

# Package ‘fftwtools’

July 22, 2025

**Version** 0.9-11

**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

**Date/Publication** 2021-03-01 14:10:02 UTC

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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**

|                       |  |
|-----------------------|--|
| <code>data</code>     | (complex or real) vector to be processed   |
| <code>inverse</code>  | (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.                                   |
| <code>HermConj</code> | (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. |
| <code>n</code>        | (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

```

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fftw2d

---

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


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## 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

|                       |  |
|-----------------------|--|
| <code>data</code>     | (complex or real) matrix to be processed (or array for <code>fftw_c2c_xd</code> )  |
| <code>inverse</code>  | (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. |
| <code>HermConj</code> | (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**

|                       |  |
|-----------------------|--|
| <code>data</code>     | (complex or real) 3-dimensional array to be processed  |
| <code>inverse</code>  | (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. |
| <code>HermConj</code> | (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)
```

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mvfftw

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


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**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**

|                         |   |
|-------------------------|---|
| <code>data</code>       | (complex or real) matrix of columns to be processed   |
| <code>inverse</code>    | (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.   |
| <code>HermConj</code>   | (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.  |
| <code>n</code>          | (integer) column length of the original data set, when using the inverse complex to real fft without providing the "Hermitian" redundant conjugate.   |
| <code>fftplanopt</code> | (integer) 0 or 1 specifying the flag passed to FFTW. 0 indicates the flag <code>FFTW_ESTIMATE</code> is used, and 1 indicates <code>FFTW_MEASURE</code> 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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