

# Package ‘nipalsMCIA’

October 18, 2024

**Title** Multiple Co-Inertia Analysis via the NIPALS Method

**Version** 1.3.1

**Description** Computes Multiple Co-Inertia Analysis (MCIA), a dimensionality reduction (jDR) algorithm, for a multi-block dataset using a modification to the Nonlinear Iterative Partial Least Squares method (NIPALS) proposed in (Hanafi et. al, 2010). Allows multiple options for row- and table-level preprocessing, and speeds up computation of variance explained. Vignettes detail application to bulk- and single cell- multi-omics studies.

**License** GPL-3

**URL** <https://github.com/Muunraker/nipalsMCIA>

**BugReports** <https://github.com/Muunraker/nipalsMCIA/issues>

**Depends** R (>= 4.3.0)

**Imports** ComplexHeatmap, dplyr, fgsea, ggplot2 (>= 3.0.0), graphics, grid, methods, MultiAssayExperiment, SummarizedExperiment, pracma, rlang, RSpecra, scales, stats

**Suggests** BiocFileCache, BiocStyle, circelize, ggpubr, KernSmooth, knitr, piggyback, reshape2, rmarkdown, rpart, Seurat (>= 4.0.0), spatstat.explore, stringr, survival, tidyverse, testthat (>= 3.0.0)

**VignetteBuilder** knitr

**biocViews** Software, Clustering, Classification, MultipleComparison, Normalization, Preprocessing, SingleCell

**Encoding** UTF-8

**RoxygenNote** 7.3.1

**Config/testthat/edition** 3

**git\_url** <https://git.bioconductor.org/packages/nipalsMCIA>

**git\_branch** devel

**git\_last\_commit** c1bf9f2

**git\_last\_commit\_date** 2024-08-31

**Repository** Bioconductor 3.20

**Date/Publication** 2024-10-17

**Author** Maximilian Mattessich [cre] (<<https://orcid.org/0000-0002-1233-1240>>),  
 Joaquin Reyna [aut] (<<https://orcid.org/0000-0002-8468-2840>>),  
 Edel Aron [aut] (<<https://orcid.org/0000-0002-8683-4772>>),  
 Ferhat Ay [aut] (<<https://orcid.org/0000-0002-0708-6914>>),  
 Steven Kleinstein [aut] (<<https://orcid.org/0000-0003-4957-1544>>),  
 Anna Konstorum [aut] (<<https://orcid.org/0000-0003-4024-2058>>)

**Maintainer** Maximilian Mattessich <maximilian.mattessich@northwestern.edu>

## Contents

nipalsMCIA-package . . . . .	3
block_preproc . . . . .	3
block_weights_heatmap . . . . .	4
cc_preproc . . . . .	5
col_preproc . . . . .	5
data_blocks . . . . .	6
deflate_block_bl . . . . .	7
deflate_block_gs . . . . .	7
extract_from_mae . . . . .	8
get_colors . . . . .	9
get_metadata_colors . . . . .	9
get_tv . . . . .	10
global_scores_eigenvalues_plot . . . . .	11
global_scores_heatmap . . . . .	11
gsea_report . . . . .	12
metadata_NCI60 . . . . .	13
NipalsResult-class . . . . .	13
nipals_iter . . . . .	14
nipals_multiblock . . . . .	14
nmb_get_bl . . . . .	16
nmb_get_bs . . . . .	17
nmb_get_bs_weights . . . . .	18
nmb_get_eigs . . . . .	18
nmb_get_gl . . . . .	19
nmb_get_gs . . . . .	19
nmb_get_metadata . . . . .	20
ord_loadings . . . . .	20
predict_gs . . . . .	21
projection_plot . . . . .	22
simple_mae . . . . .	23
vis_load_ord . . . . .	24
vis_load_plot . . . . .	25

**Index**

**26**

---

nipalsMCIA-package      *nipalsMCIA: Multiple Co-Inertia Analysis via the NIPALS Method*

---

### Description

Computes Multiple Co-Inertia Analysis (MCIA), a dimensionality reduction (jDR) algorithm, for a multi-block dataset using a modification to the Nonlinear Iterative Partial Least Squares method (NIPALS) proposed in (Hanafi et. al, 2010). Allows multiple options for row- and table-level preprocessing, and speeds up computation of variance explained. Vignettes detail application to bulk- and single cell- multi-omics studies.

### Author(s)

**Maintainer:** Maximilian Mattessich <maximilian.mattessich@northwestern.edu> ([ORCID](#))

Authors:

- Joaquin Reyna <joreyna@live.com> ([ORCID](#))
- Edel Aron <edel.aron@yale.edu> ([ORCID](#))
- Anna Konstorum <konstorum.anna@gmail.com> ([ORCID](#))

### See Also

Useful links:

- <https://github.com/Muunraker/nipalsMCIA>
- Report bugs at <https://github.com/Muunraker/nipalsMCIA/issues>

---

block\_preproc      *Block-level preprocessing*

---

### Description

A function that normalizes an input dataset (data block) according to a variety of options. Intended to be used after column/row-level normalization.

### Usage

```
block_preproc(df, block_preproc_method)
```

### Arguments

df                      dataset to preprocess (must be in data matrix form)

block\_preproc\_method

method which is used to normalize blocks, with options:

- ‘unit\_var’ FOR CENTERED MATRICES ONLY - divides each block by the square root of its variance
- ‘num\_cols’ divides each block by the number of variables in the block.
- ‘largest\_sv’ divides each block by its largest singular value.
- ‘none’ performs no preprocessing

**Value**

the preprocessed dataset

**Examples**

```
df <- matrix(rbinom(15, 1, prob = 0.3), ncol = 3)
preprocessed_dataframe <- block_preproc(df, "unit_var")
```

---

block\_weights\_heatmap *block\_weights\_heatmap*

---

**Description**

Function to plot heatmap of block score weights

**Usage**

```
block_weights_heatmap(mcia_results)
```

**Arguments**

`mcia_results` MCIA results object returned from ‘nipals\_multiblock‘

**Details**

Plotting function for heatmap of block score weights

**Value**

heatmap object containing the block weights as a heatmap

**Examples**

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                plots = "none", tol = 1e-12)
block_weights_heatmap(mcia_results)
```

---

`cc_preproc`*Centered Column Profile Pre-processing*

---

**Description**

Converts data blocks into centered column profiles where each block has unit variance. Mimics the pre-processing in the Omicade4 package (Meng et al. 2014)

**Usage**

```
cc_preproc(df)
```

**Arguments**

`df` the data frame to apply pre-processing to, in "sample" x "variable" format

**Details**

Performs the following steps on a given data frame:

- Offsets data to make whole matrix non-negative
- Divides each column by its sum
- Subtracts (row sum/total sum) from each row
- Multiplies each column by  $\sqrt{\text{column sum/total sum}}$
- Divides the whole data frame by its total variance (the sqrt of the sum of singular values)

**Value**

the processed data frame

**Examples**

```
df <- matrix(rbinom(15, 1, prob = 0.3), ncol = 3)
preprocessed_dataframe <- cc_preproc(df)
```

---

`col_preproc`*Centered Column Profile Pre-processing*

---

**Description**

Converts data blocks into centered column profiles where each block has unit variance. Mimics the pre-processing in the Omicade4 package (Meng et al. 2014)

**Usage**

```
col_preproc(df, col_preproc_method)
```

**Arguments**

`df` the data frame to apply pre-processing to, in "sample" x "variable" format

`col_preproc_method`

denotes the type of column-centered preprocessing. Options are:

- ‘colprofile’ Performs the following steps on a given data frame:
  - Offsets data to make whole matrix non-negative
  - Divides each column by its sum
  - Subtracts (row sum/total sum) from each row
  - Multiplies each column by  $\sqrt{\text{column sum/total sum}}$
- ‘standardized’ centers each column and divides by its standard deviation.
- ‘centered\_only’ ONLY centers data

**Details**

Performs preprocessing on a sample/variable (row/column) level according to the parameter given.

**Value**

the processed data frame

**Examples**

```
df <- matrix(rbinom(15, 1, prob = 0.3), ncol = 3)
preprocessed_dataframe <- col_preproc(df, col_preproc_method = 'colprofile')
```

---

data\_blocks

*NCI-60 Multi-Omics Data*

---

**Description**

A dataset of measurements of 12,895 mRNA, 537 miRNA, and 7,016 protein variables (columns) on 21 cancer cell lines (rows) from the NCI-60 cancer cell line database.

**Value**

Large list with 3 elements (one for each omic)

**Source**

Meng et. al, 2016 supplementary materials <https://doi.org/10.1093/bib/bbv108>

**References**

<https://github.com/aedin/NCI60Example>



**Details**

Subtracts the component of each column in the direction of a given global scores vector to yield a 'deflated' data matrix.

**Value**

the deflated data frame

**Examples**

```
df <- matrix(rbinom(15, 1, prob = 0.3), ncol = 3)
global_score <- rbinom(5, 1, prob = 0.3)
deflated_data <- deflate_block_gs(df, global_score)
```

---

extract_from_mae	<i>Extract a list of harmonized data matrices from an MAE object</i>
------------------	--

---

**Description**

Extract a list of harmonized data matrices for input into nipals\_multiblock() from an MAE object

**Usage**

```
extract_from_mae(MAE_object, subset_data = "all")
```

**Arguments**

MAE_object	an MAE object containing experiment data for extraction colData field optional experiments should either be SummarizedExperiment, SingleCellExperiment, or RangedSummarizedExperiment classes
subset_data	<ul style="list-style-type: none"> <li>• 'all' use all experiments in MAE object</li> <li>• 'c(omic1,omic2,...)' list of omics from names(MAE_object)</li> </ul>

**Value**

List of harmonized data matrices for input into nipals\_multiblock()

**Examples**

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
NCI60_input = extract_from_mae(data_blocks_mae,subset='all')
```



---

get\_colors                      *Assigning colors to different omics*

---

### Description

Creates a list of omics and associated colors for plotting. The default palette was chosen to be color-blindness friendly.

### Usage

```
get_colors(  
  mcia_results,  
  color_pal = scales::viridis_pal,  
  color_pal_params = list()  
)
```

### Arguments

mcia\_results    object returned from nipals\_multiblock() function  
color\_pal       a function which returns color palettes (e.g. scales)  
color\_pal\_params    list of parameters for the corresponding function

### Value

List of omics with assigned colors

### Examples

```
data(NCI60)  
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",  
                             colData=metadata_NCI60)  
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,  
                                 plots = "none", tol = 1e-12)  
colors_omics <- get_colors(mcia_results)
```

---

get\_metadata\_colors            *Assigning colors to different values of a metadata column*

---

### Description

Creates a list of metadata columns and associated colors for plotting. The default palette was chosen to be color-blindness friendly.

### Usage

```
get_metadata_colors(  
  mcia_results,  
  color_col,  
  color_pal = scales::viridis_pal,  
  color_pal_params = list()  
)
```

**Arguments**

`mcia_results` object returned from `nipals_multiblock()` function  
`color_col` an integer or string specifying the column that will be used for `color_col`  
`color_pal` a function which returns color palettes (e.g. `scales`)  
`color_pal_params` list of parameters for the corresponding function

**Value**

List of metadata columns with assigned colors

**Examples**

```

data(NCI60)
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                 plots = "none", tol = 1e-12)
colors_omics <- get_metadata_colors(mcia_results, "cancerType",
                                   color_pal_params = list(option = "E"))

```

---

get\_tv

*Computes the total variance of a multi-omics dataset*

---

**Description**

Computes the total variances of all data blocks in a multi-omics dataset, intended for datasets that do not use ‘CCpreproc’

**Usage**

```
get_tv(ds)
```

**Arguments**

`ds` a list of multi-omics dataframes/matrices in "sample x variable" format

**Value**

the total variance of the dataset (i.e. sum of block variances)

**Examples**

```

data(NCI60)
tot_var <- get_tv(data_blocks)

```

---

```
global_scores_eigenvalues_plot  
    global_scores_eigenvalues_plot
```

---

**Description**

Function to plot eigenvalues of scores up to num\_PCs

**Usage**

```
global_scores_eigenvalues_plot(mcia_results)
```

**Arguments**

mcia\_results    MCIA results object returned from ‘nipals\_multiblock‘

**Details**

Plotting function for eigenvalues of scores up to num\_PCs

**Value**

Displays the contribution plot using eigenvalues

**Examples**

```
data(NCI60)  
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",  
                             colData=metadata_NCI60)  
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,  
                                plots = "none", tol=1e-12)  
global_scores_eigenvalues_plot(mcia_results)
```

---

```
global_scores_heatmap Plotting a heatmap of global factors scores (sample v. factors)
```

---

**Description**

Plots a heatmap of MCIA global scores

**Usage**

```
global_scores_heatmap(  
  mcia_results,  
  color_col = NULL,  
  color_pal = scales::viridis_pal,  
  color_pal_params = list(option = "D")  
)
```

**Arguments**

mcia_results	the mcia object matrix after running MCIA, must also contain metadata with columns corresponding to color_col
color_col	an integer or string specifying the column that will be used for color_col
color_pal	a list of colors or function which returns a list of colors
color_pal_params	a list of parameters for the color function

**Value**

ComplexHeatmap object

---

gsea_report	<i>Perform biological annotation-based comparison</i>
-------------	---

---

**Description**

Runs fgsea for the input gene vector

**Usage**

```
gsea_report(
  metagenes,
  path.database,
  factors = NULL,
  pval.thr = 0.05,
  nproc = 4
)
```

**Arguments**

metagenes	Vector of gene scores where the row names are HUGO symbols
path.database	path to a GMT annotation file
factors	vector of factors which should be analyzed
pval.thr	p-value threshold (default to 0.05)
nproc	number of processors to utilize

**Value**

data frame with the most significant p-value number of significant pathways  
the selectivity scores across the given factors

---

 metadata\_NCI60

*NCI-60 Multi-Omics Metadata*


---

**Description**

Metadata for the included multi-omics dataset, denoting the cancer type associated with each of the 21 cell lines.

**Value**

List with 21 elements

**Source**

Meng et. al, 2016 supplementary materials <https://doi.org/10.1093/bib/bbv108>

**References**

<https://github.com/aedin/NCI60Example>

---

 NipalsResult-class

*An S4 class to contain results computed with ‘nipals\_multiblock()’*


---

**Description**

An S4 class to contain results computed with ‘nipals\_multiblock()’

**Value**

A NipalsResult object.

**Slots**

`global_scores` A matrix containing global scores as columns.

`global_loadings` A matrix containing global loadings as columns.

`block_score_weights` A matrix containing block weights as columns.

`block_scores` A list of matrices. Each matrix contains the scores as columns for a given block.

`block_loadings` A list of matrices. Each matrix contains the loadings as columns for a given block.

`eigvals` A list of singular values of the data matrix at each deflation step.

`col_preproc_method` character for the column-level preprocessing method used. See ‘col\_preproc()’.

`block_preproc_method` character for the block-level preprocessing method used. See ‘block\_preproc()’.

`block_variances` A list of variances for each block.

`metadata` A data frame of metadata originally passed into ‘nipals\_multiblock()’.

---

nipals_iter	<i>NIPALS Iteration</i>
-------------	-------------------------

---

### Description

Applies one iteration stage/loop of the NIPALS algorithm.

### Usage

```
nipals_iter(ds, tol = 1e-12, maxIter = 1000)
```

### Arguments

ds	a list of data matrices, each in "sample" x "variable" format
tol	a number for the tolerance on the stopping criterion for NIPALS
maxIter	a number for the maximum number of times NIPALS should iterate

### Details

Follows the NIPALS algorithm as described by Hanafi et. al. (2010). Starts with a random vector in sample space and repeatedly projects it onto the variable vectors and block scores to generate block and global loadings/scores/weights. The loop stops when either the stopping criterion is low enough, or the maximum number of iterations is reached. Intended as a utility function for 'nipals\_multiblock' to be used between deflation steps.

### Value

a list containing the global/block scores, loadings and weights for a given order

### Examples

```
data(NCI60)
data_blocks <- lapply(data_blocks, as.matrix)
nipals_results <- nipals_iter(data_blocks, tol = 1e-7, maxIter = 1000)
```

---

nipals_multiblock	<i>Main NIPALS computation loop</i>
-------------------	-------------------------------------

---

### Description

Applies the full adjusted NIPALS algorithm to generate block and global scores/loadings with the desired deflation method.

**Usage**

```
nipals_multiblock(
  data_blocks_mae,
  col_preproc_method = "colprofile",
  block_preproc_method = "unit_var",
  num_PCs = 10,
  tol = 1e-09,
  max_iter = 1000,
  color_col = NULL,
  deflationMethod = "block",
  plots = "all"
)
```

**Arguments**

- data\_blocks\_mae** a MultiAssayExperiment class object (with sample metadata as a dataframe in the colData attribute).
- col\_preproc\_method** an option for the desired column-level data pre-processing, either:
- ‘colprofile’ applies column-centering, row and column weighting by contribution to variance.
  - ‘standardized’ centers each column and divides by its standard deviation.
  - ‘centered\_only’ ONLY centers data
- block\_preproc\_method** an option for the desired block-level data pre-processing, either:
- ‘unit\_var’ FOR CENTERED MATRICES ONLY - divides each block by the square root of its variance
  - ‘num\_cols’ divides each block by the number of variables in the block.
  - ‘largest\_sv’ divides each block by its largest singular value.
  - ‘none’ performs no preprocessing
- num\_PCs** the maximum order of scores/loadings
- tol** a number for the tolerance on the stopping criterion for NIPALS
- max\_iter** a number for the maximum number of times NIPALS should iterate
- color\_col** Optional argument with the column name of the ‘metadata’ data frame used to define plotting colors
- deflationMethod** an option for the desired deflation method, either:
- ‘block’ deflation via block loadings (for MCIA, default)
  - ‘global’ deflation via global scores (for CPCA)
- plots** an option to display various plots of results:
- ‘all’ displays plots of block scores, global scores, and eigenvalue scree plot
  - ‘global’ displays only global score projections and eigenvalue scree plot
  - ‘none’ does not display plots

## Details

Follows the NIPALS algorithm as described by Hanafi et. al. (2010). For each order of scores/loadings, the vectors are computed via the 'nipals\_iter' function, then used to deflate the data matrix according to the desired deflation method. This process is repeated up to the desired maximum order of scores/loadings.

## Value

a 'nipalsResult' object with the following fields:

- 'global\_scores' a matrix containing global scores as columns (NOT normalized to unit variance)
- 'global\_loadings' a matrix containing global loadings as columns
- 'global\_score\_weights' a matrix of weights to express global scores as a combination of block scores. Has dimensions "num\_Blocks" by "num\_PCs"
- 'eigvals' a matrix containing the eigenvalue for each computed global score.
- 'block scores' a list of matrices, each contains the scores for one block
- 'block loadings' a list of matrices, each contains the loadings for one block (w/ unit length)
- 'block score weights' a matrix containing weights for each block score of each order used to construct the global scores.
- 'col\_preproc\_method' the column preprocessing method used on the data.
- 'block\_variances' a list of variances of each block AFTER NORMALIZATION OPTION APPLIED
- 'metadata' the metadata dataframe supplied with the 'metadata' argument. Note: overrides metadata present in any MAE class object.

## Examples

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
NIPALS_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                   tol = 1e-12, max_iter = 1000,
                                   col_preproc_method = "colprofile",
                                   deflationMethod = "block")
MCIA_results <- nipals_multiblock(data_blocks_mae, num_PCs = 4)
CPCA_results <- nipals_multiblock(data_blocks_mae, num_PCs = 4,
                                  deflationMethod = 'global')
```

---

nmb\_get\_bl

*Accessor function for block loadings*

---

## Description

Retrieves the block loadings as a list of matrices from a 'NipalsResult' object, typically output from 'nipals\_multiblock()'.



**Usage**

```
nmb_get_bl(nmb_object)
```

**Arguments**

nmb\_object      A 'NipalsResult' object.

**Value**

a list of matrices containing block loadings.

**Examples**

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
block_loadings<- nmb_get_bl(mcia_out)
```

---

nmb\_get\_bs

*Accessor function for block scores*

---

**Description**

Retrieves the block scores as a list of matrices from a 'NipalsResult' object, typically output from 'nipals\_multiblock()'.

**Usage**

```
nmb_get_bs(nmb_object)
```

**Arguments**

nmb\_object      A 'NipalsResult' object.

**Value**

a list of matrices containing block scores.

**Examples**

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
block_scores <- nmb_get_bs(mcia_out)
```

---

nmb\_get\_bs\_weights      *Accessor function for block score weights*

---

**Description**

Retrieves the block score weights from a 'NipalsResult' object, typically output from 'nipals\_multiblock()'.

**Usage**

```
nmb_get_bs_weights(nmb_object)
```

**Arguments**

nmb\_object      A 'NipalsResult' object.

**Value**

a matrix containing the block score weights.

**Examples**

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
block_score_weights <- nmb_get_bs_weights(mcia_out)
```

---

nmb\_get\_eigs      *Accessor function for eigenvalues*

---

**Description**

Retrieves the eigenvalues from a 'NipalsResult' object, typically output from 'nipals\_multiblock()'.

**Usage**

```
nmb_get_eigs(nmb_object)
```

**Arguments**

nmb\_object      A 'NipalsResult' object.

**Value**

a matrix containing the eigenvalues for all global scores.

**Examples**

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
nipals_eigvals <- nmb_get_eigs(mcia_out)
```

---

`nmb_get_gl`*Accessor function for global loadings*

---

**Description**

Retrieves the global loadings as a matrix from a ‘NipalsResult’ object, typically output from ‘nipals\_multiblock()’.

**Usage**

```
nmb_get_gl(nmb_object)
```

**Arguments**

`nmb_object` A ‘NipalsResult’ object.

**Value**

a matrix containing global loadings.

**Examples**

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks, row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
global_loadings <- nmb_get_gl(mcia_out)
```

---

`nmb_get_gs`*Accessor function for global scores*

---

**Description**

Retrieves the global scores as a matrix from a ‘NipalsResult’ object, typically output from ‘nipals\_multiblock()’.

**Usage**

```
nmb_get_gs(nmb_object)
```

**Arguments**

`nmb_object` A ‘NipalsResult’ object.

**Value**

a matrix containing global scores.

**Examples**

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
global_scores <- nmb_get_gs(mcia_out)
```

---

nmb_get_metadata	<i>Accessor function for metadata</i>
------------------	---------------------------------------

---

**Description**

Retrieves the metadata from a 'NipalsResult' object, typically output from 'nipals\_multiblock()'.

**Usage**

```
nmb_get_metadata(nmb_object)
```

**Arguments**

nmb\_object      A 'NipalsResult' object.

**Value**

a dataframe containing metadata associated with the 'NipalsResult' object.

**Examples**

```
data("NCI60")
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
mcia_out <- nipals_multiblock(data_blocks_mae, num_PCs = 10)
nipals_metadata <- nmb_get_metadata(mcia_out)
```

---

ord_loadings	<i>Ranked global loadings dataframe</i>
--------------	---

---

**Description**

Creates a dataframe with ranked loadings for a given factor

**Usage**

```
ord_loadings(
  mcia_results,
  omic = "all",
  factor = 1,
  absolute = FALSE,
  descending = TRUE
)
```

**Arguments**

mcia_results	object returned from nipals_multiblock() function
omic	choose an omic to rank, or choose 'all' for all, ((omic = "all", omic = "miRNA", etc.))
factor	choose a factor (numeric value from 1 to number of factors in mcia_results)
absolute	whether to rank by absolute value
descending	whether to rank in descending or ascending order

**Value**

ranked dataframe

**Examples**

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                plots = "none", tol = 1e-12)
all_pos_1 <- ord_loadings(mcia_results = mcia_results, omic = "all",
                        absolute = FALSE, descending = TRUE, factor = 1)
```

---

predict\_gs

*Prediction of new global scores based on block loadings and weights*

---

**Description**

Uses previously-computed block scores and weights to compute a global score for new data. Only validated for MCIA results, as CPCA loadings aren't compatible with un-deflated data.

**Usage**

```
predict_gs(mcia_results, test_data)
```

**Arguments**

mcia_results	an mcia object output by nipals_multiblock() containing block scores, weights, and pre-processing identifier.
test_data	an MAE object with the same block types and features as the training dataset. Feature and omic order must match 'bl'.

**Details**

Projects the new observations onto each block loadings vector, then weights the projection according to the corresponding block weights.

**Value**

a matrix of predicted global scores for the training data

**Examples**

```

data(NCI60)
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 2)
new_data <- data_blocks_mae # should update with a truly new dataset
preds <- predict_gs(mcia_results, new_data)

```

---

projection\_plot      *projection\_plot*

---

**Description**

Function to generate a projection plot of MCIA results.

**Usage**

```

projection_plot(
  mcia_results,
  projection,
  orders = c(1, 2),
  block_name = NULL,
  color_col = NULL,
  color_pal = scales::viridis_pal,
  color_pal_params = list(option = "E"),
  legend_loc = "bottomleft",
  color_override = NULL,
  cex = 0.5
)

```

**Arguments**

mcia_results	MCIA results object returned from ‘nipals_multiblock‘
projection	of plot, with the following options <ul style="list-style-type: none"> <li>• ‘all‘ - scatter plot of two orders of global and block scores (aka factors).</li> <li>• ‘global‘ - scatter plot of two orders of global scores only (aka factors).</li> <li>• ‘block‘ - scatter plot of two orders of block scores only (aka factors) for given block.</li> </ul>
orders	Option to select orders of factors to plot against each other (for projection plots)
block_name	Name of the block to be plotted (if ‘projection = block‘ argument used).
color_col	an integer or string specifying the column that will be used for color_col
color_pal	a list of colors or function which returns a list of colors
color_pal_params	a list of parameters for the color function
legend_loc	Option for legend location, or "none" for no legend.
color_override	Option to override colors when necessary, helpful for projection = "global" or "block"
cex	Resizing parameter for drawing the points



vis\_load\_ord

*Visualize ranked loadings***Description**

Visualize a scree plot of loadings recovered from nipalsMCIA() output loadings matrix ranked using the ord\_loadings() functions

**Usage**

```
vis_load_ord(
  mcia_results,
  omic,
  factor = 1,
  n_feat = 15,
  absolute = TRUE,
  descending = TRUE,
  color_pal = scales::viridis_pal,
  color_pal_params = list()
)
```

**Arguments**

mcia_results	object returned from nipals_multiblock() function
omic	name of the given omic dataset
factor	choose a factor (numeric value from 1 to number of factors in mcia_results)
n_feat	number of features to visualize
absolute	whether to rank by absolute value
descending	whether to rank in descending or ascending order
color_pal	a list of colors or function which returns a list of colors
color_pal_params	a list of parameters for the color function

**Value**

Plot in features for a factor by rank

**Examples**

```
data(NCI60)
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",
                             colData=metadata_NCI60)
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,
                                plots = "none", tol = 1e-12)
vis_load_ord(mcia_results, omic="mrna")
```



---

vis_load_plot	<i>Visualize all loadings on two factor axes</i>
---------------	--

---

**Description**

Visualize all loadings recovered from nipalsMCIA() output loadings matrix ranked using across two factor axes

**Usage**

```
vis_load_plot(  
  mcia_results,  
  axes = c(1, 2),  
  color_pal = scales::viridis_pal,  
  color_pal_params = list()  
)
```

**Arguments**

mcia_results	object returned from nipals_multiblock() function
axes	list of two numbers associated with two factors to visualize
color_pal	a list of colors or function which returns a list of colors
color_pal_params	a list of parameters for the color function

**Value**

Plot of MCIA feature loadings for chosen axes

**Examples**

```
data(NCI60)  
data_blocks_mae <- simple_mae(data_blocks,row_format="sample",  
                             colData=metadata_NCI60)  
mcia_results <- nipals_multiblock(data_blocks_mae, num_PCs = 10,  
                                 plots = "none", tol = 1e-12)  
vis_load_plot(mcia_results, axes = c(1, 4))
```

# Index

- \* **data**
  - data\_blocks, 6
  - metadata\_NCI60, 13
- \* **internal**
  - nipalsMCIA-package, 3
- \* **multi-omics**
  - data\_blocks, 6
  - metadata\_NCI60, 13
  
- block\_preproc, 3
- block\_weights\_heatmap, 4
  
- cc\_preproc, 5
- col\_preproc, 5
  
- data\_blocks, 6
- deflate\_block\_bl, 7
- deflate\_block\_gs, 7
  
- extract\_from\_mae, 8
  
- get\_colors, 9
- get\_metadata\_colors, 9
- get\_tv, 10
- global\_scores\_eigenvalues\_plot, 11
- global\_scores\_heatmap, 11
- gsea\_report, 12
  
- metadata\_NCI60, 13
  
- nipals\_iter, 14
- nipals\_multiblock, 14
- nipalsMCIA (nipalsMCIA-package), 3
- nipalsMCIA-package, 3
- NipalsResult (NipalsResult-class), 13
- NipalsResult-class, 13
- nmb\_get\_bl, 16
- nmb\_get\_bs, 17
- nmb\_get\_bs\_weights, 18
- nmb\_get\_eigs, 18
- nmb\_get\_gl, 19
- nmb\_get\_gs, 19
- nmb\_get\_metadata, 20
  
- ord\_loadings, 20
  
- predict\_gs, 21
- projection\_plot, 22
  
- simple\_mae, 23
  
- vis\_load\_ord, 24
- vis\_load\_plot, 25