

Package ‘FindIT2’

January 9, 2025

Title find influential TF and Target based on multi-omics data

Version 1.12.0

Description This package implements functions to find influential TF and target based on different input type. It have five module:
Multi-peak multi-gene annotaion(mmPeakAnno module),
Calculate regulation potential(calcRP module),
Find influential Target based on ChIP-Seq and RNA-Seq data(Find influential Target module),
Find influential TF based on different input(Find influential TF module),
Calculate peak-gene or peak-peak correlation(peakGeneCor module).
And there are also some other useful function like integrate different source information, calculate jaccard similarity for your TF.

License Artistic-2.0

URL <https://github.com/shanguandong1996/FindIT2>

BugReports <https://support.bioconductor.org/t/FindIT2>

biocViews Software, Annotation, ChIPSeq, ATACSeq, GeneRegulation, MultipleComparison, GeneTarget

Encoding UTF-8

Roxygen list(markdown = TRUE)

RoxygenNote 7.1.2

Suggests BiocStyle, knitr, rmarkdown, sessioninfo, testthat (>= 3.0.0), TxDb.Athaliana.BioMart.plantsmart28

VignetteBuilder knitr

Depends GenomicRanges, R (>= 3.5.0)

Imports withr, BiocGenerics, GenomeInfoDb, rtracklayer, S4Vectors, GenomicFeatures, dplyr, rlang, patchwork, ggplot2, BiocParallel, qvalue, stringr, utils, stats, ggrepel, tibble, tidy, SummarizedExperiment, MultiAssayExperiment, IRanges, progress, purrr, glmnet, methods

Config/testthat/edition 3

git_url <https://git.bioconductor.org/packages/FindIT2>

git_branch RELEASE_3_20

git_last_commit 1bcb4fc

git_last_commit_date 2024-10-29

Repository Bioconductor 3.20

Date/Publication 2025-01-09

Author Guandong Shang [aut, cre] (<<https://orcid.org/0000-0002-9509-0314>>)

Maintainer Guandong Shang <shangguandong1996@163.com>

Contents

ATAC_normCount	2
calcRP_coverage	3
calcRP_region	4
calcRP_TFHit	5
enhancerPromoterCor	6
findIT_enrichFisher	7
findIT_enrichWilcox	8
findIT_MARA	9
findIT_regionRP	10
findIT_TFHit	12
findIT_TTPair	13
getAssocPairNumber	14
integrate_ChIP_RNA	15
integrate_replicates	16
jaccard_findIT_enrichFisher	17
jaccard_findIT_TTpair	18
loadPeakFile	18
mm_geneBound	19
mm_geneScan	20
mm_nearestGene	21
peakGeneCor	22
plot_annoDistance	23
plot_peakGeneAlias_summary	23
plot_peakGeneCor	24
RNADiff_LEC2_GR	25
RNA_normCount	26
test_featureSet	26
test_geneSet	27
TF_target_database	28
Index	29

ATAC_normCount	<i>ATAC normCount of E50h-72h in Chr5</i>
----------------	---

Description

ATAC normCount of E50h-72h in Chr5

Usage

data(ATAC_normCount)

Format

A matrix

Source

<https://doi.org/10.1016/j.devcel.2020.07.003>

calcRP_coverage	<i>calcRP_coverage</i>
-----------------	------------------------

Description

calculate regulatory potential using big wig files, which is useful for ATAC or H3K27ac histone modification data.

Usage

```
calcRP_coverage(  
  bwFile,  
  Txdb,  
  gene_included,  
  Chrs_included,  
  decay_dist = 1000,  
  scan_dist = 20000,  
  verbose = TRUE  
)
```

Arguments

bwFile	bw file
Txdb	Txdb
gene_included	a character vector which represent gene set which you want to calculate RP for
Chrs_included	a character vector which represent chromosomes where you want to calculate gene RP in
decay_dist	decay distance
scan_dist	scan distance
verbose	whether you want to report detailed running message

Details

Please note that because of `rtracklayer::import` has some issue on 32 bit R of windows, so the `calcRP_coverage` can not work on this system. But if your R is 64 bit, which now be applied on the most windows R, this function still work.

Value

data.frame

Examples

```

if (.Platform$OS.type != "windows" & require(Txdb.Athaliana.BioMart.plantsmart28)) {
  Txdb <- Txdb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))
  bwFile <- system.file("extdata", "E50h_sampleChr5.bw", package = "FindIT2")

  RP_df <- calcRP_coverage(
    bwFile = bwFile,
    Txdb = Txdb,
    Chrs_included = "Chr5"
  )
}

```

calcRP_region

calcRP_region

Description

calculate regulatory potential based on mm_geneScan result and peakCount matrix, which is useful for ATAC or H3K27ac histone modification data.

Usage

```

calcRP_region(
  mmAnno,
  peakScoreMt,
  Txdb,
  Chrs_included,
  decay_dist = 1000,
  log_transform = FALSE,
  verbose = TRUE
)

```

Arguments

mmAnno	the annotated GRange object from mm_geneScan
peakScoreMt	peak count matrix. The rownames are feature_id in mmAnno, while the colnames are sample names
Txdb	Txdb
Chrs_included	a character vector which represent chromosome where you want to calculate gene RP in. If Chromosome is not be set, it will calculate gene RP in all chromosomes in Txdb.
decay_dist	decay distance
log_transform	whether you want to log and norm your RP
verbose	whether you want to report detailed running message

Value

a MultiAssayExperiment object containg detailed peak-RP-gene relationship and sumRP info

Examples

```

if (require(Txdb.Athaliana.BioMart.plantsmart28)) {
  data("ATAC_normCount")
  library(SummarizedExperiment)
  Txdb <- Txdb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))

  peak_path <- system.file("extdata", "ATAC.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)
  mmAnno <- mm_geneScan(peak_GR, Txdb)

  regionRP <- calcRP_region(
    mmAnno = mmAnno,
    peakScoreMt = ATAC_normCount,
    Txdb = Txdb,
    Chrs_included = "Chr5"
  )

  sumRP <- assays(regionRP)$sumRP
  fullRP <- assays(regionRP)$fullRP
}

```

calcRP_TFHit

calcRP_TFHit

Description

calculate regulatory potential based on ChIP-Seq peak data, which is useful for TF ChIP-seq data.

Usage

```

calcRP_TFHit(
  mmAnno,
  Txdb,
  decay_dist = 1000,
  report_fullInfo = FALSE,
  verbose = TRUE
)

```

Arguments

mmAnno	the annotated GRange object from mm_geneScan
Txdb	Txdb
decay_dist	decay distance
report_fullInfo	whether you want to report full peak-RP-gene info
verbose	whether you want to report detailed running message

Details

If your origin peak_GR of mmAnno have column named feature_score, calcRP_TFHit will consider this column when calculating sumRP. Otherwise, it will consider all peak Hit feature_score is 1.

Value

if report_fullInfo is TRUE, it will output GRanges with detailed info. While FALSE, it will output data frame

Examples

```
if (require(Txdb.Athaliana.BioMart.plantsmart28)){
  Txdb <- Txdb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))
  peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)
  mmAnno <- mm_geneScan(peak_GR, Txdb)

  # if you just want to get RP_df, you can set report_fullInfo FALSE
  fullRP_hit <- calcRP_TFHit(
    mmAnno = mmAnno,
    Txdb = Txdb,
    report_fullInfo = TRUE
  )

  RP_df <- metadata(fullRP_hit)$peakRP_gene
}
```

enhancerPromoterCor *enhancerPromoterCor*

Description

enhancerPromoterCor

Usage

```
enhancerPromoterCor(
  peak_GR,
  Txdb,
  up_scanPromoter = 500,
  down_scanPromoter = 500,
  up_scanEnhancer = 20000,
  down_scanEnhancer = 20000,
  peakScoreMt,
  parallel = FALSE,
  verbose = TRUE
)
```

Arguments

peak_GR	peak GRange with a column named feature_id representing you peak name
Txdb	Txdb
up_scanPromoter	the scan distance which is used to scan nearest promoter

down_scanPromoter the scan distance which is used to scan nearest promoter

up_scanEnhancer the scan distance which is used to scan feature

down_scanEnhancer the scan distance which is used to scan feature

peakScoreMt peak count matrix. The rownames are feature_id in peak_GR

parallel whether you want to parallel to speed up

verbose whether you want to report detailed running message

Value

mmAnno with Cor, pvalue, padj, qvalue column

Examples

```
if (require(Txdb.Athaliana.BioMart.plantsmart28)){
  data("ATAC_normCount")
  Txdb <- Txdb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))
  peak_path <- system.file("extdata", "ATAC.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)[1:100]
  mm_ePLink <- enhancerPromoterCor(
    peak_GR = peak_GR,
    Txdb = Txdb,
    peakScoreMt = ATAC_normCount,
    parallel = FALSE)
}
```

findIT_enrichFisher *findI(nfluentia)T(F)_enrichFisher*

Description

find influential TF of your input peak set compared with your whole peak sets based on TF ChIP-Seq or motif data.

Usage

```
findIT_enrichFisher(input_feature_id, peak_GR, TF_GR_database)
```

Arguments

input_feature_id a character vector which represent peaks set which you want to find influential TF for

peak_GR a GRange object represent your whole feature location with a column named feature_id, which your input_feature_id should a part of it.

TF_GR_database TF peak GRange with a column named TF_id representing you TF name

Value

data.frame

Examples

```
data("test_featureSet")
peak_path <- system.file("extdata", "ATAC.bed.gz", package = "FindIT2")
peak_GR <- loadPeakFile(peak_path)
ChIP_peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
ChIP_peak_GR <- loadPeakFile(ChIP_peak_path)
ChIP_peak_GR$TF_id <- "AT1G28300"

result_findIT_enrichFisher <- findIT_enrichFisher(
  input_feature_id = test_featureSet,
  peak_GR = peak_GR,
  TF_GR_database = ChIP_peak_GR
)
```

findIT_enrichWilcox *findIT_enrichWilcox*

Description

findIT_enrichWilcox

Usage

```
findIT_enrichWilcox(
  input_feature_id,
  peak_GR,
  TF_GR_database,
  background_peaks = NULL,
  background_number = 3000
)
```

Arguments

input_feature_id a character vector which represent peaks set which you want to find influential TF for

peak_GR a GRange object represent your whole feature location with a column named feature_id, which your input_feature_id should a part of it.

TF_GR_database TF peak GRange with a column named TF_id representing you TF name

background_peaks a character vector which represent background peak set. If you do not assign background peaks, program will sample background_number peaks as background peaks from all feature_id in your peak_GR

background_number background peaks number

Value

data.frame

Examples

```

data("test_featureSet")
peak_path <- system.file("extdata", "ATAC.bed.gz", package = "FindIT2")
peak_GR <- loadPeakFile(peak_path)
ChIP_peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
ChIP_peak_GR <- loadPeakFile(ChIP_peak_path)
ChIP_peak_GR$TF_id <- "AT1G28300"

result_findIT_enrichWilcox <- findIT_enrichWilcox(
  input_feature_id = test_featureSet,
  peak_GR = peak_GR,
  TF_GR_database = ChIP_peak_GR
)

```

findIT_MARA

*findIT_MARA***Description**

findIT_MARA

Usage

```

findIT_MARA(
  input_feature_id,
  peak_GR,
  peakScoreMt,
  TF_GR_database,
  log = TRUE,
  meanScale = TRUE,
  output = c("coef", "cor"),
  verbose = TRUE
)

```

Arguments

input_feature_id	a character vector which represent peaks set which you want to find influential TF for
peak_GR	a GRange object represent your whole feature location with a column named feature_id, which your input_feature_id should a part of it.
peakScoreMt	peak count matrix.
TF_GR_database	TF peak GRange with a column named TF_id representing you TF name. If you have TF_score column, MARA will consider it. otherwise, MARA will consider each hit is 1.
log	whether you want to log your peakScoreMt

meanScale whether you want to mean-centered per row
 output one of 'coef' and 'cor'. Default is coef
 verbose whether you want to report detailed running message

Value

a data.frame

Examples

```
data("ATAC_normCount")
data("test_featureSet")

peak_path <- system.file("extdata", "ATAC.bed.gz", package = "FindIT2")
peak_GR <- loadPeakFile(peak_path)

ChIP_peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
ChIP_peak_GR <- loadPeakFile(ChIP_peak_path)
ChIP_peak_GR$TF_id <- "AT1G28300"

set.seed(20160806)

result_findIT_MARA <- findIT_MARA(
  input_feature_id = test_featureSet,
  peak_GR = peak_GR,
  peakScoreMt = ATAC_normCount,
  TF_GR_database = ChIP_peak_GR
)
```

findIT_regionRP *findI(nfluentia)T(F)_regionRP*

Description

find Influential TF of your input gene set based on regulatory potential data and TF ChIP-Seq or motif data

Usage

```
findIT_regionRP(
  regionRP,
  Txdb,
  TF_GR_database,
  input_genes,
  background_genes = NULL,
  background_number = 3000,
  verbose = TRUE
)
```

Arguments

regionRP	the MultiAssayExperiment object from calcRP_region
Txdb	Txdb
TF_GR_database	TF peak GRange with a column named TF_id representing you TF name
input_genes	a character vector which represent genes set which you want to find influential TF for
background_genes	a character vector which represent background genes set. If you do not assign background gene , program will sample background_number genes as background genes from all gene sets.
background_number	background genes number
verbose	whether you want to report detailed running message

Value

a MultiAssayExperiment object containing detailed TF-percent and TF-pvalue

Examples

```

if (require(Txdb.Athaliana.BioMart.plantsmart28)) {
  data("ATAC_normCount")
  data("test_geneSet")
  Txdb <- Txdb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))

  peak_path <- system.file("extdata", "ATAC.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)

  ChIP_peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
  ChIP_peak_GR <- loadPeakFile(ChIP_peak_path)
  ChIP_peak_GR$TF_id <- "AT1G28300"

  mmAnno <- mm_geneScan(peak_GR, Txdb)

  regionRP <- calcRP_region(
    mmAnno = mmAnno,
    peakScoreMt = ATAC_normCount,
    Txdb = Txdb,
    Chrs_included = "Chr5"
  )

  set.seed(20160806)
  result_findIT_regionRP <- findIT_regionRP(
    regionRP = regionRP,
    Txdb = Txdb,
    TF_GR_database = ChIP_peak_GR,
    input_genes = test_geneSet,
    background_number = 3000
  )
}

```

findIT_TFHit	<i>findI(nfluentia)T(F)_TFHit</i>
--------------	-----------------------------------

Description

find influential TF of your input gene set based on TF ChIP-Seq or motif data

Usage

```
findIT_TFHit(
  input_genes,
  Txdb,
  TF_GR_database,
  scan_dist = 20000,
  decay_dist = 1000,
  Chrs_included,
  background_genes = NULL,
  background_number = 3000,
  verbose = TRUE
)
```

Arguments

input_genes	a character vector which represent genes set which you want to find influential TF for
Txdb	Txdb
TF_GR_database	TF peak GRange with a column named TF_id representing you TF name
scan_dist	scan distance
decay_dist	decay distance
Chrs_included	a character vector represent chromosomes which you want to sample background genes from
background_genes	a character vector which represent background genes set. If you do not assign background gene , program will sample background_number genes as background genes from all gene sets.
background_number	background genes number
verbose	whether you want to report detailed running message

Value

data.frame

Examples

```
if (require(TxDb.Athaliana.BioMart.plantsmart28)) {
  data("test_geneSet")
  Txdb <- TxDb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))
}
```

```

ChIP_peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
ChIP_peak_GR <- loadPeakFile(ChIP_peak_path)
ChIP_peak_GR$TF_id <- "AT1G28300"

set.seed(20160806)
result_findIT_TFHit <- findIT_TFHit(
  input_genes = test_geneSet,
  Txdb = Txdb,
  TF_GR_database = ChIP_peak_GR
)
}

```

findIT_TTPair	<i>findI(nfluentia)T(F)_T(F)T(arget)Pair</i>
---------------	--

Description

find influential TF of your input gene set based on public TF-Target data

Usage

```

findIT_TTPair(
  input_genes,
  TF_target_database,
  gene_background = NULL,
  TFHit_min = 5,
  TFHit_max = 10000
)

```

Arguments

input_genes	a character vector which represent genes set which you want to find influential TF for
TF_target_database	TF_target pair data with two column named TF_id and target_gene
gene_background	a character vector represent your bakcaground gene. If you do not assign back-ground gene, program will consider all target gene as background
TFHit_min	minimal size of target gene regulated by TF
TFHit_max	maximal size of target gene regulated by TF

Value

data.frame

Examples

```

data("TF_target_database")
data("test_geneSet")

result_findIT_TTPair <- findIT_TTPair(
  input_genes = test_geneSet,
  TF_target_database = TF_target_database
)

```

```

getAssocPairNumber    getAssocPairNumber

```

Description

get associated peak number of gene and vice verse.

Usage

```

getAssocPairNumber(
  mmAnno,
  output_type = c("gene_id", "feature_id"),
  output_summary = FALSE
)

```

Arguments

`mmAnno` the annotated GRange object from `mm_geneScan` or `mm_nearestGene`
`output_type` one of 'gene_id' or 'feature_id'
`output_summary` whether you want to detailed info

Value

data.frame

Examples

```

if (require(TxDb.Athaliana.BioMart.plantsmart28)) {
  Txdb <- TxDb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))

  peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)
  peakAnno <- mm_nearestGene(peak_GR, Txdb)

  getAssocPairNumber(peakAnno)
}

```

```
integrate_ChIP_RNA    integrate_ChIP_RNA
```

Description

integrate ChIP-Seq and RNA-Seq data to find TF target genes

Usage

```
integrate_ChIP_RNA(
  result_geneRP,
  result_geneDiff,
  lfc_threshold = 1,
  padj_threshold = 0.05
)
```

Arguments

`result_geneRP` the simplify result from `calcRP_TFHit(report_fullInfo = FALSE)` or `RP_df <- metadata(fullRP_hit)$peakRP_gene`.

`result_geneDiff` the result from RNA diff result with three column `gene_id`, `log2FoldChange`, `padj`

`lfc_threshold` the threshold which decide significant genes

`padj_threshold` the threshold which decide significant genes

Value

a ggplot object if having significant genes in your result. If not, it will report a data.frame with integrated info.

Examples

```
if (require(TxDb.Athaliana.BioMart.plantsmart28)) {
  data("RNADiff_LEC2_GR")
  Txdb <- TxDb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))
  peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)
  mmAnno <- mm_geneScan(peak_GR, Txdb)

  result_geneRP <- calcRP_TFHit(
    mmAnno = mmAnno,
    Txdb = Txdb
  )
  # output a plot
  merge_data <- integrate_ChIP_RNA(
    result_geneRP = result_geneRP,
    result_geneDiff = RNADiff_LEC2_GR
  )
  # if you want to extract merge target data
  target_data <- merge_data$data
}
```

```
}

```

```
integrate_replicates  integrate_replicates
```

Description

integrate value from replicates

Usage

```
integrate_replicates(
  mt,
  colData,
  fun = NULL,
  type = c("value", "rank", "rank_zscore", "pvalue")
)
```

Arguments

mt	value matrix
colData	a data.frame with a single column named with "type". Rows of colData correspond to columns of mt.
fun	the function you want to use. If set NULL, program will decide integrate method according to your 'type' parameter.
type	one of 'value', 'rank', 'rank_zscore', 'pvalue'. value will use mean to integrate replicates, rank will use product, rank_zscore will use Stouffer's method and pvalue will use CCT(Cauchy distribution)

Value

matrix

Examples

```
mt <- matrix(runif(100, 0, 1), nrow = 10)
colnames(mt) <- paste0(paste0("type", 1:5), "_", rep(1:2, 5))
rownames(mt) <- paste0("TF", 1:10)

colData <- data.frame(
  type = gsub("_[0-9]", "", colnames(mt)),
  row.names = colnames(mt)
)

integrate_replicates(mt, colData, type = "value")
```

```
jaccard_findIT_enrichFisher
      jaccard_findIT_enrichFisher
```

Description

jaccard_findIT_enrichFisher

Usage

```
jaccard_findIT_enrichFisher(
  input_feature_id,
  peak_GR,
  TF_GR_database,
  input_TF_id
)
```

Arguments

`input_feature_id` a character vector which represent peaks set which you want to find influential TF for (same as your `find_IT_enrichFisher` parameter)

`peak_GR` a GRange object represent your whole feature location with a column named `feature_id`, which your `input_feature_id` should a part of it.

`TF_GR_database` TF peak GRange with a column named `TF_id` representing you TF name

`input_TF_id` TF_id which you want to calculate jaccard index for

Value

jaccard similarity matrix

Examples

```
data("test_featureSet")
peak_path <- system.file("extdata", "ATAC.bed.gz", package = "FindIT2")
peak_GR <- loadPeakFile(peak_path)

ChIP_peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
ChIP_peak_GR <- loadPeakFile(ChIP_peak_path)
ChIP_peak_GR$TF_id <- "AT1G28300"
result_findIT_enrichFisher <- findIT_enrichFisher(
  input_feature_id = test_featureSet,
  peak_GR = peak_GR,
  TF_GR_database = ChIP_peak_GR
)

jaccard_findIT_enrichFisher(
  input_feature_id = test_featureSet,
  peak_GR = peak_GR,
  TF_GR_database = ChIP_peak_GR,
  input_TF_id = result_findIT_enrichFisher$TF_id[1]
)
```

jaccard_findIT_TTPair *jaccard_findIT_TTPair*

Description

jaccard_findIT_TTPair

Usage

```
jaccard_findIT_TTPair(input_genes, TF_target_database, input_TF_id)
```

Arguments

input_genes a character vector which represent gene set which you want to find influential TF for (same as your find_IT_TTPair parameter)

TF_target_database TF_target pair data

input_TF_id TF_id which you want to calculate jaccard index for

Value

jaccard similarity matrix

Examples

```
data("TF_target_database")
data("test_geneSet")
result_findIT_TTPair <- findIT_TTPair(
  input_genes = test_geneSet,
  TF_target_database = TF_target_database
)

jaccard_findIT_TTPair(
  input_genes = test_geneSet,
  TF_target_database = TF_target_database,
  input_TF_id = result_findIT_TTPair$TF_id[1:3]
)
```

loadPeakFile

loadPeakFile

Description

read peak file and transform it into GRanges object

Usage

```
loadPeakFile(filePath, TFBS_database = FALSE)
```

Arguments

filePath peak Path

TFBS_database whether your peak file is a TFBS database file. If you want the final GRanges have a column named "TF_id", you should set TFBS_database TRUE. The GRanges with TF_id can be applied in "TF_GR_database" parameter of findIT_TFHit, findIT_enrichFisher, findIT_enrichWilcox, findIT_regionRP. If FALSE, the GRanges will have a column named "feature_id", which always be the input of "peak_GR" parameter.

Details

The GRanges with TF_id always be the input of "TF_GR_database" parameter. It represents the TFBS database like motif scan result, public database CHIP-seq site and so on.

The GRanges with feature_id always be the input of "peak_GR" parameter.

Value

GRanges object with a column named feature_id or TF_id

Examples

```
peakfile <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
loadPeakFile(peakfile)
```

mm_geneBound	<i>mm_geneBound</i>
--------------	---------------------

Description

find related peaks of your input genes, which is useful when you want to plot volcano plot or heatmap of peaks.

Usage

```
mm_geneBound(peak_GR, Txdb, input_genes, verbose = TRUE, ...)
```

Arguments

peak_GR peak GRRange with a column named feature_id representing you peak name

Txdb Txdb

input_genes a character vector which represent genes set which you want to find related peak for

verbose whether you want to report detailed running message

... additional arguments in distanceToNearest

Value

data.frame with three column: related peak id, your input gene id, and distance

Examples

```

if (require(TxDb.Athaliana.BioMart.plantsmart28)) {
  Txdb <- TxDb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))
  peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)
  peak_pair <- mm_geneBound(peak_GR, Txdb, c("AT5G01015", "AT5G67570"))
  peak_pair
}

```

mm_geneScan

mm_geneScan

Description

Annotate peaks using geneScan mode, which means every peak have more than one related genes.

Usage

```

mm_geneScan(
  peak_GR,
  Txdb,
  upstream = 3000,
  downstream = 3000,
  reportGeneInfo = FALSE,
  verbose = TRUE,
  ...
)

```

Arguments

peak_GR	peak GRange with a column named feature_id representing you peak name
Txdb	Txdb
upstream	distance to start site(upstream)
downstream	distance to start site(downstream)
reportGeneInfo	whether you want to add gene info
verbose	whether you want to report detailed running message
...	additional arguments in findOverlaps

Value

Granges object with annotated info

Examples

```

if (require(TxDb.Athaliana.BioMart.plantsmart28)) {
  Txdb <- TxDb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))
  peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)
  peakAnno <- mm_geneScan(peak_GR, Txdb)
  peakAnno
}

```

mm_nearestGene	<i>mm_nearestGene</i>
----------------	-----------------------

Description

Annotate peaks using nearest gene mode, which means every peak only have one related gene.

Usage

```
mm_nearestGene(peak_GR, Txdb, reportGeneInfo = FALSE, verbose = TRUE, ...)
```

Arguments

peak_GR	peak GRange with a column named feature_id representing you peak name
Txdb	Txdb
reportGeneInfo	whether you want to report full gene info
verbose	whether you want to report detailed running message
...	additional arguments in distanceToNearest

Value

Granges object with annotated info

Examples

```

if (require(TxDb.Athaliana.BioMart.plantsmart28)) {
  Txdb <- TxDb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))

  peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)
  peakAnno <- mm_nearestGene(peak_GR, Txdb)
  peakAnno
}

```

peakGeneCor	<i>peakGeneCor</i>
-------------	--------------------

Description

peakGeneCor

Usage

```
peakGeneCor(mmAnno, peakScoreMt, geneScoreMt, parallel = FALSE, verbose = TRUE)
```

Arguments

mmAnno	the annotated GRange object from mm_geneScan or mm_nearestGene
peakScoreMt	peak count matrix. The rownames are feature_id in mmAnno, while the colnames are sample names.
geneScoreMt	gene count matrix. The rownames are gene_id in mmAnno, while the colnames are sample names.
parallel	whether you want to use bplapply to speed up calculation
verbose	whether you want to report detailed running message

Value

mmAnno with Cor, pvalue, padj, qvalue column

Examples

```
if (require(TxDb.Athaliana.BioMart.plantsmart28)){
  Txdb <- TxDb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))
  data("RNA_normCount")
  data("ATAC_normCount")
  peak_path <- system.file("extdata", "ATAC.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)[1:100]
  mmAnno <- mm_geneScan(peak_GR, Txdb)

  ATAC_colData <- data.frame(
    row.names = colnames(ATAC_normCount),
    type = gsub("_R[0-9]", "", colnames(ATAC_normCount))
  )

  ATAC_normCount_merge <- integrate_replicates(ATAC_normCount, ATAC_colData)
  RNA_colData <- data.frame(
    row.names = colnames(RNA_normCount),
    type = gsub("_R[0-9]", "", colnames(RNA_normCount))
  )

  RNA_normCount_merge <- integrate_replicates(RNA_normCount, RNA_colData)
  mmAnnoCor <- peakGeneCor(
    mmAnno = mmAnno,
    peakScoreMt = ATAC_normCount_merge,
    geneScoreMt = RNA_normCount_merge,
    parallel = FALSE
  )
}
```

```

    )
    mmAnnoCor
  }

```

plot_annoDistance *plot_annoDistance*

Description

plot the distance distribution of mmAnno from mm_nearestGene, which helps you decide whether your TF is promoter or enhancer dominant

Usage

```
plot_annoDistance(mmAnno, quantile = c(0.01, 0.99))
```

Arguments

mmAnno the annotated GRange object from mm_nearestGene
 quantile the quantile of distanceToTSS you want to show

Value

a ggplot2 object

Examples

```

if (require(Txdb.Athaliana.BioMart.plantsmart28)) {
  Txdb <- Txdb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))

  peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)
  peakAnno <- mm_nearestGene(peak_GR, Txdb)
  plot_annoDistance(peakAnno)
}

```

plot_peakGeneAlias_summary
 plot_peakGeneAlias_summary

Description

plot_peakGeneAlias_summary

Usage

```
plot_peakGeneAlias_summary(
  mmAnno,
  mmAnno_corFilter = NULL,
  output_type = c("gene_id", "feature_id"),
  fillColor = "#ca6b67"
)
```

Arguments

```
mmAnno          the annotated GRange object from mm_geneScan or mm_nearestGene
mmAnno_corFilter the filter mmAnno object according to p-value or cor, default is NULL
output_type     one of 'gene_id' or 'feature_id'
fillColor       the bar plot color
```

Value

a ggplot object

Examples

```
if (require(TxDb.Athaliana.BioMart.plantsmart28)) {
  Txdb <- TxDb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))

  peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)
  peakAnno <- mm_nearestGene(peak_GR, Txdb)

  plot_peakGeneAlias_summary(peakAnno)
}
```

plot_peakGeneCor *plot_peakGeneCor*

Description

plot_peakGeneCor

Usage

```
plot_peakGeneCor(
  mmAnnoCor,
  select_gene,
  addLine = TRUE,
  addFullInfo = TRUE,
  sigShow = c("pvalue", "padj", "qvalue")
)
```


Arguments

mmAnnoCor	the annotated GRange object from peakGeneCor or enhancerPromoterCor
select_gene	a gene_id which you want to show
addLine	whether add cor line
addFullInfo	whether add full feature info on plot
sigShow	one of 'pvalue' 'padj' 'qvalue'

Value

ggplot2 object

Examples

```

if (require(TxDb.Athaliana.BioMart.plantsmart28)) {
  data("RNA_normCount")
  data("ATAC_normCount")
  Txdb <- TxDb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))
  peak_path <- system.file("extdata", "ATAC.bed.gz", package = "FindIT2")
  peak_GR <- loadPeakFile(peak_path)[1:100]
  mmAnno <- mm_geneScan(peak_GR, Txdb)

  ATAC_colData <- data.frame(
    row.names = colnames(ATAC_normCount),
    type = gsub("_R[0-9]", "", colnames(ATAC_normCount))
  )

  integrate_replicates(ATAC_normCount, ATAC_colData) -> ATAC_normCount_merge
  RNA_colData <- data.frame(
    row.names = colnames(RNA_normCount),
    type = gsub("_R[0-9]", "", colnames(RNA_normCount))
  )
  integrate_replicates(RNA_normCount, RNA_colData) -> RNA_normCount_merge
  mmAnnoCor <- peakGeneCor(
    mmAnno = mmAnno,
    peakScoreMt = ATAC_normCount_merge,
    geneScoreMt = RNA_normCount_merge,
    parallel = FALSE
  )

  plot_peakGeneCor(mmAnnoCor, select_gene = "AT5G01010")
}

```

RNADiff_LEC2_GR

RNA diff result from LEC2_GR VS LEC2_DMSO

Description

RNA diff result from LEC2_GR VS LEC2_DMSO

Usage

```
data(RNADiff_LEC2_GR)
```

Format

a data frame

Source

<https://doi.org/10.1016/j.devcel.2020.07.003>

RNA_normCount	<i>RNA normCount of E50h-72h in Chr5</i>
---------------	--

Description

RNA normCount of E50h-72h in Chr5

Usage

```
data(RNA_normCount)
```

Format

A matrix

Source

<https://doi.org/10.1016/j.devcel.2020.07.003>

test_featureSet	<i>test_featureSet</i>
-----------------	------------------------

Description

test_featureSet

Usage

```
data(test_featureSet)
```

Format

character vector represent your interesting feature_id set

Details

For the detailed progress producing input_feature_id, you can see ?test_geneSet

test_geneSet	<i>test_geneSet</i>
--------------	---------------------

Description

test_geneSet

Usage

```
data(test_geneSet)
```

Format

character vector represent your interesting gene set

Examples

```
## Not run:
# source
if (require(Txdb.Athaliana.BioMart.plantsmart28)) {
  library(FindIT2)
  Txdb <- Txdb.Athaliana.BioMart.plantsmart28
  seqlevels(Txdb) <- paste0("Chr", c(1:5, "M", "C"))
  ChIP_peak_path <- system.file("extdata", "ChIP.bed.gz", package = "FindIT2")
  ChIP_peak_GR <- loadPeakFile(ChIP_peak_path)
  ATAC_peak_path <- system.file("extdata", "ATAC.bed.gz", package = "FindIT2")
  ATAC_peak_GR <- loadPeakFile(ATAC_peak_path)

  mmAnno_geneScan <- mm_geneScan(
    peak_GR = ChIP_peak_GR,
    Txdb = Txdb,
    upstream = 2e4,
    downstream = 2e4
  )

  peakRP_gene <- calcRP_TFHit(
    mmAnno = mmAnno_geneScan,
    Txdb = Txdb,
    report_fullInfo = FALSE
  )

  data("RNADiff_LEC2_GR")
  merge_result <- integrate_ChIP_RNA(
    result_geneRP = peakRP_gene,
    result_geneDiff = RNADiff_LEC2_GR
  )

  target_result <- merge_result$data
  test_geneSet <- target_result$gene_id[1:50]

  related_peaks <- mm_geneBound(
    peak_GR = ATAC_peak_GR,
    Txdb = Txdb,
    input_genes = test_geneSet
  )
}
```

```

)
test_featureSet <- unique(related_peaks$feature_id)
# save(test_geneSet, file = "data/test_geneSet.rda", version = 2)
# save(test_featureSet, file = "data/test_featureSet.rda", version = 2)
}

## End(Not run)

```

TF_target_database *TF-target database*

Description

TF-target database

Usage

```
data(TF_target_database)
```

Format

a data frame

Source

<http://bioinformatics.psb.ugent.be/webtools/iGRN/pages/download>

Examples

```

## Not run:
# source
library(dplyr)
data <- read.table("~/reference/annoation/Athaliana/TF_target/iGRN_network_full.txt",
                  sep = "\t",
                  stringsAsFactors = FALSE)

data %>%
  rename(TF_id = V1, target_gene = V2) %>%
  select(TF_id, target_gene) %>%
  TF_target_database <- filter(TF_id %in% c("AT1G28300",
    "AT5G63790", "AT5G24110", "AT3G23250")) %>%
  as.data.frame()

save(TF_target_database, file = "inst/extdata/TF_target_database.rda", version = 2,
      compress = "bzip2")

## End(Not run)

```

Index

* datasets

- ATAC_normCount, [2](#)
- RNA_normCount, [26](#)
- RNADiff_LEC2_GR, [25](#)
- test_featureSet, [26](#)
- test_geneSet, [27](#)
- TF_target_database, [28](#)

ATAC_normCount, [2](#)

calcRP_coverage, [3](#)

calcRP_region, [4](#)

calcRP_TFHit, [5](#)

enhancerPromoterCor, [6](#)

findIT_enrichFisher, [7](#)

findIT_enrichWilcox, [8](#)

findIT_MARA, [9](#)

findIT_regionRP, [10](#)

findIT_TFHit, [12](#)

findIT_TTPair, [13](#)

getAssocPairNumber, [14](#)

integrate_ChIP_RNA, [15](#)

integrate_replicates, [16](#)

jaccard_findIT_enrichFisher, [17](#)

jaccard_findIT_TTpair, [18](#)

loadPeakFile, [18](#)

mm_geneBound, [19](#)

mm_geneScan, [20](#)

mm_nearestGene, [21](#)

peakGeneCor, [22](#)

plot_annoDistance, [23](#)

plot_peakGeneAlias_summary, [23](#)

plot_peakGeneCor, [24](#)

RNA_normCount, [26](#)

RNADiff_LEC2_GR, [25](#)

test_featureSet, [26](#)

test_geneSet, [27](#)

TF_target_database, [28](#)