Package 'fftwtools'

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Title Wrapper for 'FFTW3' Includes: One-Dimensional, Two-Dimensional, Three-Dimensional, and Multivariate Transforms

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Depends R (>= 3.0)

SystemRequirements fftw3 (libfftw3-dev (deb), or fftw-devel (rpm))

Suggests fftw

Description Provides a wrapper for several 'FFTW' functions. This package provides access to the two-dimensional 'FFT', the multivariate 'FFT', and the one-dimensional real to complex 'FFT' using the 'FFTW3' library. The package includes the functions fftw() and mvfftw() which are designed to mimic the functionality of the R functions fft() and mvfft(). The 'FFT' functions have a parameter that allows them to not return the redundant complex conjugate when the input is real data.

License GPL (>= 2)

ByteCompile true

URL https://github.com/krahim/fftwtools

NeedsCompilation yes

Repository CRAN

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R topics documented:

`fftw` *Compute fft using fftw3*

Description

These functions compute the FFT using the FFTW3 libraries. Use fftw_r2c(x, HermConj=0) for real to complex fft. This will return the result without the redundant complex conjugate. This follows the R convention for returning the unscaled inverse of the FFT. The function fftw_c2r(res, HermConj=0, n=length(x)) will invert the FFT from the result not containing the redundant complex conjugate. You must specify, n, the dimension of the original data–length–if the redundant complex conjugate is not included.

Usage

```
fftw(data, inverse=0, HermConj=1, n=NULL)
fftw(data, inverse=0, HermConj=1, n=NULL)
fftw_r2c(data, HermConj=1)
fftw_c2c(data, inverse=0)
fftw_c2r(data, HermConj=1, n=NULL)
```

Arguments

`data`	(complex or real) vector to be processed
`inverse`	(integer) 1 or 0 indicating if inverse FFT is preformed. The return follows the format of the R FFT commands–the output is not scaled.
`HermConj`	(integer) 1 or 0 indicating if either "Hermitian" redundant conjugate should be returned, or that the complex to real data includes the "Hermitian" redundant conjugate.
`n`	(integer) column length of the original data set. This is required when using the inverse complex to real FFT without providing the "Hermitian" redundant conjugate.

Author(s)

Karim Rahim

Examples

```
res <- fftw_r2c(1:9)
res
fftw_c2r(res)/9
res
fftw_c2r(res)/9

res <- fftw_r2c(1:10)
res
fftw_c2r(res)/10
```

```
res
fftw_c2r(res)/10

res <- fftw_r2c(1:9, HermConj=0)
res
fftw_c2r(res, HermConj=0, n=9)/9

res <- fftw_r2c(1:10, HermConj=0)
res
fftw_c2r(res, HermConj=0, n=10)/10

fftw_r2c(1:3)
fftw_c2r(fftw_r2c(1:3))/3
fftw_c2r(fftw_r2c(1:2))/2
fftw_c2r(fftw_r2c(1:4))/4


fftw_r2c(1:3, HermConj=1)
fftw_c2r(fftw_r2c(1:3, HermConj=0), HermConj=0, n=3)/3

fftw_c2r(fftw_r2c(1:4, HermConj=0), HermConj=0, n=4)/4
fftw_c2r(fftw_r2c(1:20, HermConj=0), HermConj=0, n=20)/20
```

`fftw2d` *Compute a two-dimensional FFT on a matrix using FFTW3*

Description

Computes two-dimensional FFT on a matrix using the FFTW3 libraries. Use fftw_r2c_2d(x, HermConj=0) for real to complex FFT. This will return the result without the "Hermitian" redundancy. These functions follow the R convention when returning the inverse of the FFT. For the two-dimension fft, the inverse is currently requires the entire matrix, including the redundant complex conjugate.

The function `fftw_c2c_xd` can calculate a higher dimensional FFT on a higher dimensional array.

Usage

```
fftw2d(data, inverse=0, HermConj=1)
fftw_r2c_2d(data, HermConj=1)
fftw_c2c_2d(data, inverse=0)
fftw_c2c_xd(data, inverse=0)
```

Arguments

`data`	(complex or real) matrix to be processed (or array for `fftw_c2c_xd`)
`inverse`	(integer) 1 or 0 indicating if inverse FFT is preformed. The return follows the format of the R FFT commands–the output is not scaled.
`HermConj`	(integer) 1 or 0 indicating if either "Hermitian" redundant conjugate should be returned.

Author(s)

Karim Rahim and Ege Rubak

Examples

```
x=c(1, 2, 3, 9, 8, 5, 1, 2, 9, 8, 7, 2)
x= t(matrix(x, nrow=4))
mvfft(x)
t(mvfft(t(mvfft(x))))
fftw2d(x)
fftw2d(x, HermConj=0)

fftw2d(fftw2d(x), inverse=1)/12
fftw2d(fftw2d(t(x)), inverse=1)/12
fftw_r2c_2d(x)
fftw_r2c_2d(x, HermConj=0)

fftw_c2c_xd(x)
```

`fftw3d` *Compute a two-dimensional FFT on a matrix using FFTW3*

Description

Computes three-dimensional FFT on an array using the FFTW3 libraries. Use fftw_r2c_3d(x, HermConj=0) for real to complex FFT. This will return the result without the "Hermitian" redundancy. These functions follow the R convention when returning the inverse of the FFT. For the two-dimension fft, the inverse is currently requires the entire matrix, including the redundant complex conjugate.

Usage

```
fftw3d(data, inverse=0, HermConj=1)
fftw_r2c_3d(data, HermConj=1)
fftw_c2c_3d(data, inverse=0)
```

Arguments

`data`	(complex or real) 3-dimensional array to be processed
`inverse`	(integer) 1 or 0 indicating if inverse FFT is preformed. The return follows the format of the R FFT commands–the output is not scaled.
`HermConj`	(integer) 1 or 0 indicating if either "Hermitian" redundant conjugate should be returned.

Author(s)

Karim Rahim

Examples

```
x=c(1, 2, 3, 9, 8, 5, 1, 2, 9, 8, 7, 2)
x= array(x, dim=c(3,2,2))

fftw3d(x)
fftw3d(x, HermConj=0)

fftw3d(fftw3d(x), inverse=1)/12

fftw_r2c_3d(x)
fftw_r2c_3d(x, HermConj=0)
```

`mvfftw` *Compute the FFT on each column of a matrix using FFTW3*

Description

This will compute the FFT of each column of a matrix using the FFTW3 libraries. Use mvfftw_r2c(x, HermConj=0) for real to complex fft. This will return the result without the redundant complex conjugate. This follows the R convention for returning the unscaled inverse of the FFT. The function mvfftw_c2r(res, HermConj=0, n=dim(x)[1]) will invert the FFT from the result not containing the "Hermitian" redundant conjugate. You must specify, n, the column dimension of the original data– the column length of the original data–if the redundant complex conjugate is not included.

Usage

```
mvfftw(data, inverse=0, HermConj=1, n=NULL, fftplanopt=0)
mvfftw(data, inverse=0, HermConj=1, n=NULL, fftplanopt=0)
mvfftw_r2c(data, HermConj=1, fftplanopt=0)
mvfftw_c2c(data, inverse=0, fftplanopt=0)
mvfftw_c2r(data, HermConj=1, n=NULL, fftplanopt=0)
```

Arguments

`data`	(complex or real) matrix of columns to be processed
`inverse`	(integer) 1 or 0 indicating if inverse fft is preformed. The return follows the format of the R FFT commands. The result is not scaled.
`HermConj`	(integer) 1 or 0 indicating if either "Hermitian" redundant conjugate should be returned, or that the complex to real data includes the "Hermitian" redundant conjugate.
`n`	(integer) column length of the original data set, when using the inverse coplex to real fft without providing the "Hermitian" redundant conjugate.
`fftplanopt`	(integer) 0 or 1 specifying the flag passed to FFTW. 0 indicates the flag FFTW_ESTIMATE is used, and 1 indicates FFTW_MEASURE is used. See FFTW documentation for use of these flags.

Author(s)

Karim Rahim

Examples

```
x=c(1, 2, 3, 9, 8, 5, 1, 2, 9, 8, 7, 2)
x= t(matrix(x, nrow=4))
mvfft(x)
t(mvfft(t(mvfft(x))))

res <- mvfftw_r2c(x, HermConj=1)
res
mvfftw_c2c(res, inverse=1)/3
mvfftw_c2r(res)/3

res <- mvfftw_r2c(x, HermConj=0)
res
mvfftw_c2r(res, HermConj=0, n=3)/3


mvfftw_r2c(x, HermConj=1)
mvfft(x)
res <- mvfftw_r2c(x, HermConj=0)
res
mvfftw_c2r(res, HermConj=0, n=3)/3

res <- mvfftw_r2c(t(x), HermConj=1)
res
mvfftw_c2r(res, HermConj=1)/4
res <- mvfftw_r2c(t(x), HermConj=0)
res
mvfftw_c2r(res, HermConj=0, n=4)/4


mvfftw_r2c(t(x), HermConj=1)
mvfft(t(x))

mvfftw(mvfftw(x, HermConj=0), inverse=1, HermConj=0, n=3)/3
mvfftw(mvfftw(t(x), HermConj=0), inverse=1, HermConj=0, n=4)/4
mvfftw(mvfftw(t(x), inverse=1))/4
```

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