F)

---

writeCSV *Write CSV File*

Description

Write data frame as file with comma separated values

Usage

```
writeCSV(filename,output)
```

Arguments

filename	Desired filename, in quotes: "result.csv"
output	Data frame to write to file.

---

writeT *Write Tab-delimited File*

Description

Write data frame as file with tab-delimited values

Usage

```
writeT(filename,output)
```

Arguments

filename	Desired filename, in quotes: "result.tab"
output	Data frame to write to file.

xplot *Generate Cross-plot with Density Estimates on Axes*

Description

Generate a Cross-plot with Density Estimates on Axes. Custom axes titles optional.

Usage

```
xplot(x,y,xlab=NULL,ylab=NULL,main=NULL)
```

Arguments

x	Variable 1
y	Variable 2
xlab	Label for the x-axis, in quotes
ylab	Label for the y-axis, in quotes
main	Label for the plot, in quotes

zoomIn *Dynamically explore cross-plot, zoom-in into specified region*

Description

Dynamically explore cross-plot, zoom-in into specfied region. Accepts one dataframe/matrix with two columns, or two dataframes/vectors with one column.

Usage

```
zoomIn(dat1,dat2=NULL,ptsize=1,xmin=NULL,xmax=NULL,ymin=NULL,ymax=NULL,plotype=1,
       verbose=T)
```

Arguments

dat1	Data frame with one or two columns. If one column, dat2 must also be specified.
dat2	Data frame with one column.
ptsize	Size of plotted points.
xmin	Minimum x-value (column 1) to plot
xmax	Maximum x-value (column 1) to plot
ymin	Minimum y-value (column 2) to plot
ymax	Maximum y-value (column 2) to plot
plotype	Type of plot to generate: 1= points and lines, 2 = points, 3 = lines
verbose	Verbose output? (T or F)

Index