

Package ‘tractor.base’

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Title Read, Manipulate and Visualise Magnetic Resonance Images

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Enhances oro.nifti

Description Functions for working with magnetic resonance images. Analyze, NIFTI-1, NIFTI-2 and MGH format images can be read and written; DICOM files can only be read.

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allEqual	<i>Test whether all elements of a vector are equal</i>
----------	--------------------------------------------------------

Description

This function is a wrapper around `all`, testing whether all elements of the specified vector are equal to each other.

Usage

```
allEqual(x, ignoreMissing = FALSE)
```

Arguments

x	A vector of any mode, including a list.
ignoreMissing	If TRUE, missing elements will be ignored. Otherwise the presence of missing values will result in a return value of FALSE.

Value

TRUE if all elements test (exactly) equal; FALSE otherwise.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[equivalent](#) for elementwise equivalence of two vectors.

Examples

```
allEqual(c(1,1,1)) # TRUE
allEqual(c(1,1,NA)) # FALSE
allEqual(c(1,1,NA), ignoreMissing=TRUE) # TRUE
```

asMriImage

Creating MriImage objects from data

Description

Functions for creating MriImage objects from data, including other images. All of these functions use data from arrays or MriImage objects to create a new MriImage object. asMriImage is the basic function for creating an object from its constituents: an array of voxel values and some metadata (and/or a template image).

Usage

```
asMriImage(data, templateImage = nilObject(), imageDims = NA,
  voxelDims = NA, voxelDimUnits = NA, origin = NA, tags = NA,
  reordered = NA)
```

```
extractMriImage(image, dim, loc)
```

```
trimMriImage(image, clearance = 4, indices = NULL)
```

```
reorderMriImage(image)
```

Arguments

data	An array of pixel/voxel data.
templateImage	An optional MriImage object, to be used as a metadata template.
imageDims, voxelDims, voxelDimUnits, origin, tags, reordered	Metadata for the new image object. These values override any from the metadata object or data array. See MriImage class documentation for details.
image	An MriImage object.
dim, loc	The dimension and location along that dimension for which data should be extracted.
clearance	The number of voxels' clearance left around a trimmed image.
indices	A list of indices to keep along each dimension. Determined from the specified clearance if NULL.

Details

extractMriImage reduces the dimensionality of the source image by one, by extracting a single “slice” of data along one dimension. trimMriImage trims empty space from the edges of an image, reducing the dimensions of the image and thus avoiding the storage of lots of zeroes. reorderMriImage reorders the image data (and corresponding metadata) to the LAS convention, an operation which is usually performed when an image is read from file.

Value

An MriImage object.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[MriImage](#)

`createNeighbourhoodInfo`*Image neighbourhoods*

Description

This function calculates information about a cuboidal region of an image, with a centre and a fixed voxel width.

Usage

```
createNeighbourhoodInfo(width, dim = 3, centre = rep(0, dim))
```

Arguments

<code>width</code>	An integer voxel width. Must be odd.
<code>dim</code>	An integer giving the dimensionality of the neighbourhood. Currently must be 3.
<code>centre</code>	A numeric vector giving the centre voxel of the neighbourhood. Must have exactly <code>dim</code> elements.

Value

`createNeighbourhoodInfo` returns a list with class "neighbourhoodInfo" and elements

width Copied from the `width` argument.

dim Copied from the `dim` argument.

centre Copied from the `centre` argument.

vectors `dim` x `width`^{`dim`} matrix whose columns give the locations of each point in the neighbourhood.

innerProducts A square, symmetric matrix of inner products between every location in the neighbourhood and every other.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. Journal of Statistical Software 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

createSliceGraphic *Visualise MriImage objects*

Description

Visualise `MriImage` objects noninteractively using an R graphics device. See [viewImages](#) for an interactive alternative. These functions create 2D visualisations of 3D images by slicing or maximum intensity projection.

Usage

```
createSliceGraphic(image, x = NA, y = NA, z = NA, device = c("internal",
  "png"), colourScale = 1, add = FALSE, file = NULL, zoomFactor = 1,
  windowLimits = NULL)
```

```
createProjectionGraphic(image, axis, device = c("internal", "png"),
  colourScale = 1, add = FALSE, file = NULL, zoomFactor = 1,
  windowLimits = NULL)
```

```
createContactSheetGraphic(image, axis, device = c("internal", "png"),
  colourScale = 1, add = FALSE, file = NULL, zoomFactor = 1,
  windowLimits = NULL, clearance = NULL, nColumns = NULL)
```

Arguments

<code>image</code>	An MriImage object.
<code>x, y, z</code>	Integer vectors, each of length 1. Exactly one of these must be specified to indicate the plane of interest.
<code>device</code>	Either "internal" for display on the default graphics device, or "png" for creating PNG format image file(s). Abbreviations are fine.
<code>colourScale</code>	A colour scale definition, of the sort generated by getColorScale .
<code>add</code>	Overlay the graphic on a previous one. Used only when device is "internal".
<code>file</code>	A file name, to be used when device is "png".
<code>zoomFactor</code>	Factor by which to enlarge the image. Applies only when device is "png".
<code>windowLimits</code>	Numeric vector of length 2 giving the limits of the colour scale, or NULL for limits matching the range of the image data. Passed as the <code>zlim</code> argument to image .
<code>axis</code>	A vector of axes along which slice/projection images should be created. 1 is left-right, 2 is anterior-posterior, 3 is superior-inferior.
<code>clearance</code>	Number of voxels' clearance to leave around each slice image in the contact sheet. Passed to trimMriImage .
<code>nColumns</code>	Number of slices per row in the contact sheet grid. If NULL, the function will aim for a square grid.

Value

These functions are called for their side effects.

Note

When the device option is set to "png", the "png" and "mmand" packages are required by these functions.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. Journal of Statistical Software 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

See [viewImages](#) for an interactive alternative, and [getColourScale](#) for details of how colour scales are specified. Also [image](#), which is used as the underlying plot function.

deduplicate

Concatenate and deduplicate vectors

Description

This function returns its arguments, after concatenating them using `c` and then removing elements with duplicate names. The first element with each name will remain. Unnamed elements are retained.

Usage

```
deduplicate(...)
```

Arguments

... One or more vectors of any mode, usually named.

Value

The concatenated and deduplicated vector.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

defaultInfoPanel *A simple interactive viewer for MriImage objects*

Description

The `viewImages` function provides a simple interactive viewer for `MriImage` objects. 3D and 4D images may be used.

Usage

```
defaultInfoPanel(point, data, imageNames)

timeSeriesPanel(point, data, imageNames)

polarPlotPanel(point, data, imageNames, directions, bValues = NULL)

viewImages(images, colourScales = NULL, point = NULL, interactive = TRUE,
           crosshairs = TRUE, orientationLabels = TRUE, fixedWindow = TRUE,
           indexNames = NULL, infoPanel = defaultInfoPanel, ...)
```

Arguments

<code>point</code>	For <code>viewImages</code> , a length 3 integer vector giving the initial location of the crosshairs, in voxels. For info panel functions, the current location of the crosshairs.
<code>data</code>	A list giving the data value(s) at the current crosshair location in each image displayed. Typically numeric, but in principle may be of any mode, and will be character mode when <code>indexNames</code> is not NULL.
<code>imageNames</code>	A character vector giving a name for each image displayed.
<code>directions</code>	A matrix of 3D acquisition direction vectors, one per row.
<code>bValues</code>	A vector of b-values, if the image is diffusion-weighted.
<code>images</code>	An <code>MriImage</code> object, or list of <code>MriImage</code> objects.
<code>colourScales</code>	A list of colour scales to use for each image, which will be recycled to the length of images. See getColourScale for details. The default is to use greyscale.
<code>interactive</code>	A single logical value. If TRUE, the plot is interactive.
<code>crosshairs</code>	A single logical value. If TRUE, the crosshairs are displayed.
<code>orientationLabels</code>	A single logical value. If TRUE, orientation labels are displayed.

<code>fixedWindow</code>	A single logical value. If TRUE, each image is windowed globally, rather than for each slice.
<code>indexNames</code>	A list whose elements are either NULL or a named character vector giving the names associated with each index in the image.
<code>infoPanel</code>	A function with at least three arguments, which must plot something to fill the bottom-right panel of the viewer after each change of crosshair location. The three mandatory arguments correspond to the current location in the image, the image values at that location, and the names of each image. The <code>defaultInfoPanel</code> and <code>timeSeriesPanel</code> functions are valid examples.
<code>...</code>	Additional arguments to <code>infoPanel</code> .

Value

These functions are called for their side effects.

Note

The `defaultInfoPanel` and `timeSeriesPanel` functions are not intended to be called directly. They are simple examples of valid values for the `infoPanel` argument to `viewImages`.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[getColourScale](#)

DicomMetadata-class *The DicomMetadata class*

Description

This class represents DICOM metadata, which typically contains detailed information about the scan parameters and subject.

Fields

source String naming the source file
tags Data frame of tag information
tagOffset Starting offset for tags in the file
dataOffset Starting offset for pixel data in the file
dataLength Pixel data length
explicitTypes Logical value indicating whether explicit types are used in the file
endian String naming the endianness of the file
asciiFields Character vector containing the contents of the ASCII header, if requested and present in the file.

Methods

getAsciiFields(regex = NULL) Retrieve the value of one or more fields in the ASCII header.
Returns NA if no fields match
getTagValue(group, element) Retrieve the value of a given tag, using an appropriate R type.
Returns NA if the tag is missing

emptyMatrix

The empty matrix

Description

The empty matrix is a standard matrix of dimensions 0 x 0. It is intended to be used as a placeholder where a matrix is required but no information is stored.

Usage

```
emptyMatrix()  
  
is.emptyMatrix(object)
```

Arguments

object Any object.

Value

emptyMatrix returns the empty matrix, equivalent to `matrix(NA, 0, 0)`. `is.emptyMatrix` returns TRUE if its argument is identical to the empty matrix.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. Journal of Statistical Software 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

equivalent

Test two numeric vectors for equivalence

Description

This function is a wrapper for `isTRUE(all.equal(x, y, ...))`, but with the additional capability of doing sign-insensitive comparison.

Usage

```
equivalent(x, y, signMatters = TRUE, ...)
```

Arguments

x	The first numeric vector.
y	The second numeric vector.
signMatters	Logical value: if FALSE then equivalence in absolute value is sufficient.
...	Additional arguments to all.equal , notably tolerance.

Value

TRUE if all elements of x match all elements of y to within tolerance, ignoring signs if required. FALSE otherwise.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. Journal of Statistical Software 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[all.equal](#)

Examples

```

equivalent(c(-1,1), c(1,1)) # FALSE
equivalent(c(-1,1), c(1,1), signMatters=FALSE) # TRUE
equivalent(1:2, 2:3, tolerance=2) # TRUE

```

identifyImageFileNames

Working with MRI images stored in NIfTI, Analyze and MGH formats

Description

Functions for reading, writing, locating, copying and removing MRI images stored in NIfTI, Analyze and MGH formats.

Usage

```

identifyImageFileNames(fileName, fileType = NULL, errorIfMissing = TRUE)

imageFileExists(fileName, fileType = NULL)

removeImageFiles(fileName)

symlinkImageFiles(from, to, overwrite = FALSE, relative = TRUE)

copyImageFiles(from, to, overwrite = FALSE, deleteOriginals = FALSE)

readImageFile(fileName, fileType = NULL, metadataOnly = FALSE,
  volumes = NULL, sparse = FALSE, mask = NULL, reorder = TRUE)

writeImageFile(image, fileName = NULL, fileType = NA, overwrite = TRUE,
  maxSize = NULL)

registerPathHandler(regex, handler)

```

Arguments

fileName, from, to	File names, with or without appropriate extension.
fileType	A character vector of length one, giving the file type required or expected. If this option is missing, the file type used for writing images will be taken from the tractorFileType option. See Details.
errorIfMissing	Logical value: raise an error if no suitable files were found?
overwrite	Logical value: overwrite an existing image file? For writeImageFile, an error will be raised if there is an existing file and this is set to FALSE.

relative	Logical value: if TRUE, the path stored in the symlink will be relative (e.g. "../some_dir/some_image.nii") rather than absolute (e.g. "/path/to/some_dir/some_image.nii")
deleteOriginals	Logical value: if TRUE, copyImageFiles performs a move rather than a copy.
metadataOnly	Logical value: if TRUE, only metadata are read into the object.
volumes	An optional integer vector specifying a subset of volumes to read (generally to save memory). If given, only the requested volumes in the 4D file will be read.
sparse	Logical value: should the image data be stored in a SparseArray object?
mask	An optional MriImage object representing a mask, outside of which the image to be read should be considered to be zero. This can be used to save memory when only a small part of a large image is of interest. Ignored if sparse is not TRUE.
reorder	Logical value: should the image data be reordered to LAS? This is recommended in most circumstances.
image	An MriImage object.
maxSize	If not NULL, the maximum number of bytes per pixel to use when storing the data. This can lead to a substantial loss of precision, and is usually not desirable. Only used when writing to the NIFTI file format.
regex	A regular expression.
handler	A function taking and returning a string.

Details

NIFTI and Analyze are related formats for storing magnetic resonance images. NIFTI is a more recent extension of Analyze, and contains more specific information about, for example, the orientation of the image. Its use is therefore recommended where possible. MGH format is used by the popular image processing package FreeSurfer. These formats use a number of different file extensions, but the details are abstracted away from the user by these functions.

TractoR does not allow for files with the same basic name using multiple Analyze/NIFTI/MGH formats in a single directory (e.g. "foo.nii" AND "foo.img"), and these functions will produce an error if multiple compatible files exist.

Suitable values for fileType (and the tractorFileType option, which is used as a default) are ANALYZE, NIFTI, NIFTI_PAIR (the two-file NIFTI format), MGH, ANALYZE_GZ, NIFTI_GZ, NIFTI_PAIR_GZ and MGH_GZ. The latter four are gzipped versions of the former four. NIFTI_GZ is recommended unless there is a need for one of the others. This is the default value for the tractorFileType option, but that can be changed using a call to [options](#), or by setting the TRACTOR_FILETYPE environment variable before loading the tractor.base package.

Since multiple files may be involved, copying, moving or symlinking images is not trivial. copyImageFiles and symlinkImageFiles are wrappers around the standard functions [file.copy](#) and [file.symlink](#) which handle this complexity.

registerPathHandler allows special syntaxes to be used for image paths, and is for advanced use only.

Value

`readImageFile` returns an `MriImage` object. `imageFileExists` returns TRUE if an existing file with the specified name exists (all file extensions are checked), and FALSE otherwise. `removeImageFiles` returns the result of `unlink` applied to all relevant files. `writeImageFile` and `identifyImageFileNames` return a list with the following elements, describing the identified or written files:

fileStem The file name without extension.

headerFile The full header file name.

imageFile The full image file name.

format The format of the files ("Nifti", "Analyze" or "Mgh"). Not returned by `writeImageFile`.

`copyImageFiles` and `symlinkImageFiles` are called for their side effects.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

The NIFTI-1 standard (<http://nifti.nimh.nih.gov/nifti-1>) and `MriImage`.

implode

Create a character string by concatenating the elements of a vector

Description

Create a character string by concatenating the elements of a vector, using a separator and optional final separator.

Usage

```
implode(strings, sep = "", finalSep = NULL, ranges = FALSE)
```

Arguments

<code>strings</code>	A vector, which will be coerced to mode character.
<code>sep</code>	A unit length character vector giving the separator to insert between elements.
<code>finalSep</code>	An optional unit length character vector giving the separator to insert between the final two elements.
<code>ranges</code>	Logical value. If TRUE and <code>strings</code> can be interpreted as integers, collapse runs of consecutive numbers into range notation.

Value

A character vector of length one.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[paste](#)

Examples

```
implode(1:3, ", ") # "1, 2, 3"
implode(1:3, ", ", " and ") # "1, 2 and 3"
implode(1:2, ", ", " and ") # "1 and 2"
implode(1:3, ", ", ranges=TRUE) # "1-3"
```

interpolatePalette *Functions for working with colour scales or palettes*

Description

The `getColourScale` function can be used to obtain a standard or customised colour scale for use in the package's image visualisation functions. A graded palette of colours between two or more key colours can be obtained using `interpolatePalette`.

Usage

```
interpolatePalette(colours, n, ...)
```

```
getColourScale(n)
```

Arguments

colours	A vector of colours to interpolate between, using any format recognised by colours .
n	For <code>getColourScale</code> , a number, colour name or list (see Details). For <code>interpolatePalette</code> , a single integer specifying the length of the interpolated palette.
...	Additional arguments to colorRamp .

Details

Colour scales can be specified in any of three ways. Firstly, by a single number, representing a predefined colour scale. Currently valid values are 1 (greyscale, black background), 2 (red to yellow heat scale, red background), 3 (blue to red rainbow scale, blue background), 4 (blue to white to red diverging scale, white background), 5 (white to red, white background) and 6 (white to blue, white background). Secondly, a single colour name can be given (see [colours](#)); in this case the background will be black. This is useful for binary images. Thirdly and most flexibly, a list with two named elements can be given: `colours`, a vector of colours representing the colour scale, perhaps created using `rgb`; and `background`, a single colour representing the background.

Value

For `getColourScale`, a list with elements

colours A character-mode vector representing the colours in the scale, usually of length 100. This can be passed as a colour scale to R's plotting functions.

background A single character string representing the background colour.

The `interpolatePalette` function returns a character-mode vector representing the colours in the interpolated scale.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[colours](#), [rgb](#), [colorRamp](#)

Examples

```
getColourScale(1)
```

```
interpolatePalette(c("red", "yellow"), 10)
```

isDeserialisable *Reference object serialisation and deserialisation*

Description

Rather than using R's [save](#) and [load](#) functions directly for reference objects, TractoR uses the [SerialisableObject](#) class and these functions to save and load objects. The main difference is that this approach stores only the data in the object, and not the functions which operate on them. This helps backward compatibility when new member functions are added.

Usage

```
isDeserialisable(object, expectedClass = NULL)

serialiseReferenceObject(object, file = NULL)

deserialiseReferenceObject(file = NULL, object = NULL, raw = FALSE)

registerDeserialiser(className, deserialiser)
```

Arguments

object	For <code>serialiseReferenceObject</code> , a list or object inheriting from SerialisableObject . For other functions, an object in (raw) serialised form. See Details.
expectedClass	A class name which the object is expected to inherit. Any class is acceptable if this parameter is NULL.
file	A file name to deserialise from.
raw	If TRUE, the raw serialised object is returned; otherwise the object is converted back to its original class.
className	A string naming a class to be handled by the specified deserialiser.
deserialiser	A function taking as its argument a list of serialised fields, and returning a suitable deserialised object.

Details

The `serialiseReferenceObject` function, or the `serialise` member function of the [SerialisableObject](#) class can be used to create and/or [save](#) a version of an object which contains a hierarchical representation of the data embedded in it. These serialised objects are standard R lists, with an "originalClass" attribute describing the class of the original object. The `deserialiseReferenceObject` function can be used to deserialise them. Custom deserialisers can be specified using `registerDeserialiser`, typically for legacy classes.

Note that this should generally NOT be used as the primary mechanism for saving and loading [MriImage](#) objects. Saving to standard NIFTI/Analyze format is usually preferable, and can be done using `writeImageFile`.

Value

isDeserialisable returns TRUE if the object is deserialisable and inherits from the specified class. deserialiseReferenceObject returns a raw or reconstituted object after deserialisation.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. Journal of Statistical Software 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[SerialisableObject](#), [save](#), [load](#), [writeImageFile](#).

locateExecutable	<i>Find or run an external executable file</i>
------------------	------------------------------------------------

Description

The execute function is a wrapper around the [system2](#) function in base, which additionally echoes the command being run (including the full path to the executable) if the reportr output level is Debug. locateExecutable simply returns the path to an executable file on the system PATH.

Usage

```
locateExecutable(fileName, errorIfMissing = TRUE)

execute(executable, params = NULL, errorOnFail = TRUE, silent = FALSE,
  ...)
```

Arguments

executable, fileName	Name of the executable to run.
params	A character vector giving the parameters to pass to the executable, if any. Elements will be separated by a space.
errorOnFail, errorIfMissing	Logical value: should an error be produced if the executable can't be found?
silent	Logical value: should the executable be run without any output?
...	Additional arguments to system .

Value

For execute, the return value of the underlying call to [system2](#). For locateExecutable, the location of the requested executable, or NULL if it could not be found.

Note

These functions are designed for Unix systems and may not work on Windows.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. Journal of Statistical Software 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[system2](#)

mergeMriImages	<i>Merging MriImage objects</i>
----------------	---------------------------------

Description

This function concatenates the data from a series of MriImage objects, and then attempts to work out the final dimensions of the merged image and returns it.

Usage

```
mergeMriImages(...)
```

Arguments

... MriImage objects. They do not need to have the same dimensionality, but they would usually not vary by more than one dimension.

Value

A merged image.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. Journal of Statistical Software 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[MriImage](#)

MriImage-class

The MriImage class

Description

This class represents an MRI image. An object of this class is made up of some voxel data, stored as a sparse or dense numeric array, and some metadata, such as the file it was read from, the voxel dimensions, and so on. The group generic functions [Math](#), [Ops](#) and [Summary](#) are defined for this class, as are methods for coercing to and from a standard [array](#).

Fields

`imageDims` Integer vector of dimensions

`voxelDims` Numeric vector of pixel/voxel spacings

`voxelDimUnits` Character vector of spatial and/or temporal spacing units. Millimetres and seconds (i.e., c("mm","s")) are typical

`source` String naming the file(s) that the image was read from. This is reset to the empty string if the image is modified

`origin` Numeric vector giving the spatial coordinate origin

`storedXform` Numeric matrix giving the NIfTI xform matrix read from file, if any

`reordered` Logical value indicating whether the image has been reordered. See [reorderMriImage](#)

`tags` Named list of arbitrary DICOM-style tags

`data` Sparse or dense array of data, or NULL

Methods

`apply(...)` Apply a function to the margins of the image

`binarise()` Binarise the image by setting nonzero values to one

`fill(value)` Fill the image with a particular value

`getDataAtPoint(...)` Obtain the value of the image at a particular point

`getMetadata()` Obtain a version of the image with any data removed

`getNonzeroIndices(array = TRUE, positiveOnly = FALSE)` Find voxels whose values are not zero

`getSlice(dim, loc)` Extract data from a slice of the image along one dimension
`getSparseness()` Obtain the proportion of zeroes in the image
`getTags(keys = NULL)` Retrieve some or all of the tags stored with the image
`getXform(implicit = TRUE)` Retrieve the stored or implicit xform matrix
`map(fun, ..., sparse = NULL)` Replace the current data with the result of a function
`mask(maskImage)` Mask the image, setting zero voxels in the mask to zero
`setOrigin(newOrigin)` Update the origin of the image
`setSource(newSource)` Update the source of the image
`setXform(newXform)` Update the xform matrix associated with the image
`threshold(level, defaultValue = 0)` Threshold the image by setting values below the threshold level to zero

newMriImageFromDicomDirectory

Deprecated functions

Description

These functions are deprecated, generally in favour of more succinct alternatives.

Usage

`newMriImageFromDicomDirectory(dicomDir, readDiffusionParams = FALSE,
untilMosaics = TRUE)`

`newMriImageFromFile(fileName, fileType = NULL, metadataOnly = FALSE,
volumes = NULL, sparse = FALSE, mask = NULL, reorder = TRUE)`

`writeMriImageToFile(image, fileName = NULL, fileType = NA,
overwrite = TRUE)`

`newMriImageByExtraction(image, dim, loc)`

`extractDataFromMriImage(image, dim, loc)`

`newMriImageByReordering(image)`

`newMriImageByTrimming(image, clearance = 4)`

`newMriImageWithData(data, templateImage = nilObject(), imageDims = NA,
voxelDims = NA, voxelDimUnits = NA, origin = NA, tags = NA)`

`newMriImageWithSimpleFunction(image, fun, ...)`

```

newMriImageWithBinaryFunction(image1, image2, fun, ...)

newMriImageByMasking(image, mask)

newMriImageByThresholding(image, level, defaultValue = 0)

newDicomMetadataFromFile(fileName, checkFormat = TRUE, dictionary = NULL,
  stopTag = NULL, ignoreTransferSyntax = FALSE)

removeImageFilesWithName(fileName)

```

Arguments

dicomDir	Character vector of length one giving the name of a directory containing DICOM files.
readDiffusionParams	Logical value: should diffusion MRI parameters (b-values and gradient directions) be retrieved from the files if possible?
untileMosaics	Logical value: should Siemens mosaic images be converted into 3D volumes? This may occasionally be performed in error, which can be prevented by setting this value to FALSE.
fileName	File names, with or without appropriate extension.
fileType	A character vector of length one, giving the file type required or expected. If this option is missing, the file type used for writing images will be taken from the tractorFileType option. See Details.
metadataOnly	Logical value: if TRUE, only metadata are read into the object.
volumes	An optional integer vector specifying a subset of volumes to read (generally to save memory). If given, only the requested volumes in the 4D file will be read.
sparse	Logical value: should the image data be stored in a SparseArray object?
mask	An array whose nonzero voxel locations will be masked in.
reorder	Logical value: should the image data be reordered to LAS? This is recommended in most circumstances.
image, image1, image2	MriImage objects.
overwrite	Logical value: overwrite an existing image file? For writeImageFile, an error will be raised if there is an existing file and this is set to FALSE.
dim	The dimension and location along that dimension for which data should be extracted.
loc	The dimension and location along that dimension for which data should be extracted.
clearance	The number of voxels' clearance left around a trimmed image.
data	An array of pixel/voxel data.
templateImage	An optional MriImage object, to be used as a metadata template.
imageDims	Metadata for the new image object. These values override any from the metadata object or data array. See MriImage class documentation for details.

voxelDims	Metadata for the new image object. These values override any from the metadata object or data array. See MriImage class documentation for details.
voxelDimUnits	Metadata for the new image object. These values override any from the metadata object or data array. See MriImage class documentation for details.
origin	Metadata for the new image object. These values override any from the metadata object or data array. See MriImage class documentation for details.
tags	Metadata for the new image object. These values override any from the metadata object or data array. See MriImage class documentation for details.
fun	A function, of the appropriate arity.
...	Additional argument to fun.
level	The threshold level, below which all voxels will be reset.
defaultValue	The value to reset to.
checkFormat	If TRUE, the function will check for the magic string "DICM" at byte offset 128. This string should be present, but in reality not all files contain it.
dictionary	Ignored.
stopTag	An integer vector giving the group and element numbers (in that order) of a DICOM tag, or NULL. If not NULL, the function will stop parsing the DICOM file if the specified tag is encountered. This can be used to speed up the process if a specific tag is required.
ignoreTransferSyntax	If TRUE, any transfer syntax stored in the file will be ignored, and the code will try to deduce the transfer syntax using heuristics. This may occasionally be necessary for awkward DICOM files, but is not generally recommended.

newSparseArrayWithData

Create a SparseArray object

Description

This function creates a [SparseArray](#) object from its constituent parts.

Usage

```
newSparseArrayWithData(data, coordinates, dims)
```

Arguments

data	A vector of (nonzero) array elements.
coordinates	A matrix with as many rows as data has elements, containing the coordinates of each nonzero element in the array.
dims	The dimensions of the array.

Value

A `SparseArray` object.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

nilObject

The nil object

Description

The nil object is an empty object of class `SerialisableObject`. It can be used as a placeholder where such an object of this class, or one of its subclasses, is required. It serialises to the empty list.

Usage

```
nilObject()
```

```
is.nilObject(object)
```

Arguments

object Any object.

Value

`nilObject` returns the nil object. `is.nilObject` returns TRUE if its argument is identical to the nil object, or if it is equivalent in the sense of serialising to an identical result.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also[SerialisableObject](#)

pluralise	<i>Number agreement with a vector</i>
-----------	---------------------------------------

Description

This function chooses the singular or plural form of a word based on the length of an associated vector, or an integer.

Usage

```
pluralise(singular, x = NULL, n = NULL, plural = NULL)
```

Arguments

singular	The singular form of the word.
x	A vector of any mode, whose length is used to choose the correct word form, unless n is specified.
n	An integer which is used to choose the correct word form (singular if n = 1, plural otherwise). Take priority over x if not NULL.
plural	The plural form of the word. If NULL, an 's' is simply appended to the singular form.

Value

Either singular or plural, as appropriate.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

printLabelledValues *Pretty print labelled information*

Description

This is a simple function to print a series of labels and associated data values, or key-value pairs.

Usage

```
printLabelledValues(labels, values, outputLevel = OL$Info,  
  leftJustify = FALSE)
```

Arguments

labels	A character vector of labels.
values	A character vector of values. Must have the same length as labels.
outputLevel	The output level to print the output to. See <code>setOutputLevel</code> , in the <code>reportr</code> package.
leftJustify	Logical value: if TRUE the labels will be left justified; otherwise they will be right justified.

Value

This function is called for its side effect.

Author(s)

Jon Clayden

References

Please cite the following reference when using `TractoR` in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). `TractoR`: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[setOutputLevel](#) for the `reportr` output level system.

promote	<i>Promote a vector to a single-column or single-row matrix</i>
---------	-----------------------------------------------------------------

Description

The promote function promotes a vector argument to a single-column or single-row matrix. Matrix arguments are returned unmodified.

Usage

```
promote(x, byrow = FALSE)
```

Arguments

x	A vector or matrix.
byrow	Logical value: if TRUE, a vector will be promoted to a single-row matrix; otherwise a single-column matrix will result.

Value

A matrix version of the x argument.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. Journal of Statistical Software 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[matrix](#)

readDicomDirectory *Read a directory of DICOM files*

Description

This function scans a directory for files in DICOM format, and converts them to a single Analyze/NIfTI-format image of the appropriate dimensionality.

Usage

```
readDicomDirectory(dicomDir, readDiffusionParams = FALSE,  
  untileMosaics = TRUE)
```

Arguments

dicomDir Character vector of length one giving the name of a directory containing DICOM files.

readDiffusionParams Logical value: should diffusion MRI parameters (b-values and gradient directions) be retrieved from the files if possible?

untileMosaics Logical value: should Siemens mosaic images be converted into 3D volumes? This may occasionally be performed in error, which can be prevented by setting this value to FALSE.

Value

A list containing elements

image An `MriImage` object.

bValues Diffusion b-values, if requested. Will be NA if the information could not be found in files.

bVectors Diffusion gradient vectors, if requested. Will be NA if the information could not be found in the files.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[DicomMetadata](#), [MriImage](#), [sortDicomDirectories](#).

readDicomFile	<i>Read a DICOM file into a DicomMetadata object</i>
---------------	------------------------------------------------------

Description

This function reads a DICOM file into a `DicomMetadata` object. Only DICOM files from magnetic resonance scanners are supported.

Usage

```
readDicomFile(fileName, checkFormat = TRUE, stopTag = NULL,  
              ignoreTransferSyntax = FALSE, ascii = TRUE)
```

Arguments

<code>fileName</code>	The name of a DICOM file.
<code>checkFormat</code>	If TRUE, the function will check for the magic string "DICM" at byte offset 128. This string should be present, but in reality not all files contain it.
<code>stopTag</code>	An integer vector giving the group and element numbers (in that order) of a DICOM tag, or NULL. If not NULL, the function will stop parsing the DICOM file if the specified tag is encountered. This can be used to speed up the process if a specific tag is required.
<code>ignoreTransferSyntax</code>	If TRUE, any transfer syntax stored in the file will be ignored, and the code will try to deduce the transfer syntax using heuristics. This may occasionally be necessary for awkward DICOM files, but is not generally recommended.
<code>ascii</code>	If TRUE, the function will attempt to read an embedded Siemens ASCII header, if one exists.

Value

`readDicomFile` returns a `DicomMetadata` object, or NULL on failure.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

The DICOM standard, found online at <http://dicom.nema.org/>. (Warning: may produce headaches!)
 Also [readDicomDirectory](#) for information on how to create [MriImage](#) objects from DICOM files.

relativePath *Functions for file name and path manipulation*

Description

Functions for expanding file paths, finding relative paths and ensuring that a file name has the required suffix.

Usage

```
relativePath(path, referencePath)

matchPaths(path, referencePath)

expandFileName(fileName, base = getwd())

ensureFileSuffix(fileName, suffix, strip = NULL)
```

Arguments

path, referencePath	Character vectors whose elements represent file paths.
fileName	A character vector of file names.
base	If fileName is a relative path, this option gives the base directory which the path is relative to. If fileName is an absolute path, this argument is ignored.
suffix	A character vector of file suffixes, which will be recycled if shorter than fileName.
strip	A character vector of suffixes to remove before appending suffix. The intended suffix does not need to be given here, as the function will not append it if the specified file name already has the correct suffix.

Value

The ensureFileSuffix function returns the specified file names with the requested suffixes appended. expandFileName returns the full path to the specified file name, collapsing "." elements if appropriate. relativePath returns the specified path, expressed relative to referencePath. matchPaths resolves a vector of paths against a vector of reference paths.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. Journal of Statistical Software 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[path.expand](#) performs some of what `expandFileName` does.

resolveVector	<i>Miscellaneous vector functions</i>
---------------	---------------------------------------

Description

These functions provide the (Euclidean) length of a vector, the vector cross product or angle between two vectors.

Usage

```
resolveVector(len, ...)
```

```
vectorLength(vector)
```

```
vectorCrossProduct(a, b)
```

```
angleBetweenVectors(v1, v2)
```

Arguments

len	The expected length of the vector.
...	Elements of the vector, to be concatenated together.
vector, v1, v2	Numeric vectors of any length.
a, b	Numeric 3-vectors.

Value

For `vectorLength`, the Euclidean norm or length of the specified vector, given by `sqrt(sum(vector^2))`. For `vectorCrossProduct`, the vector cross product of the two specified vectors; and for `angleBetweenVectors`, the angle (in radians) between the two specified vectors. The `resolveVector` function concatenates the values given in `...{}`, and if the result is a vector of length `len` then it is returned. If not, `NULL` is returned.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. Journal of Statistical Software 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[crossprod](#) for the matrix cross product.

SerialisableObject-class

The SerialisableObject class

Description

This reference class extends the standard [envRefClass](#) class, adding a function for simple serialisation of the data fields of an object, and one for finding all of the methods available for an object. A serialised object may be deserialised using the [deserialiseReferenceObject](#) function.

Methods

`fields()` Retrieve a list of all field names

`serialise(file = NULL)` Serialise the object to a list or file

`sortDicomDirectories` *Sort a directory of DICOM files into series*

Description

This function sorts a directory containing DICOM files into subdirectories by series UID (DICOM tag 0x0020,0x000e), subject name (0x0010,0x0010) and/or scan date (0x0008,0x0020). Each unique identifier, together with its description for series, will be used as the name for a new subdirectory, and all relevant files will be copied into that subdirectory. Duplicate file names are disambiguated if necessary.

Usage

```
sortDicomDirectories(directories, deleteOriginals = FALSE,
  sortOn = "series", seriesId = c("UID", "number", "time"), nested = TRUE)
```


Arguments

directories	A character vector giving the directories to search for DICOM files. Subdirectories will also be searched.
deleteOriginals	A single logical value. If TRUE, then the source files will be deleted after being copied to their new locations, making the operation a move rather than a copy. Nothing will be deleted if the copy fails.
sortOn	The string "series", "subject" or "date", or any combination in the order desired. This will be the basis of the sort, which will be nested if more than one type is specified.
seriesId	A string describing the kind of series identifier to use for sorting by series: "UID" (DICOM tag 0x0020,0x000e; the default), "number" (0x0020,0x0011) or "time" (0x0008,0x0031).
nested	Logical value. If TRUE and directories is of length 1, subdirectories will be created within the specified original directory. Otherwise they will be created in the working directory.

Value

This function is called for its side effect.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. Journal of Statistical Software 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also

[readDicomDirectory](#) for reading DICOM files into an Mri Image object.

SparseArray-class *The SparseArray class*

Description

This class represents an array with any number of dimensions, in which a significant proportion of entries are zero. The coordinates of nonzero entries are stored along with their values, with all remaining entries assumed to be zero. Methods are provided to index into the array in the standard way, using matrix or vector indices; and for coercing between SparseArray objects and standard (dense) arrays.

Fields

data Vector of nonzero data values
 coords Integer matrix of nonzero data locations, one per row
 dims Integer vector of dimensions

Methods

aperm(perm) Permute the dimensions of the array
 apply(margin, fun, ...) Apply a function to margins of the array
 flip(dimsToFlip) Flip the array along one or more directions
 setCoordinatesAndData(newCoords, newData) Update the nonzero locations and data values in the array
 setDimensions(newDims) Change the dimensions of the image

threadSafeTempFile *Obtain thread-safe temporary file names*

Description

This function is a wrapper around `tempfile`, which creates temporary file names whose path contains the process ID of the calling process. This avoids clashes between threads created by functions such as `mclapply` (in the “parallel” package), which can easily occur with the standard `tempfile` function.

Usage

```
threadSafeTempFile(pattern = "file")
```

Arguments

pattern Character vector giving the initial part of each file name.

Value

A character vector of temporary file names. No files are actually created.

Author(s)

Jon Clayden

References

Please cite the following reference when using TractoR in your work:

J.D. Clayden, S. Muñoz Maniega, A.J. Storkey, M.D. King, M.E. Bastin & C.A. Clark (2011). TractoR: Magnetic resonance imaging and tractography with R. *Journal of Statistical Software* 44(8):1-18. <http://www.jstatsoft.org/v44/i08/>.

See Also[tempfile](#)

 [,SparseArray,ANY,ANY-method
Indexing methods

Description

Indexing methods for [SparseArray](#) and [MriImage](#) objects. For the latter class, arguments are passed to the equivalents for array or [SparseArray](#). For [SparseArray](#), indexing may be blank, or by numeric vector or matrix.

Usage

```
## S4 method for signature 'SparseArray,ANY,ANY'
x[i, j, ..., drop = TRUE]

## S4 replacement method for signature 'SparseArray,ANY,ANY'
x[i, j, ...] <- value

## S4 method for signature 'MriImage,missing,missing'
x[i, j, ..., drop = TRUE]

## S4 method for signature 'MriImage,ANY,missing'
x[i, j, ..., drop = TRUE]

## S4 method for signature 'MriImage,missing,ANY'
x[i, j, ..., drop = TRUE]

## S4 method for signature 'MriImage,ANY,ANY'
x[i, j, ..., drop = TRUE]

## S4 replacement method for signature 'MriImage,missing,missing'
x[i, j, ...] <- value

## S4 replacement method for signature 'MriImage,ANY,missing'
x[i, j, ...] <- value

## S4 replacement method for signature 'MriImage,missing,ANY'
x[i, j, ...] <- value

## S4 replacement method for signature 'MriImage,ANY,ANY'
x[i, j, ...] <- value
```

Arguments

x	An object of the appropriate type.
i, j, ...	Indexing objects.
drop	Scalar value: should unitary dimensions be dropped?
value	New value(s) for replacement forms.

Value

A vector, array or [SparseArray](#).

Author(s)

Jon Clayden

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