

# Package ‘ijtiff’

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**Type** Package

**Title** Comprehensive TIFF I/O with Full Support for 'ImageJ' TIFF Files

**Version** 2.2.5

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**Description** General purpose TIFF file I/O for R users.

Currently the only such package with read and write support for TIFF files with floating point (real-numbered) pixels, and the only package that can correctly import TIFF files that were saved from 'ImageJ' and write TIFF files than can be correctly read by 'ImageJ' <<https://imagej.nih.gov/ij/>>. Also supports text image I/O.

**License** GPL-3

**URL** <https://docs.ropensci.org/ijtiff/>,  
<https://github.com/ropensci/ijtiff>

**BugReports** <https://github.com/ropensci/ijtiff/issues>

**Depends** R (>= 3.5)

**Imports** checkmate (>= 1.9.3), cli, dplyr, fs (>= 1.3.1), graphics, grDevices, magrittr (>= 1.5), methods, purrr, readr, rlang (>= 0.3.3), strex (>= 1.4), stringr (>= 1.4), withr (>= 2.1), zeallot

**Suggests** abind, covr, EBImage, knitr, mockery, pacman, rmarkdown, rprojroot, spelling, testthat (>= 2.1), tiff, vdiff

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**LazyData** true

**RoxygenNote** 7.1.1

**SystemRequirements** libtiff, libjpeg, zlib

**NeedsCompilation** yes

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as_EBImage	<i>Convert an <code>ijtiff_img</code> to an <code>EBImage::Image</code>.</i>
------------	--

---

### Description

This is for interoperability with the the EBImage package.

### Usage

```
as_EBImage(img, colormode = NULL, scale = TRUE, force = TRUE)
```

### Arguments

img	An <code>ijtiff_img</code> object (or something coercible to one).
colormode	A numeric or a character string containing the color mode which can be either "Grayscale" or "Color". If not specified, a guess is made. See 'Details'.
scale	Scale values in an integer image to the range [0, 1]? Has no effect on floating-point images.

force This function is designed to take `ijtiff_imgs` as input. To force any old array through this function, use `force = TRUE`, but take care to check that the result is what you'd like it to be.

### Details

The guess for the `colormode` is made as follows: \* If `img` has an attribute `color_space` with value "RGB", then `colormode` is set to "Color". \* Else if `img` has 3 or 4 channels, then `colormode` is set to "Color". \* Else `colormode` is set to "Grayscale".

### Value

An `EImage::Image`.

### Examples

```
img <- read_tif(system.file("img", "Rlogo.tif", package = "ijtiff"))
str(img)
str(as_EImage(img))
```

---

count\_frames

*Count the number of frames in a TIFF file.*

---

### Description

TIFF files can hold many frames. Often this is sensible, e.g. each frame could be a time-point in a video or a slice of a z-stack.

### Usage

```
count_frames(path)
```

```
frames_count(path)
```

### Arguments

path A string. The path to the tiff file to read.

### Details

For those familiar with TIFF files, this function counts the number of directories in a TIFF file. There is an adjustment made for some ImageJ-written TIFF files.

### Value

A number, the number of frames in the TIFF file. This has an attribute `n_dirs` which holds the true number of directories in the TIFF file, making no allowance for the way ImageJ may write TIFF files.

**Examples**

```
count_frames(system.file("img", "Rlogo.tif", package = "ijttiff"))
```

---

display

*Basic image display.*


---

**Description**

Display an image that has been read in by `read_tif()` as it would look in 'ImageJ'. This function is really just `EBImage::display()` on the inside. If you do not have EBImage installed, a more basic display is offered.

**Usage**

```
display(img, method = NULL, basic = FALSE, normalize = TRUE)
```

**Arguments**

<code>img</code>	An <code>ijttiff_img</code> object.
<code>method</code>	The way of displaying images. Defaults to "browser" when R is used interactively, and to "raster" otherwise. The default behavior can be overridden by setting <code>options("EBImage.display")</code> . This has no effect when <code>basic = TRUE</code> .
<code>basic</code>	Force the basic (non-EBImage) display.
<code>normalize</code>	Normalize the image before displaying (for better contrast)? This only has an effect if the EBImage functionality is used. The basic display always normalizes.

**Examples**

```
if (requireNamespace("EBImage")) {
  img <- read_tif(system.file("img", "Rlogo.tif", package = "ijttiff"))
  display(img)
  display(img[, , 1, 1]) # first (red) channel, first frame
  display(img[, , 2, 1]) # second (green) channel, first frame
  display(img[, , 3, 1]) # third (blue) channel, first frame
  display(img, basic = TRUE) # displays first (red) channel, first frame
}
```

---

ijtiff	ijtiff: <i>TIFF I/O for ImageJ users</i>
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---

### Description

This is a general purpose TIFF I/O utility for R. The `tiff` package already exists for this purpose but `ijtiff` adds some functionality and overcomes some bugs therein.

### Details

- `ijtiff` can write TIFF files whose pixel values are real (floating-point) numbers; `tiff` cannot.
- `ijtiff` can read and write *text images*; `tiff` cannot.
- `tiff` struggles to interpret channel information and gives cryptic errors when reading TIFF files written by the *ImageJ* software; `ijtiff` works smoothly with these images.

---

ijtiff_img	ijtiff_img <i>class</i> .
------------	---------------------------

---

### Description

A class for images which are read or to be written by the `ijtiff` package.

### Usage

```
ijtiff_img(img, ...)
as_ijtiff_img(img, ...)
```

### Arguments

<code>img</code>	An array representing the image. <ul style="list-style-type: none"> <li>• For a single-plane, grayscale image, use a matrix <code>img[y, x]</code>.</li> <li>• For a multi-plane, grayscale image, use a 3-dimensional array <code>img[y, x, plane]</code>.</li> <li>• For a multi-channel, single-plane image, use a 4-dimensional array with a redundant 4th slot <code>img[y, x, channel, ]</code> (see <code>ijtiff_img</code> 'Examples' for an example).</li> <li>• For a multi-channel, multi-plane image, use a 4-dimensional array <code>img[y, x, channel, plane]</code>.</li> </ul>
<code>...</code>	Named arguments which are set as attributes.

### Value

A 4 dimensional array representing an image, indexed by `img[y, x, channel, frame]`, with selected attributes.

**Examples**

```
img <- matrix(1:4, nrow = 2) # to be a single-channel, grayscale image
ijttiff_img(img, description = "single-channel, grayscale")
img <- array(seq_len(2^3), dim = rep(2, 3)) # 1 channel, 2 frame
ijttiff_img(img, description = "blah blah blah")
img <- array(seq_len(2^3), dim = c(2, 2, 2, 1)) # 2 channel, 1 frame
ijttiff_img(img, description = "blah blah")
img <- array(seq_len(2^4), dim = rep(2, 4)) # 2 channel, 2 frame
ijttiff_img(img, software = "R")
```

---

linescan-conversion     *Rejig linescan images.*

---

**Description**

ijttiff has the fourth dimension of an [ijttiff\\_img](#) as its time dimension. However, some linescan images (images where a single line of pixels is acquired over and over) have the time dimension as the y dimension, (to avoid the need for an image stack). These functions allow one to convert this type of image into a conventional [ijttiff\\_img](#) (with time in the fourth dimension) and to convert back.

**Usage**

```
linescan_to_stack(linescan_img)

stack_to_linescan(img)
```

**Arguments**

linescan_img	A 4-dimensional array in which the time axis is the first axis. Dimension 4 must be 1 i.e. <code>dim(linescan_img)[4] == 1</code> .
img	A conventional <a href="#">ijttiff_img</a> , to be turned into a linescan image. Dimension 1 must be 1 i.e. <code>dim(img)[1] == 1</code> .

**Value**

The converted image, an object of class [ijttiff\\_img](#).

**Examples**

```
linescan <- ijttiff_img(array(rep(1:4, each = 4), dim = c(4, 4, 1, 1)))
print(linescan)
stack <- linescan_to_stack(linescan)
print(stack)
linescan <- stack_to_linescan(stack)
print(linescan)
```

---

print.ijtiff_img	<i>Print method for an ijtiff_img.</i>
------------------	--

---

**Description**

Print method for an ijtiff\_img.

**Usage**

```
## S3 method for class 'ijtiff_img'  
print(x, ...)
```

**Arguments**

x	An object of class <a href="#">ijtiff_img</a> .
...	Not currently used.

**Value**

The input (invisibly).

---

read_tags	<i>Read TIFF tag information without actually reading the image array.</i>
-----------	--

---

**Description**

TIFF files contain metadata about images in their *TIFF tags*. This function is for reading this information without reading the actual image.

**Usage**

```
read_tags(path, frames = 1)
```

```
tags_read(path, frames = 1)
```

**Arguments**

path	A string. The path to the tiff file to read.
frames	Which frames do you want to read tags from. Default first frame only. To read from the 2nd and 7th frames, use <code>frames = c(2, 7)</code> , to read from all frames, use <code>frames = "all"</code> .

**Value**

A list of lists.

**Author(s)**

Simon Urbanek, Kent Johnson, Rory Nolan.

**See Also**

[read\\_tif\(\)](#)

**Examples**

```
read_tags(system.file("img", "Rlogo.tif", package = "ijttiff"))
read_tags(system.file("img", "Rlogo-banana.tif", package = "ijttiff"),
  frames = c(2, 4)
)
```

---

read\_tif

*Read an image stored in the TIFF format*

---

**Description**

Reads an image from a TIFF file/content into a numeric array or list.

**Usage**

```
read_tif(path, frames = "all", list_safety = "error", msg = TRUE)
```

```
tif_read(path, frames = "all", list_safety = "error", msg = TRUE)
```

**Arguments**

path	A string. The path to the tiff file to read.
frames	Which frames do you want to read. Default all. To read the 2nd and 7th frames, use <code>frames = c(2,7)</code> .
list_safety	A string. This is for type safety of this function. Since returning a list is unlikely and probably unexpected, the default is to error. You can instead opt to throw a warning ( <code>list_safety = "warning"</code> ) or to just return the list quietly ( <code>list_safety = "none"</code> ).
msg	Print an informative message about the image being read?

**Details**

TIFF files have the capability to store multiple images, each having multiple channels. Typically, these multiple images represent the sequential frames in a time-stack or z-stack of images and hence each of these images has the same dimension. If this is the case, they are all read into a single 4-dimensional array `img` where `img` is indexed as `img[y,x,channel,frame]` (where we have `y`, `x` to comply with the conventional row, col indexing of a matrix - it means that images displayed as arrays of numbers in the R console will have the correct orientation). However, it is possible that the images in the TIFF file have varying dimensions (most people have never seen this), in which



case they are read in as a list of images, where again each element of the list is a 4-dimensional array `img`, indexed as `img[y, x, channel, frame]`.

A (somewhat random) set of TIFF tags are attributed to the read image. These are `IMAGEDEPTH`, `BITSPERSAMPLE`, `SAMPLESPERPIXEL`, `SAMPLEFORMAT`, `PLANARCONFIG`, `COMPRESSION`, `THRESHHOLDING`, `XRESOLUTION`, `YRESOLUTION`, `RESOLUTIONUNIT`, `INDEXED` and `ORIENTATION`. More tags should be added in a subsequent version of this package. You can read about TIFF tags at <https://www.awaresystems.be/imaging/tiff/tifftags.html>.

TIFF images can have a wide range of internal representations, but only the most common in image processing are supported (8-bit, 16-bit and 32-bit integer and 32-bit float samples).

### Value

An object of class `ijtiff_img` or a list of `ijtiff_imgs`.

### Note

- 12-bit TIFFs are not supported.
- There is no standard for packing order for TIFFs beyond 8-bit so we assume big-endian packing.

### Author(s)

Simon Urbanek wrote most of this code for the 'tiff' package. Rory Nolan lifted it from there and changed it around a bit for this 'ijtiff' package. Credit should be directed towards Lord Urbanek.

### See Also

`write_tif()`

### Examples

```
img <- read_tif(system.file("img", "Rlogo.tif", package = "ijtiff"))
```

---

text-image-io

*Read/write an image array to/from disk as text file(s).*

---

### Description

Write images (arrays) as tab-separated .txt files on disk. Each channel-frame pair gets its own file.

**Usage**

```
write_txt_img(img, path, rds = FALSE, msg = TRUE)
```

```
read_txt_img(path, msg = TRUE)
```

```
txt_img_write(img, path, rds = FALSE, msg = TRUE)
```

```
txt_img_read(path, msg = TRUE)
```

**Arguments**

<code>img</code>	An image, represented by a 4-dimensional array, like an <a href="#">ijtiff_img</a> .
<code>path</code>	The name of the input/output output file(s), <i>without</i> a file extension.
<code>rds</code>	In addition to writing a text file, save the image as an RDS (a single R object file)?
<code>msg</code>	Print an informative message about the image being read?

**Examples**

```
img <- read_tif(system.file("img", "Rlogo.tif", package = "ijtiff"))
tmptxt <- tempfile(pattern = "img", fileext = ".txt")
write_txt_img(img, tmptxt)
tmptxt_ch1_path <- paste0(strex::str_before_last_dot(tmptxt), "_ch1.txt")
print(tmptxt_ch1_path)
txt_img <- read_txt_img(tmptxt_ch1_path)
```

---

tif\_tags\_reference      *TIFF tag reference.*

---

**Description**

A dataset containing the information on all known baseline and extended TIFF tags.

**Usage**

```
tif_tags_reference()
```

**Details**

A data frame with 96 rows and 10 variables:

**code\_dec** decimal numeric code of the TIFF tag

**code\_hex** hexadecimal numeric code of the TIFF tag

**name** the name of the TIFF tag

**short\_description** a short description of the TIFF tag

**tag\_type** the type of TIFF tag: either "baseline" or "extended"

**url** the URL of the TIFF tag at <https://www.awaresystems.be>

**libtiff\_name** the TIFF tag name in the libtiff C library

**c\_type** the C type of the TIFF tag data in libtiff

**count** the number of elements in the TIFF tag data

**default** the default value of the data held in the TIFF tag

### Source

<https://www.awaresystems.be>

### Examples

```
tif_tags_reference()
```

---

write\_tif

*Write images in TIFF format*

---

### Description

Write images into a TIFF file.

### Usage

```
write_tif(  
    img,  
    path,  
    bits_per_sample = "auto",  
    compression = "none",  
    overwrite = FALSE,  
    msg = TRUE  
)
```

```
tif_write(  
    img,  
    path,  
    bits_per_sample = "auto",  
    compression = "none",  
    overwrite = FALSE,  
    msg = TRUE  
)
```

**Arguments**

<code>img</code>	An array representing the image. <ul style="list-style-type: none"> <li>• For a single-plane, grayscale image, use a matrix <code>img[y, x]</code>.</li> <li>• For a multi-plane, grayscale image, use a 3-dimensional array <code>img[y, x, plane]</code>.</li> <li>• For a multi-channel, single-plane image, use a 4-dimensional array with a redundant 4th slot <code>img[y, x, channel, ]</code> (see <a href="#">ijtiff_img</a> 'Examples' for an example).</li> <li>• For a multi-channel, multi-plane image, use a 4-dimensional array <code>img[y, x, channel, plane]</code>.</li> </ul>
<code>path</code>	file name or a raw vector
<code>bits_per_sample</code>	number of bits per sample (numeric scalar). Supported values are 8, 16, and 32. The default "auto" automatically picks the smallest workable value based on the maximum element in <code>img</code> . For example, if the maximum element in <code>img</code> is 789, then 16-bit will be chosen because 789 is greater than $2^8 - 1$ but less than or equal to $2^{16} - 1$ .
<code>compression</code>	A string, the desired compression algorithm. Must be one of "none", "LZW", "PackBits", "RLE", "JPEG", "deflate" or "Zip". If you want compression but don't know which one to go for, I recommend "Zip", it gives a large file size reduction and it's lossless. Note that "deflate" and "Zip" are the same thing. Avoid using "JPEG" compression in a TIFF file if you can; I've noticed it can be buggy.
<code>overwrite</code>	If writing the image would overwrite a file, do you want to proceed?
<code>msg</code>	Print an informative message about the image being written?

**Value**

The input `img` (invisibly).

**Author(s)**

Simon Urbanek wrote most of this code for the 'tiff' package. Rory Nolan lifted it from there and changed it around a bit for this 'ijtiff' package. Credit should be directed towards Lord Urbanek.

**See Also**

[read\\_tif\(\)](#)

**Examples**

```
img <- read_tif(system.file("img", "Rlogo.tif", package = "ijtiff"))
temp_dir <- tempdir()
write_tif(img, paste0(temp_dir, "/", "Rlogo"))
img <- matrix(1:4, nrow = 2)
write_tif(img, paste0(temp_dir, "/", "tiny2x2"))
list.files(temp_dir, pattern = "tif$")
```

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