

# Package ‘PEA’

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**Type** Package

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**Suggests** gplots, cairoDevice, exomePeak, MetPeak, BayesPeak, ggplot2

**Description** PEA is an integrated R toolkit that aims to facilitate plant epitranscriptome data analysis. This toolkit contains a comprehensive set of functions for read mapping, CMR (chemical modifications of RNA) calling from epitranscriptome sequencing data, CMR prediction at the transcriptome scale, and CMR annotation (location distribution analysis, motif scanning and discovery, and gene functional enrichment analysis.)

**LazyData** true

**License** GPL (>= 2)

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classifier

*Building machine learning-based classification models*

---

## Description

This function builds classification models with different machine learning algorithms including random forest (randomForest) and support vector machine (svm)

## Usage

```
classifier( method = c("randomForest", "svm"), featureMat,
           positiveSamples, negativeSamples, ...)
```

## Arguments

method	a character string specifying machine learning method used to construct prediction models. Currently the user-optional values are "randomForest" and "svm".
featureMat	a numeric matrix recording feature values for each sample.
positiveSamples	a character vector recording positive samples used to train classification model.
negativeSamples	a character vector recording negative samples used to train classification model.
...	Further parameters passed to train classification model.

**Details**

For the random forest algorithm, the important parameters are mtry (number of features randomly selected for bulding the decision tree. Default:sqrt(ncol(featureMat))) and ntree (number of trees to be built. Default:500). More information about the parameters related to random forest can be found in R package RandomForest.

For the svm algorithm, the default kernel function is the "radial"(radial basis function; RBF). Other optional kernels are the "linear", the "polynomial", and the "sigmoid" fuctions. The range of degree (for the kernel type of polynomial), gamma (for radial), coef0 (for polynomial and sigmoid) and cost (the cost parameters for all kernels) should be designated. Please refer the description of "svm" function in R package e1071 for more information about the parameters of svm.

**Value**

An object of class model.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:

##random forest and using five-fold cross validation for obtaining optimal parameters
cl <- classifier( method = "randomForest", featureMat = featureMat,
                  positiveSamples = positiveSamples,
                  negativeSamples = negativeSamples)

## End(Not run)
```

---

CMRAnnotation

---

*CRM Annotation*


---

**Description**

This function is designed to perform annotation analysis including CMR location and enrichment profiling, CMR-related motif scanning and motif discovery, and CMR-related gene function enrichment analysis.

**Usage**

```
CMRAnnotation(cmrMat, genomic = T, UTRMat = NULL, GTF = NULL, SNR = T,
              annotation = c("location", "motifScan", "motifDetect", "GO"),
              cmrSeq = NULL, RNAseq = NULL, motifPos = NULL, plot = T, ...)
```

**Arguments**

cmrMat	A BED format matrix representing the CMR position.
genomic	Logical, whic TRUE indicates the genomic position.
UTRMat	A matrix with six columns representing the relative position of 5'UTR, CDS and 3'UTR.
GTF	A string vector of file name, which specifies the reference genome annotation in GTF format.
SNR	Logical, where TRUE indicates the CMR is at single nucleotide resolution.
annotation	A string vector specified which annotation method would be used.
cmrSeq	A list containing CMR-realted sequences.
RNAseq	A string vector representing the RNA sequence in FASTA format.
motifPos	If SNR = F, the motifPos will be used, which indicates the relative position of specified consensus motif.
plot	Logical, where TRUE indicates perform a visualization for the results.
...	Further parameters used CMR annotation.

**Value**

##For location analysis: A list containing:

cmrMat	The input CMR matrix.
position	The location of each CMR (e.g. 5'UTR, CDS or 3'UTR)
distribution	The relative position of CMR in the transcript.

####For motif scan

A PWM matrix and motif logo.

####For motif detect

A list containing consensus motifs in PWM (position weight matrix) format.

####For GO enrichment

A list recording enrichment results for three subcategories (MF, BP and CC):

BP	The GO enrichment results for BP(biological process).
MF	The GO enrichment results for MF(molecular function).
CC	The GO enrichment results for CC(cellular component).

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

## Examples

```
## Not run:

#####location distribution analysis#####
GTF <- '/home/malab14/Arabidopsis_tair10.gtf'
##Extract the UTR position information from GTF file and perform location
##distribution analysis
UTRMat <- getUTR(GTF = GTF)
results <- CMRAnnotation(cmrMat = cmrMat, SNR = T, UTRMat = UTRMat,
                        annotation = "location")

#####Motif analysis#####
testSeq <- "/home/malab14/test.fa"
results.scan <- CMRAnnotation(cmrSeq = testSeq, annotation = "motifScan")
results.detect <- CMRAnnotation(cmrSeq = testSeq, annotation = "motifDetect")

#####GO analysis#####
enrichment <- CMRAnnotation(cmrMat = cmrMat, GTF = GTF, annotation = "GO",
                          topNodes = 20, dataset = "athaliana_eg_gene")

## End(Not run)
```

---

CMRCalling	<i>Identify CMRs (chemical modifications of RNA) from epitranscriptome sequencing data</i>
------------	--

---

## Description

CMRCalling is designed to identify different types of CMRs from epitranscriptome sequencing data.

## Usage

```
CMRCalling(CMR = c("m6A", "m6Am", "m5C", "hm5C", "pseudoU", "m1A"),
           cpus = 1, IPBAM = NULL, inputBAM = NULL,
           GTF = NULL, paired = FALSE, ...)
```

## Arguments

CMR	A string, which specifies the CMR type.
cpus	A integer number specifying the number of cpus to be used for parallel computing.
IPBAM	A string vector of file name, which specifies the IP samples in BAM format.
inputBAM	A string vector of file name, which specifies the input control samples in BAM format.
GTF	A string vector of file name, which specifies the reference genome annotation in GTF format.

paired                Logical, if TRUE, the paired-end parameters will be used for CMR calling, otherwise, the single-end parameters would be used.

...                    Further parameters used CMR calling.

**Value**

A matrix in BED format containing the CMRs.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:
#####reads mapping#####
input.fq <- "/home/malab14/input.fastq"
RIP.fq <- "/home/malab14/RIP.fastq"
referenceGenome <- "/home/malab14/tair10.fa"
GTF <- "/home/malab14/Arabidopsis.gtf"
input.bam <- readsMapping(alignment = "tophat", fq = input.fq,
                        refGenome = referenceGenome, paired = F)
RIP.bam <- readsMapping(alignment = "tophat", fq = RIP.fq,
                        refGenome = referenceGenome, paired = F)
cmrMat <- CMRCalling(CMR = 'm6A', method = 'SlidingWindow',
                    IPBAM = RIP.bam, inputBAM = input.bam)

## End(Not run)
```

---

cross_validation	<i>Cross validation method</i>
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**Description**

The ML-based classification model is trained and tested with N-fold cross validation method.

**Usage**

```
cross_validation(seed = 1, method = c("randomForest", "svm"),
                featureMat, positives, negatives, cross = 5, cpus = 1, ...)
```

**Arguments**

seed                an integer number specifying a random seed for randomly partitioning dataset.

method              a character string specifying machine learning method. Possible values are "randomForest" or "nnet".

featureMat          a numeric feature matrix.

positives	a character vector recording positive samples
negatives	a character vector recording negative samples.
cross	number of fold for cross validation.
cpus	an integer number specifying the number of cpus to be used for parallel computing.
...	Further parameters used to cross validation. Same with the parameters used in the classifier function.

## Details

In machine learning, the cross validation method has been widely used to evaluate the performance of ML-based classification models (classifiers).

For N-fold cross validation, positive and negative samples are randomly partitioned into N groups with approximately equal amount of samples, and each group is successively used for testing the performance of the ML-based classifier trained with the other N-1 groups of positive and negative samples.

For each round of cross validation, the prediction accuracy of the ML-based classifier was assessed using the receiver operating characteristic (ROC) curve analysis. The ROC curve is a two-dimensional plot of the false positive rate (FPR, x-axis) against the true positive rate (TPR, y-axis) at all possible thresholds. The value of area under the ROC curve (AUC) was used to quantitatively score the prediction accuracy of the ML-based classifier. The AUC value is ranged from 0 to 1.0, with higher AUC value indicates a better prediction accuracy of the ML-based classifier.

After N groups have been successively used as the testing set, the N sets of (FPR, TPR) pairs were imported into R package ROCR to visualize the ROC curves. The mean value of N AUCs was then computed as the overall performance of the ML-based classification model.

## Value

A list recording results from each fold cross validation including the components:

positives.train	positive samples used to train prediction model.
negatives.train	negative samples used to train prediction model.
positives.test	positive samples used to test prediction model.
negatives.test	negative samples used to test prediction model.
ml	machine learning method.
classifier	prediction model constructed with the best parameters obtained from training dataset.
positives.train.score	scores of positive samples in training dataset predicted by classifier.
negatives.train.score	scores of negative samples in training dataset predicted by classifier.

```

positives.test.score      scores of postive samples in testing dataset predicted by classifier.
negatives.test.score      scores of negative samples in testing dataset predicted by classifier.
train.AUC                 AUC value of the ML-based classifier on training dataset.
test.AUC                  AUC value of the ML-based classifier on testing dataset.

```

### Author(s)

Jingjing Zhai, Chuang Ma, Jie Song

### Examples

```

## Not run:

positives <- c("AT1G01060", "AT1G09530", "AT1G09570", "AT1G12610")
cvRes <- cross_validation(featureMat = featureMat, positives = positives,
                          negatives = negatives, cpus = 1)

## End(Not run)

```

---

extractCov	<i>Extract the reads coverage from BAM file</i>
------------	---

---

### Description

Extracting reads coverage at each nucleotide using bedtools or Rsamtools.

### Usage

```
extractCov(BAM, refGenome, method = c("bedtools", "Rsamtools"))
```

### Arguments

BAM	A character vector representing file name in bam format.
refGenome	A character vector representing file name of reference genome in FASTA format.
method	A string, which specifies the method to be used. For 'bedtools', users have to install the bedtools in the terminal by typing "sudo apt-get install bedtools". if not specified, "bedtools" will be used as default.

### Value

A string containing file name of coverage.



**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:

BAM <- '/home/malab14/test.bam'
refGenome <- '/home/malab14/'
results <- extractCov(BAM = BAM, refGenome = refGenome, method = "bedtools")

## End(Not run)
```

---

extractSeqs	<i>Extract sequences according to samples</i>
-------------	---

---

**Description**

Extracting the sequences of fixed length according to the samples.

**Usage**

```
extractSeqs(RNAseq, samples, seqLen = 101)
```

**Arguments**

RNAseq	A character string specified the file name of cDNA sequences.
samples	A character vector specified the samples.
seqLen	The length of extracted sequence.

**Value**

A list containing the extracted sequences.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:

cDNA <- '/home/malab14/tair10_cDNA.fa'
GTF <- '/home/malab14/Arabidopsis.gtf'
#Convert genomic position to cDNA position
peaks <- G2T.bedPos = cmrMat, GTF = GTF)
##Search consensus motif in cDNA sequence
motifPos <- searchMotifPos(RNAseq = cDNA)
```

```
posSamples <- findConfidentPosSamples(peaks = peaks, motifPos = motifPos)

posSeq <- extractSeqs(RNAseq = cDNA, samples = posSamples$positives,
                      seqLen = 101)

## End(Not run)
```

---

featureEncoding	<i>Feature encoding</i>
-----------------	-------------------------

---

**Description**

This function contains three feature encoding scheme, binary, k-mer and PseDNC. For binary encoding scheme, a vector of 404 (4\*101) features is generated through assigning 'A', 'C', 'G', 'U' and 'N' with (1,0,0,0), (0,1,0,0), (0,0,1,0), (0,0,0,1) and (0,0,0,0), respectively. Here 'N' is a gap used to ensure the fixed features of each sample, if an m6A/non- m6A site occurs near the initiation or termination of the transcript. For K-mer encoding, the composition of short sequence with different lengths was considered to encoding samples. For PseDNC (pseudo dinucleotide composition) encoding, the local and global sequence-order information along the RNA sequence was used for scoring the each sample.

**Usage**

```
featureEncoding(RNAseq, lambda = 6, w = 0.9)
```

**Arguments**

- RNAseq            A list containing the FASTA format sequences.
- lambda           The lambda parameter for the PseDNC-related features, default is 6.
- w                The weighting parameter for PseDNC-related features, default is 0.9.

**Value**

A matrix with features.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

---

`findConfidentPosSamples`*Find confident positive samples*

---

**Description**

The confident positive samples are identified if only one CMR signal existed in the corresponding peak.

**Usage**

```
findConfidentPosSamples(peaks, RNAseq = NULL, motifPos = NULL, ...)
```

**Arguments**

<code>peaks</code>	A BED format matrix containing the peak regions.
<code>RNAseq</code>	A character string specified the file name of cDNA sequences.
<code>motifPos</code>	A list containing the position of the consensus motif for each transcript.
<code>...</code>	Further paramters used for find confident positive samples.

**Value**

A list containing two elements: the positive samples and its transcript IDs.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:

cDNA <- '/home/malab14/tair10_cDNA.fa'
GTF <- '/home/malab14/Arabidopsis.gtf'
#Convert genomic position to cDNA position
peaks <- G2T(bedPos = cmrMat, GTF = GTF)
##Search consensus motif in cDNA sequence
motifPos <- searchMotifPos(RNAseq = cDNA)
posSamples <- findConfidentPosSamples(peaks = peaks, motifPos = motifPos)

## End(Not run)
```

---

findUnlabelSamples	<i>Find unlabeled samples</i>
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---

### Description

The unlabeled samples are extracted from the same set of transcripts with consensus motif (e.g. RRACH) of confident positive samples, but exclude the confident positive samples.

### Usage

```
findUnlabelSamples(cDNAID, motifPos, posSamples, ...)
```

### Arguments

cDNAID	A character vector representing the transcripts IDs.
motifPos	A list containing the position of the consensus motif for each transcript.
posSamples	A character vector specified the positive samples, which can be generated by function "findConfidentPosSamples".
...	Further parameters used for find confident positive samples.

### Value

A list containing two elements: the positive samples and its transcript IDs.

### Author(s)

Jingjing Zhai, Chuang Ma, Jie Song

### Examples

```
## Not run:

cDNA <- '/home/malab14/tair10_cDNA.fa'
GTF <- '/home/malab14/Arabidopsis.gtf'
#Convert genomic position to cDNA position
peaks <- G2T(bedPos = cmrMat, GTF = GTF)
##"cmrMat" can be generated by function "CMRCalling".
##Search consensus motif in cDNA sequence
motifPos <- searchMotifPos(RNAseq = cDNA)
posSamples <- findConfidentPosSamples(peaks = peaks, motifPos = motifPos)
unlabelSamples <- findUnlabelSamples(cDNAID = posSamples$cDNAID,
                                     motifPos = motifPos,
                                     posSamples = posSamples$positives)

## End(Not run)
```

G2T

*Convert the genomic position to transcriptomic position***Description**

According to the reference genome GTF annotation file, transform the genomic position to transcriptomic position, if one position can be mapped multiple transcripts, all of them will be retained.

**Usage**

```
G2T(bedPos, GTF)
```

**Arguments**

bedPos	A matrix in BED format containing genomic position.
GTF	A string vector of file name, which specifies the reference genome annotation in GTF format.

**Value**

A list recording transcriptomic position.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:
cdNA <- '/home/malab14/tair10_cdna.fa'
GTF <- '/home/malab14/Arabidopsis.gtf'
peaks <- G2T(bedPos = cmrMat, GTF = GTF)
###The cmrMat can be generated by the function "CMRCalling".

## End(Not run)
```

getUTR

*Get the genomic features for each transcript***Description**

According to the reference genome GTF annotation file, a matrix containing the five prime UTR, CDS and three prime UTR positional information will be generated.

**Usage**

```
getUTR(GTF)
```

**Arguments**

GTF	A string vector of file name, which specifies the reference genome annotation in GTF format.
-----	--

**Value**

A matrix with six columns containing:

five_UTR_Start	The start position for five prime UTR.
five_UTR_End	The end position for five prime UTR.
CDS_Start	The start position for CDS.
CDS_End	The end position for CDS.
three_UTR_Start	The start position for three prime UTR.
three_UTR_End	The end position for three prime UTR.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:

GTF <- '/home/malab14/Arabidopsis.gtf'
UTRMat <- getUTR(GTF = GTF)

## End(Not run)
```

---

motifDetect

*De novo motif discovery in the peak regions*


---

**Description**

The de novo motif discovery is performed through genetic algorithm in 'rGADEM' package.

**Usage**

```
motifDetect(sequence, plot = T, ...)
```

**Arguments**

sequence	A character vector representing the file name of the sequence in FASTA format.
plot	Logical, where TRUE indicates that perform visualization for the results.
...	Further paramters used for motif detection, see GADEM.

**Value**

A list containing consensus motifs in PWM (position weight matrix) format.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:  
  
results <- motifDetect(sequence = 'peak.fa')  
  
## End(Not run)
```

---

motifScan

*Scanning the motifs in the peak regions*

---

**Description**

For a given motif, all peak regions will be scanned and then calculates a position weight matrix(PWM) for the analyzed motifs. Finally, a motif logo will be generated to show the positional differences in the frequency of four nucleotides.

**Usage**

```
motifScan(sequence, motif = "[ag][ag]ac[act]")
```

**Arguments**

sequence	A character vector representing the file name of the sequence in FASTA format.
motif	A string, which specifies the motif to be searched.

**Value**

A PWM matrix and motif logo.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:

results <- motifScan(sequence = 'peak.fa')

## End(Not run)
```

peakCalling

*Peak Calling***Description**

Identify genomic regions in a genome that have been enriched with aligned reads as a consequence of performing MeRIP-seq or ChIP-seq experiment.

**Usage**

```
peakCalling(IPBAM, inputBAM, GTF, expName = NULL,
            method = c("SlidingWindow", "exomePeak", "MetPeak",
                       "MACS2", "BayesPeak"), paired = F, ...)
```

**Arguments**

IPBAM	A string vector of file name, which specifies the IP samples in BAM format.
inputBAM	A string vector of file name, which specifies the input control samples in BAM format.
GTF	A string vector of file name, which specifies the reference genome annotation in GTF format.
expName	A string, which specifies the name generated in the output directory which contains all the results.
paired	Logical, if TRUE, the paired-end parameters will be used for peak calling, otherwise, the single-end parameters would be used.
method	A string, which specifies the method used for peak calling, the default is "SlidingWindow".
...	Further parameters used peak calling.

**Value**

A list containing two elements:

peaks	A enriched peak region matrix in BED format.
method	A string represent which method was used for peak calling.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song



**Examples**

```
## Not run:
#####reads mapping#####
input.fq <- "/home/malab14/input.fastq"
RIP.fq <- "/home/malab14/RIP.fastq"
referenceGenome <- "/home/malab14/tair10.fa"
GTF <- "/home/malab14/Arabidopsis.gtf"
input.bam <- readsMapping(alignment = "tophat", fq = input.fq,
                          refGenome = referenceGenome, paired = F)
RIP.bam <- readsMapping(alignment = "tophat", fq = RIP.fq,
                        refGenome = referenceGenome, paired = F)
#####peak calling using Fisher exact-based sliding window#####
peaks <- peakCalling(IPBAM = RIP.bam, inputBAM = input.bam,
                     refGenome = referenceGenome,
                     method = 'SlindingWindow')

## End(Not run)
```

pseudoURatio

*Pseudouridine ratio***Description**

Calculate the pseudouridine ratio from the pseudo-seq data.

**Usage**

```
pseudoURatio(refGenome, inputBAM, cpus = 1)
```

**Arguments**

refGenome	A character vector representing file name of reference genome in FASTA format.
inputBAM	A string vector of file name, which specifies the input control samples in BAM format.
cpus	an integer number specifying the number of cpus to be used for parallel computing.

**Value**

A list containing the position and ratio for each pseudouridine.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

## References

Carlile, T.M., et al. Pseudouridine profiling reveals regulated mRNA pseudouridylation in yeast and human cells. *Nature* 2014;515(7525):143-146.

## Examples

```
## Not run:

inutBAM <- '/home/malab14/test.bam'
referenceGenome <- "/home/malab14/test_cDNA.fa"
results <- pseudoURatio(refGenome = referenceGenome,
                        inputBAM = inputBAM, cpus = 1)

## End(Not run)
```

---

PSOL	<i>Machine learning-based PSOL(positive samples only learning algorithm) algorithm</i>
------	--

---

## Description

Firstly, this function selects an initial negative set with the machine learning(ML)-based positive-only sample learning (PSOL) algorithm. The PSOL algorithm has been previously applied to predict stress-response genes and genomic loci encoding functional noncoding RNAs (see References).

## Usage

```
PSOL(featureMatrix = NULL, positives, balanced = FALSE, ratio = 10,
      unlabels, cpus = 1, PSOLResDic = NULL, iterator = 10, TPR = 0.995,
      cross = 5, method = c("randomForest", "svm"), ... )
```

## Arguments

featureMatrix	A numeric matrix recording the features for all sample.
positives	A character vector recording positive samples
balanced	A logical value, where TRUE represents balance the positive and negative samples according to the ratio.
ratio	A numeric value of the the ratio between negative and positive samples.
unlabels	A character vector recording unlabeled samples.
cpus	An integer number specifying the number of cpus will be used for parallel computing.
PSOLResDic	A character string, PSOL Result directory
iterator	An integer value, iterator times.
TPR	A numeric value ranged from 0 to 1.0, used to select the prediction score cutoff.
cross	An integer value, cross-times cross validation.
method	A character string, machine learning method.
...	Further parameters used for PSOL.

**Value**

A list containing three components:

positives	a character vector including the input positive samples.
negatives	a character vector recording the selected negative samples.
model	a class object representing the model.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song.

**References**

- [1] Chunlin Wang, Chris Ding, Richard F. Meraz and Stephen R. Holbrook. PSOL: a positive sample only learning algorithm for finding non-coding RNA genes. *Bioinformatics*, 2006, 22(21): 2590-2596.
- [2] Chuang Ma, Xiangfeng Wang. Machine learning-based differential network analysis: a case study of stress-responsive transcriptomes in *Arabidopsis thaliana*. 2013(Submitted).

---

QCBAM

*Quality control for BAM format files*

---

**Description**

Performing quality control for mapping results in BAM format.

**Usage**

```
QCBAM(BAM, quality = c(35, 30), paired = F)
```

**Arguments**

BAM	A character vector representing file name in bam format.
quality	A vector which specifies the base-call quality score to be filtered for single-end and paired-end, respectively.
paired	Logical, where TRUE indicates the BAM files are generated with paired-end reads.

**Value**

A list containing filtered files which passed the quality control.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:
BAM <- '/home/malab14/test.bam'
results <- QCBAM(BAM = BAM)

## End(Not run)
```

readMapping

*Reads mapping***Description**

Mapping FASTQ format reads to the reference genome with user adjustable method.

**Usage**

```
readMapping(alignment = c("bowtie", "bowtie2", "tophat",
                          "tophat2", "hisat", "hisat2"),
            fq, index = NULL, refGenome = NULL,
            paired = FALSE, softwareDir = NULL, ...)
```

**Arguments**

alignment	A string, which specifies the method to be used for reads mapping.
fq	A character vector representing file name in FASTQ format.
index	A character vector representing file name of index used for alignment. If not specified, it will generate index files automaticly.
refGenome	A character vector representing file name of reference genome in FASTA format.
paired	Logical, if TRUE, the paired-end parameters will be used for reads mapping, otherwise, the single-end parameters would be used.
softwareDir	Optional, if the corresponding alignment tools are not in the environment variables, please specify the directory of corresponding tools.
...	Further parameters used for reads mapping.

**Value**

A list recording the results including:

command	The command used for reads mapping.
resDir	A character vector containg the directory of alignment files.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

## Examples

```
## Not run:
#####Single-end alignment#####
fq <- '/home/malab14/test.fastq'
referenceGenome <- '/home/malab14/tair10.fa'
test.bam <- readsMapping(alignment = 'tophat', fq = fq,
                        refGenome = referenceGenome, paired = F)

#####Paired-end alignment#####
fq1 <- '/home/malab14/test1.fastq'
fq2 <- '/home/malab14/test2.fastq'
referenceGenome <- '/home/malab14/tair10.fa'
test.bam <- readMapping(alignment = 'tophat', fq = c(fq1, fq2),
                      refGenome = referenceGenome, paired = T)

#####Custome parameters#####
fq <- '/home/malab14/test.fastq'
referenceGenome <- '/home/malab14/tair10.fa'
test.bam <- readMapping(alignment = 'tophat', fq = fq,
                      refGenome = referenceGenome,
                      paired = F, ... = c("-p 5"))

## End(Not run)
```

---

runTopGO

*Go enrichment*


---

## Description

GO (Gene Ontology) enrichment analysis through "topGO" package.

## Usage

```
runTopGO(geneID, statistic = "fisher", algorithm = "elim",
        topNodes = 20,
        dataset = "athaliana_eg_gene", plot = TRUE)
```

## Arguments

geneID	A character vector representing the gene set to be used for GO enrichment.
statistic	A character string specifying which test to use.
algorithm	A character string specifying which algorithm to use.
topNodes	The number of top GO terms to be included in the results.
dataset	A character string specifying which dataset to use, the default is: <i>athaliana_eg_gene</i>
plot	Logical, if TRUE, a dot plot will be generated to represent the significance of each GO term.

**Value**

A list recording enrichment results for three subcategories (MF, BP and CC).

BP	The GO enrichment results for BP(biological process).
MF	The GO enrichment results for MF(molecular function).
CC	The GO enrichment results for CC(cellular component).

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:

mart <- biomaRt::useMart(biomart = "plants_mart", dataset = "athaliana_eg_gene",
                        host = 'plants.ensembl.org')
GTOGO <- biomaRt::getBM(attributes = c( "ensembl_gene_id", "go_id"), mart = mart)
GTOGO <- GTOGO[GTOGO$go_id != '', ]
all.genes <- sort(unique(as.character(GTOGO$ensembl_gene_id)))
geneID <- samples(all.genes, 100)
results <- runTopGO(geneID = geneID)

## End(Not run)
```

---

searchMotifPos

*Scanning the motif in the sequence*


---

**Description**

For a given motif, all sequence will be scanned return the central position for the motif.

**Usage**

```
searchMotifPos(sequence, motif = "[ag][ag]ac[act]", cenPos = 2)
```

**Arguments**

sequence	A character vector representing the file name of the sequence in FASTA format.
motif	A string, which specifies the motif to be searched.
cenPos	Integer represents the central position for the motif.

**Value**

A list containing the motif central position.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

**Examples**

```
## Not run:

sequence <- '/home/malab10/tair10_cDNA.fa'
results <- motifPosition(sequence = sequence)

## End(Not run)
```

---

SlidingWindow

*Fisher exact test based sliding window*


---

**Description**

Peak calling through Fisher exact test based sliding window method (see References).

**Usage**

```
SlidingWindow(input, RIP, mappedInput = NULL,
              mappedRIP = NULL, level = 0.05,
              ratio = -2, ...)
```

**Arguments**

input	A string vector of file name, which specifies the input control samples in BAM format.
RIP	A string vector of file name, which specifies the IP samples in BAM format.
mappedInput	Integer, which represents the number of mapped reads number in the input control samples.
mappedRIP	Integer, which represents the number of mapped reads number in the IP samples.
level	Significance level for the p-value.
ratio	The ratio between the normalized mapped reads number in IP and input samples, respectively.
...	Further parameters used for peak calling.

**Value**

A matrix in BED format containing the enriched peaks.

**Author(s)**

Jingjing Zhai, Chuang Ma, Jie Song

## References

Meyer, K.D., et al. Comprehensive analysis of mRNA methylation reveals enrichment in 3'UTRs and near stop codons. *Cell* 2012; 149(7):1635-1646

## Examples

```
## Not run:
#####reads mapping#####
input.fq <- "/home/malab14/input.fastq"
RIP.fq <- "/home/malab14/RIP.fastq"
referenceGenome <- "/home/malab14/tair10.fa"
GTF <- "/home/malab14/Arabidopsis.gtf"
input.bam <- readsMapping(alignment = "tophat", fq = input.fq,
                          refGenome = referenceGenome, paired = F)
RIP.bam <- readsMapping(alignment = "tophat", fq = RIP.fq,
                        refGenome = referenceGenome, paired = F)
#####peak calling#####
peaks <- SlidingWindow(RIP = RIP.bam, input = input.bam,
                       mappedInput = 20693001,
                       mappedRIP = 22070873, refGenome = referenceGenome)

## End(Not run)
```



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