Package 'ASpli'

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Description Integrative pipeline for the analysis of alternative splicing using RNAseq.

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ASpli-package *Analysis of Alternative Splicing Using RNAseq*

Description

ASpli is an integrative and flexible package that facilitates the characterization of genome-wide changes in AS under different experimental conditions. ASpli analyzes the differential usage of introns, exons, and splice junctions using read counts, and estimates the magnitude of changes in AS by calculating differences in the percentage of exon inclusion or intron retention using splice junctions. This integrative approach allows the identification of changes in both annotated and novel AS events.

ASpli allows users to produce self-explanatory intermediate outputs, based on the aim of their analysis. A typical workflow involves parsing the genome annotation into new features called bins, overlapping read alignments against those bins, and inferring differential bin usage based on the number of reads aligning to the bins and junctions.

Details

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Type:	Package
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License:	GPL
Depends:	methods, GenomicRanges, GenomicFeatures, edgeR, methods, BiocGenerics, IRanges, GenomicAlignments, Gvi

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

References

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- Genome wide comparative analysis of the effects of PRMT5 and PRMT4/CARM1 arginine methyltransferases on the Arabidopsis thaliana transcriptome. BMC Genomics. Hernando, E, Sanchez, S, Mancini, E, Yanovsky MJ. DOI:10.1186/s12864-015-1399-2
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- The dengue virus NS5 protein intrudes in the cellular spliceosome and modulates splicing. PLOS Pathogens. De Maio, F., Risso, G., Iglesias, G., Shah, P, Pozzi, B., Gebhard, L., Mammi, L., Mancini, E., Yanovsky, M., Andino, R., Krogan, N., Srebrow, A. and Gamarnik, A. DOI:10.1371/journal.ppat.1005841

Examples

```
library(GenomicFeatures)
gtfFileName <- aspliExampleGTF()
genomeTxDb <- txdbmaker::makeTxDbFromGFF( gtfFileName )
features <- binGenome( genomeTxDb )
BAMFiles <- aspliExampleBamList()
targets <- data.frame(
  row.names = paste0('Sample',c(1:12)),
  bam = BAMFiles,
  f1 = c( 'A','A','A','A','A','A',
          'B','B','B','B','B','B'),
  f2 = c( 'C','C','C','D','D','D',
          'C','C','C','D','D','D'),
  stringsAsFactors = FALSE)
  getConditions(targets)
  mBAMs <- data.frame(bam      = sub("_[02]","",targets$bam[c(1,4,7,10)]),
                      condition= c("A_C","A_D","B_C","B_D"))

gbcounts  <- gbCounts( features = features,
                           targets = targets,
                           minReadLength = 100, maxISize = 50000,
                           libType="SE",
                           strandMode=0)
asd   <- jCounts(counts = gbcounts,
                     features = features,
                     minReadLength = 100,
                     libType="SE",
                     strandMode=0)


gb      <- gbDUreport(counts=gbcounts,
contrast = c( 1, -1, -1, 1 ) )
jdur    <- jDUreport(asd,
                     contrast =  c( 1, -1, -1, 1 ) ,
                     mergedBams = mBAMs)
sr      <- splicingReport(gb, jdur, counts =gbcounts    )
is      <- integrateSignals(sr,asd)
```

`AS accessors` *Accessors for ASpliAS object*

Description

Methods to retrieve and set data in ASpliAS object. Setting data into an ASpliAS object is not a typical task and must be done with care, because it can affect the integrity of the object.

Usage

```
altPSI( x )
esPSI( x )
irPIR( x )
joint( x )
junctionsPIR( x )
junctionsPJU( x )
```

Arguments

x	An ASpliAS object

Value

Returns dataframes with genomic metadata and PSI and PIR metrics

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

Examples

```
# Accessing data tables from an ASpliAS object

#as <- aspliASexample()

#ap <- altPSI(as)
#ep <- esPSI(as)
#ip <- irPIR(as)
#j  <- joint(as)
#jpi <- junctionsPIR(as)
#jps <- junctionsPJU(as)

# Setting data tables to an ASpliAS object

#as2 <- new( 'ASpliAS' )

#altPSI( as2 )  <- ap
#esPSI( as2 )  <- ep
#irPIR( as2 )  <- ip
#joint( as2 )  <- j
#junctionsPIR( as2 )  <- jpi
#junctionsPJU( as2 )  <- jps
```

ASpli-deprecated *Deprecated functions in package 'ASpli'*

Description

These functions are provided for compatibility with older versions of 'ASpli' only, and will be defunct at the next release.

Details

The following functions are deprecated and will be made defunct; use the replacement indicated below:

- loadBAM: gbCounts
- readCounts: gbCounts
- AsDiscover: jCounts, splicingReport, integrateSignals
- DUreport: gbDUreport, jDUreport
- DUreportBinSplice: gbDUreport
- junctionDUreport: jDUreport
- mergeBinDUAS: splicingReport, integrateSignals
- junctionsPSI: junctionsPJU
- plotGenomicRegions: exportSplicingReports, exportIntegratedSignals

ASpliAS-class *Class "ASpliAS"*

Description

Results of PSI and PIR using experimental junctions

Slots

irPIR: Reports: event, e1i counts (J1), ie1 counts (J2), j_within (J3), PIR by condition. J1, J2, J3 sum of junctions (J1, J2, J3) by condition.

altPSI: Reports: event, J1 (start), J2 (end), J3 (exclusion), PSI. J1, J2, J3 sum of junctions (J1, J2, J3) by condition.

esPSI: Reports: event, J1 (start), J2 (end), J3 (exclusion), PSI. J1, J2, J3 sum of junctions (J1, J2, J3) by condition.

join: It is a combination of irPIR, altPSI and esPSI tables

junctionsPIR: PIR metric for each experimental junction using e1i and ie2 counts. Exclusion junction is the junction itself. This output helps to discover new introns as well as new retention events

`junctionsPJU`: Given a junction, it is possible to analyze if it shares start, end or both with another junction. If so, is because there is more than one way for/of splicing. Ratio between them along samples is reported.

`targets`: DataFrame with targets.

`.ASpliVersion`: ASpli version when this object was created. It should not be modified by the user.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

Methods: `AsDiscover`

Accesors: `altPSI`, `irPIR`, `esPSI`, `joint`, `junctionsPIR`, `junctionsPJU`

`ASpliCounts` *Class* "`ASpliCounts`"

Description

Contains results of read overlaps against all feature levels summarization

Slots

`gene.counts`

`exon.intron.counts`

`junction.counts`

`e1i.counts`

`ie2.counts`

`gene.rd`

`bin.rd`

`condition.order`

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

ASpliCounts-class *Class* "ASpliCounts"

Description

Contains results of read overlaps against all feature levels summarization

Slots

`gene.counts`: Object of class "data.frame"

`exon.intron.counts`: Object of class "data.frame"

`junction.counts`: Object of class "data.frame"

`e1i.counts`: Object of class "data.frame"

`ie2.counts`: Object of class "data.frame"

`gene.rd`: Object of class "data.frame"

`bin.rd`: Object of class "data.frame"

`condition.order`: Object of class "character"

`targets`: Object of class "data.frame"

`.ASpliVersion`: ASpli version when this object was created. It should not be modified by the user.

Methods

AsDiscover psi and pir metrics

countsb bin counts accesor

countse1i e1i counts accesor

countsg gene counts accesor

countsie2 ie2 counts accesor

countsj junction counts accesor

DUreport_DEXSeq differential expression and usage estimation using DEXSeq

DUreport differential expression and usage estimation using DEXSeq

rdsb bin read densities accesor

rdsg gen read densities acceesor

rds compute read densities on genes and bins

writeCounts Export count tables

writeRds Export read density tables

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

ASpliDU-class *Class* "ASpliDU"

Description

Contains results of differential expression at gene level and differential usage at bin and junction level estimation using DEreport method.

Slots

genes

bins

junctions

contrast

.ASpliVersion: ASpli version when this object was created. It should not be modified by the user.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

ASpliFeatures-class *Class* "ASpliFeatures"

Description

Contains Genomic Ranges of different features extracted from a TxDb

Slots

genes:

bins:

junctions:

transcriptExons:

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

---

ASpliIntegratedSignals-class
Class "ASpliIntegratedSignals"

Description

Contains results of differential expression at junction level.

Slots

signals

filters

.ASpliVersion: ASpli version when this object was created. It should not be modified by the user.

Author(s)

Andres Rabinovich, Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

---

ASpliJDU-class *Class* "ASpliJDU"

Description

Contains results of differential expression at junction level.

Slots

localec

localej

anchorc

anchorj

jir

jes

jalt

contrast

.ASpliVersion: ASpli version when this object was created. It should not be modified by the user.

Author(s)

Andres Rabinovich, Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

ASpliSplicingReport-class *Class* "ASpliSplicingReport"

Description

Contains results of differential expression at junction level.

Slots

`binbased`

`localebased`

`anchorbased`

`contrast`

`.ASpliVersion`: ASpli version when this object was created. It should not be modified by the user.

Author(s)

Andres Rabinovich, Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

binGenome *Feature coordinates extraction*

Description

Exons and introns are subdivided into new features called exon and intron bins and are then classified into exclusively exonic bins, exclusively intronic bins or alternative splicing (AS) bins .

Usage

```
binGenome(genome, geneSymbols = NULL, logTo = "ASpli_binFeatures.log", cores = 1)
```

Arguments

`genome`	An object of class transcriptDb (TxDb)
`geneSymbols`	A dataframe with symbol (common names) of TxDb genes. If geneSymbols is NULL, gene name will be repeated
`logTo`	Filename where to print features extraction log
`cores`	Number of cores to use in parallel when binning the genome

Details

Exon and intron coordinates are extracted from gene annotation, only those from multi-exonic genes are saved for further evaluation. In case more than one isoform exist, some exons and introns will overlap. Exons and introns are then disjoint into new features called exon and intron bins, and then they are classified into exclusively exonic bins, exclusively intronic bind or alternative splicing bins (AS-bins), which are labeled according to which alternative splicing event are assumed to came from:

- ES: exon skipping
- IR: intron retention
- Alt5|3'ss: alternative five/three prime splicing site
- "*" (ES*, IR*, AltSS*) means this AS bin/region is involved simultaneously in more than one AS event type
- external: from the beginning or the end of a transcript

Subgenic features are labeled as follow (hypothetical GeneAAA):

- GeneAAA:E001: defines first exonic bin
- GeneAAA:I001: defines first intronic bin
- GeneAAA:Io001: defines first intron before disjoint into bins
- GeneAAA:J001: defines first junction

Junctions are defined as the last position of five prime exon (donor position) and first position of three prime exon (aceptor position). Using TxDb object, it is possible to extract annotated/known junctions. This information will be useful for the analysis of "experimental" junctions (reads aligned with gaps). Bins and junctions are labelled always in 5' to 3' sense. This notation is strand independent. It implies that bin / junction with lower numbering is always at 5'.

Value

An ASpliFeatures object. It is a list of features using GRanges format.

Author(s)

Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

featuresg, featuresb, featuresj

Examples

```
# Create a transcript DB from gff/gtf annotation file.
library(GenomicFeatures)
gtfFileName <- aspliExampleGTF()
genomeTxDb <- txdbmaker::makeTxDbFromGFF( gtfFileName )

# Create an ASpliFeatures object from TxDb
```

```
features <- binGenome( genomeTxDb )

# Extract gene, bin and junctions features
GeneCoord <- featuresg(features)
BinCoord <- featuresb(features)
JunctionCoord <- featuresj(features)
```

`binGenome-methods` *Feature coordinates extraction*

Description

Feature coordinates extraction from a Transcript Database

Methods

`signature(genome = "TxDb")` An object of class transcriptDb (TxDb)

Author(s)

Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

`featuresg`, `featuresb` , `featuresj`

`Counts accesors` *Accessors for ASpliCounts object*

Description

Accessors for ASpliCounts object

Usage

```
countsb(x)
countse1i(x)
countsg(x)
countsie2(x)
countsj(x)
rdsg(x)
rdsb(x)
condition.order(x)
targets(x)
```

Arguments

x	An ASpliCounts object

Value

Returns dataframes with counts by sample and genomic metadata

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

Examples

```
# Get data tables from an ASpliCounts object

#counts <- aspliCountsExample()

#cb1  <- countsb(counts)
#ce1i <- countse1i(counts)
#cg   <- countsg(counts)
#cie2 <- countsie2(counts)
#cj   <- countsj(counts)
#rg   <- rdsg(counts)
#rb   <- rdsb(counts)
#co   <- condition.order(counts)
#tg   <- targets(counts)

# Set data tables to an ASpliCounts object

#countsb(counts)   <- cb1
#countse1i(counts) <- ce1i
#countsg(counts)   <- cg
#countsie2(counts) <- cie2
#countsj(counts)   <- cj
#rdsg(counts)      <- rg
#rdsb(counts)      <- rb
```

DU accessors *Accessors for ASpliDU object*

Description

Accessors for ASpliDU object

Usage

```
genesDE( x )
binsDU( x )
junctionsDU( x )
```

Arguments

x	An ASpliDU object

Value

Returns dataframes with genomic metadata and logFC and pvalue

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

Examples

```
# Get data tables from an ASpliDU object

#du <- aspliDUexample1()

#gde <- genesDE( du )
#bdu <- binsDU( du )
#jdu <- junctionsDU( du )

# Set data tables to an ASpliDU object

#genesDE( du )     <- gde
#binsDU( du )      <- bdu
#junctionsDU( du ) <- jdu
```

DUreport *Differential gene expression and differential bin usage estimation*

Description

Estimate differential expression at gene level and differential usage at bin level. When targets has only two conditions, and contrast is not set, the estimation of differential expression and usage is done with an exact test, otherwise is estimated using a generalized linear model.

Usage

```
DUreport( counts,
          targets,
          minGenReads = 10,
          minBinReads = 5,
          minRds = 0.05,
          offset = FALSE,
          offsetAggregateMode =  c( "geneMode", "binMode" )[1],
          offsetUseFitGeneX = TRUE,
          contrast = NULL,
```

```
            forceGLM = FALSE,
            ignoreExternal = TRUE,
            ignoreIo = TRUE,
            ignoreI = FALSE,
            filterWithContrasted = FALSE,
            verbose = FALSE)
```

Arguments

counts	An object of class ASpliCounts
targets	A data.frame containing sample, bam and experimental factor columns.
minGenReads	Genes with at least an average of minGenReads reads for any condition are included into the differential expression test. Bins from genes with at least an average of minGenReads reads for all conditions are included into the differential bin usage test. Default value is 10 reads.
minBinReads	Bins with at least an average of minGenReads reads for any condition are included into the differential bin usage test. Default value is 5 reads.
minRds	Genes with at least an average of minRds read density for any condition are included into the differential expression test. Bins from genes with at least an average of minRds read density for all conditions are included into the differential bin usage test. Bins with at least an average of minRds read density for any condition are included into the differential bin usage test. Default value is 0.05.
ignoreExternal	Ignore Exon Bins at the beginning or end of the transcript. Default value is TRUE.
ignoreIo	Ignore original introns. Default TRUE
ignoreI	Ignore intron bins, test is performed only for exons. Default FALSE
offset	Corrects bin expression using an offset matrix derived from gene expression data. Default = FALSE
offsetAggregateMode	Choose the method to aggregate gene counts to create the offset matrix. When offsetAggregateMode is 'geneMode' and option offsetUseFitGeneX is TRUE, a generalized linear model is used to create the offset matrix. When offsetAggregateMode is 'geneMode' and option offsetUseFitGeneX is FALSE, the offset matrix is generated by adding a prior count to the gene count matrix. When offsetAggregateMode is 'binMode' a matrix from obtained from the sum of exonic bin counts, this only takes those bins that passes filters using minGenReads, minBinReads and minRds. Options:=c("geneMode", "binMode")[1]
,	
offsetUseFitGeneX	Default= TRUE
contrast	Define the comparison between conditions to be tested. contrast should be a vector with length equal to the number of experimental conditions defined by targets. The values of this vector are the coefficients that will be used to weight each condition, the order of the values corresponds to the order given by

getConditions function. When contrast is NULL, defaults to a vector containing -1, as the first value, 1 as the second an zero for all the remaining values, this corresponds to a pair comparison where the first condition is assumed to be a control and the second condition is the treatment, all other conditions are ignored. Default = NULL

forceGLM — Force the use of a generalized linear model to estimate differential expression and usage. Default = FALSE

filterWithContrasted — A logical value specifying if bins, genes and junction will be filtered by read quantity and read density using data from those conditions that will be used in the comparison, i.e. those which coefficients in contrast argument are different from zero. The default value is FALSE, it is strongly recommended to do not change this value.

verbose — A logical value that indicates that detailed information about each step in the analysis will be presented to the user.

Value

An ASpliDU object with results at genes, bins level.

Author(s)

Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

edgeR, junctionDUreport Accessors: genesDE, binsDU Export: writeDU

Examples

```
#This function has been deprecated and is no longer neded. Please see vignette for new pipeline.
```

DUreport.norm *Differential gene expression and differential bin usage estimation*

Description

Estimate differential expression at gene level and differential usage at bin level. When targets has only two conditions, and contrast is not set, the estimation of differential expression and usage is done with an exact test, otherwise is estimated using a generalized linear model.

Usage

```
DUreport.norm( counts,
          minGenReads = 10,
          minBinReads = 5,
          minRds = 0.05,
          contrast = NULL,
          ignoreExternal = TRUE,
          ignoreIo = TRUE,
          ignoreI = FALSE,
          filterWithContrasted = TRUE,
          verbose = FALSE,
          threshold = 5)
```

Arguments

counts	An object of class ASpliCounts
minGenReads	Genes with at least an average of minGenReads reads for any condition are included into the differential expression test. Bins from genes with at least an average of minGenReads reads for all conditions are included into the differential bin usage test. Default value is 10 reads.
minBinReads	Bins with at least an average of minGenReads reads for any condition are included into the differential bin usage test. Default value is 5 reads.
minRds	Genes with at least an average of minRds read density for any condition are included into the differential expression test. Bins from genes with at least an average of minRds read density for all conditions are included into the differential bin usage test. Bins with at least an average of minRds read density for any condition are included into the differential bin usage test. Default value is 0.05.
ignoreExternal	Ignore Exon Bins at the beginning or end of the transcript. Default value is TRUE.
ignoreIo	Ignore original introns. Default TRUE
ignoreI	Ignore intron bins, test is performed only for exons. Default FALSE
contrast	Define the comparison between conditions to be tested. contrast should be a vector with length equal to the number of experimental conditions defined by targets. The values of this vector are the coefficients that will be used to weight each condition, the order of the values corresponds to the order given by getConditions function. When contrast is NULL, defaults to a vector containing -1, as the first value, 1 as the second an zero for all the remaining values, this corresponds to a pair comparison where the first condition is assumed to be a control and the second condition is the treatment, all other conditions are ignored. Default = NULL
filterWithContrasted	A logical value specifying if bins, genes and junction will be filtered by read quantity and read density using data from those conditions that will be used in the comparison, i.e. those which coefficients in contrast argument are different from zero. The default value is TRUE, it is strongly recommended to do not change this value.

verbose	A logical value that indicates that detailed information about each step in the analysis will be presented to the user.
threshold	Default = 5

Value

An ASpliDU object with results at genes, bins level.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

edgeR, jDUreport Accessors: genesDE, binsDU Export: writeDU

Examples

```
#check ASpli package examples
```

DUreport.offset *Differential gene expression and differential bin usage estimation*

Description

Estimate differential expression at gene level and differential usage at bin level. When targets has only two conditions, and contrast is not set, the estimation of differential expression and usage is done with an exact test, otherwise is estimated using a generalized linear model.

Usage

```
DUreport.offset( counts,
          minGenReads = 10,
          minBinReads = 5,
          minRds = 0.05,
          offsetAggregateMode =  c( "geneMode", "binMode" )[1],
          offsetUseFitGeneX = TRUE,
          contrast = NULL,
          ignoreExternal = TRUE,
          ignoreIo = TRUE,
          ignoreI = FALSE,
          filterWithContrasted = TRUE,
          verbose = FALSE)
```

Arguments

counts	An object of class ASpliCounts
minGenReads	Genes with at least an average of minGenReads reads for any condition are included into the differential expression test. Bins from genes with at least an average of minGenReads reads for all conditions are included into the differential bin usage test. Default value is 10 reads.
minBinReads	Bins with at least an average of minGenReads reads for any condition are included into the differential bin usage test. Default value is 5 reads.
minRds	Genes with at least an average of minRds read density for any condition are included into the differential expression test. Bins from genes with at least an average of minRds read density for all conditions are included into the differential bin usage test. Bins with at least an average of minRds read density for any condition are included into the differential bin usage test. Default value is 0.05.
ignoreExternal	Ignore Exon Bins at the beginning or end of the transcript. Default value is TRUE.
ignoreIo	Ignore original introns. Default TRUE
ignoreI	Ignore intron bins, test is performed only for exons. Default FALSE
offset	Corrects bin expression using an offset matrix derived from gene expression data. Default = FALSE
offsetAggregateMode	Choose the method to aggregate gene counts to create the offset matrix. When offsetAggregateMode is 'geneMode' and option offsetUseFitGeneX is TRUE, a generalized linear model is used to create the offset matrix. When offsetAggregateMode is 'geneMode' and option offsetUseFitGeneX is FALSE, the offset matrix is generated by adding a prior count to the gene count matrix. When offsetAggregateMode is 'binMode' a matrix from obtained from the sum of exonic bin counts, this only takes those bins that passes filters using minGenReads, minBinReads and minRds. Options:=c("geneMode", "binMode")[1]
,	
offsetUseFitGeneX	Default= TRUE
contrast	Define the comparison between conditions to be tested. contrast should be a vector with length equal to the number of experimental conditions defined by targets. The values of this vector are the coefficients that will be used to weight each condition, the order of the values corresponds to the order given by getConditions function. When contrast is NULL, defaults to a vector containing -1, as the first value, 1 as the second an zero for all the remaining values, this corresponds to a pair comparison where the first condition is assumed to be a control and the second condition is the treatment, all other conditions are ignored. Default = NULL
filterWithContrasted	A logical value specifying if bins, genes and junction will be filtered by read quantity and read density using data from those conditions that will be used in the comparison, i.e. those which coefficients in contrast argument are different

from zero. The default value is TRUE, it is strongly recommended to do not change this value.

verbose A logical value that indicates that detailed information about each step in the analysis will be presented to the user.

Value

An ASpliDU object with results at genes, bins level.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

edgeR, jDUreport Accessors: genesDE, binsDU Export: writeDU

Examples

```
#check ASpli pacakge example
```

DUreportBinSplice *Differential gene expression and differential bin usage estimation*

Description

Estimate differential expression at gene level and differential usage at bin level using diffSpliceDGE function from edgeR package. This is an alternative approach to DUreport. The results at gene level are the same as the results from DUreport. The results at bin level are slightly different.

Usage

```
DUreportBinSplice( counts,
                   targets,
                   minGenReads = 10,
                   minBinReads = 5,
                   minRds = 0.05,
                   contrast = NULL,
                   forceGLM = FALSE,
                   ignoreExternal = TRUE,
                   ignoreIo = TRUE,
                   ignoreI = FALSE,
                   filterWithContrasted = FALSE,
                   verbose = TRUE )
```

Arguments

counts	An object of class ASpliCounts
targets	A dataframe containing sample, bam and experimental factor columns.
minGenReads	Genes with at least an average of minGenReads reads for any condition are included into the differential expression test. Bins from genes with at least an average of minGenReads reads for all conditions are included into the differential bin usage test. Default value is 10 reads.
minBinReads	Bins with at least an average of minGenReads reads for any condition are included into the differential bin usage test. Default value is 5 reads.
minRds	Genes with at least an average of minRds read density for any condition are included into the differential expression test. Bins from genes with at least an average of minRds read density for all conditions are included into the differential bin usage test. Bins with at least an average of minRds read density for any condition are included into the differential bin usage test. Default value is 0.05.
ignoreExternal	Ignore Exon Bins at the beginning or end of the transcript. Default value is TRUE.
ignoreIo	Ignore original introns. Default TRUE
ignoreI	Ignore intron bins, test is performed only for exons. Default FALSE
contrast	Define the comparison between conditions to be tested. contrast should be a vector with length equal to the number of experimental conditions defined by targets. The values of this vector are the coefficients that will be used to weight each condition, the order of the values corresponds to the order given by getConditions function. When contrast is NULL, defaults to a vector containing -1, as the first value, 1 as the second an zero for all the remaining values, this corresponds to a pair comparison where the first condition is assumed to be a control and the second condition is the treatment, all other conditions are ignored. Default = NULL
forceGLM	Force the use of a generalized linear model to estimate differential expression. It is not used to differential usage of bins. Default = FALSE
filterWithContrasted	A logical value specifying if bins, genes and junction will be filtered by read quantity and read density using data from those conditions that will be used in the comparison, i.e. those which coefficients in contrast argument are different from zero. The default value is FALSE, it is strongly recommended to do not change this value.
verbose	A logical value that indicates that detailed information about each step in the analysis will be presented to the user.

Value

An ASpliDU object with results at genes, bins level.

Author(s)

Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

edgeR, junctionDUreport Accessors: genesDE, binsDU Export: writeDU

Examples

```
#This function has been deprecated. Please see vignette for new pipeline.
```

`Examine ASpliDU objects`

Examine ASpliDU objects

Description

AspliDU object may contain results of differential expression of genes, differential usage of bins and junctions, however not everything is calculated at the same or even present. Calculations for genes and bins can be done independently from junctions. Functions `containsJunctions` and `containsGenesAndBins` allow to interrogate an ASpliDU object about the kind of results it contain.

Usage

```
containsJunctions( du )
containsGenesAndBins( du )
```

Arguments

du	An ASpliDU object.

Value

A logical value that indicates that results for genes and bins, or results for junctions are available in the object.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

Examples

```
# see ASpli package
```

`Example data` *Example Aspli objects*

Description

ASpli includes functions to easily build ASpli objects, used in examples in the vignette and man pages.

Usage

```
aspliASexample()
aspliBamsExample()
aspliCountsExample()
aspliDUexample1()
aspliDUexample2()
aspliExampleBamList()
aspliExampleGTF()
aspliFeaturesExample()
aspliJunctionDUexample()
aspliTargetsExample()
```

Value

An ASpli object with example data.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

Examples

```
#as <- aspliASexample()
#bams <- aspliBamsExample()
#counts <- aspliCountsExample()
#du1 <- aspliDUexample1()
#du2 <- aspliDUexample2()
#bamfiles <- aspliExampleBamList()
#gtffile <- aspliExampleGTF()
#features <- aspliFeaturesExample()
#jdu <- aspliJunctionDUexample()
#targets <-aspliTargetsExample()
```

exportIntegratedSignals *Export integrated signals.*

Description

Export integrated signals in an easy to analyze HTML table.

Usage

```
exportIntegratedSignals( is, output.dir="is",
                         sr, counts, features, asd,
                         mergedBams,
                         jCompletelyIncluded = FALSE, zoomRegion = 1.5,
                         useLog = FALSE, tcex = 1, ntop = NULL,
                         openInBrowser = FALSE,
                         makeGraphs = TRUE, bforce=FALSE
                        )
```

Arguments

is	An object of class ASpliIntegratedSignals
sr	An object of class ASpliSplicingReport
counts	An object of class ASpliCounts
features	An object of class ASpliFeatures
asd	An object of class ASpliAS
output.dir	HTML reports output directory
mergedBams	Dataframe with two columns, bams and conditions. Bams are paths to merged bams for each condition to be ploted.
jCompletelyIncluded	If TRUE only plot junctions completely included in plot region. Else plot any overlapping junction in the region
zoomRegion	Magnify plot region by this factor
useLog	Plot counts log
tcex	Text size
ntop	Only show n top signals
openInBrowser	Open reports in browser when done
makeGraphs	Generate graphs in reports
bforce	Force plot generation even if plot already exists

Value

Produces html reports

Author(s)

Andres Rabinovich, Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

gbDUreport, jDUreport, ASpliSplicingReport, splicingReport, ASpliIntegratedSignals

Examples

```
  # Create a transcript DB from gff/gtf annotation file.
  # Warnings in this examples can be ignored.
  library(GenomicFeatures)
  genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
                                package="ASpli") )

  # Create an ASpliFeatures object from TxDb
  features <- binGenome( genomeTxDb )

  # Define bam files, sample names and experimental factors for targets.
  bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
                     "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )

  targets <- data.frame(
              row.names = paste0('Sample_',c(1:6)),
              bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
              factor1 = c( 'C','C','C','D','D','D'))

  # Read counts from bam files
  gbcounts  <- gbCounts( features = features,
                           targets = targets,
                           minReadLength = 100, maxISize = 50000,
                           libType="SE",
                           strandMode=0)
jcounts   <- jCounts(counts = gbcounts,
                     features = features,
                     minReadLength = 100,
                     libType="SE",
                     strandMode=0)


  # Test for factor1
  gbPaired <- gbDUreport(gbcounts, contrast = c(1, -1))
  jPaired  <- jDUreport(jcounts, , contrast = c(1, -1))

  # Generate a splicing report merging bins and junctions DU
  sr       <- splicingReport(gbPaired, jPaired, gbcounts)
  is       <- integrateSignals(sr, jcounts)

  #Make merged bams dataframe
  mergedBamsFileNames <- c( "A_C.bam", "A_D.bam" )
 mergedBams <- data.frame(bams = system.file( 'extdata', mergedBamsFileNames, package="ASpli" ),
  condition = c("C", "D"), stringsAsFactors = FALSE)
```

```
  # Export integrated signals
  exportIntegratedSignals(is, output.dir = paste0(tempdir(), "/is"), sr, gbcounts,
                      features, jcounts, mergedBams, makeGraphs = TRUE, bforce = TRUE )
```

---

exportSplicingReports *Export splicing reports*

Description

Export splicing reports in easy to analyze HTML tables.

Usage

```
exportSplicingReports( sr, output.dir="sr" ,
openInBrowser = FALSE, maxBinFDR = 0.2, maxJunctionFDR = 0.2 )
```

Arguments

sr	An object of class ASpliSplicingReport
output.dir	HTML reports output directory
openInBrowser	Open reports in browser when done
maxBinFDR	Only show bins with FDR < maxBinFDR
maxJunctionFDR	Only show junctions with FDR < maxJunctionFDR

Value

Produces html reports

Author(s)

Andres Rabinovich, Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

gbDUreport, jDUreport, splicingReport, ASpliSplicingReport

Examples

```
# Create a transcript DB from gff/gtf annotation file.
  # Warnings in this examples can be ignored.
  library(GenomicFeatures)
  genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
                                package="ASpli") )

  # Create an ASpliFeatures object from TxDb
  features <- binGenome( genomeTxDb )
```

```
  # Define bam files, sample names and experimental factors for targets.
  bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
                     "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )

  targets <- data.frame(
               row.names = paste0('Sample_',c(1:6)),
               bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
               factor1 = c( 'C','C','C','D','D','D'),
               subject = c(0, 1, 2, 0, 1, 2))

  # Read counts from bam files

gbcounts  <- gbCounts( features = features,
                           targets = targets,
                           minReadLength = 100, maxISize = 50000,
                           libType="SE",
                           strandMode=0)
jcounts   <- jCounts(counts = gbcounts,
                     features = features,
                     minReadLength = 100,
                     libType="SE",
                     strandMode=0)

  # Test for factor1 controlling for paired subject
  gbPaired <- gbDUreport(gbcounts, formula = formula(~subject+factor1))
  jPaired  <- jDUreport(jcounts, formula = formula(~subject+factor1))

  # Generate a splicing report merging bins and junctions DU
  sr              <- splicingReport(gbPaired, jPaired, gbcounts)

  # Export splicing report
  exportSplicingReports(output.dir = paste0(tempdir(), "/sr"), sr)
```

`Features accesors` *Accessors for ASpliFeatures object*

Description

Accessors for ASpliFeatures object

Usage

```
featuresg( x )
featuresb( x )
featuresj( x )
transcriptExons( x )
```

Arguments

x	An ASpliFeatures object

Value

Returns a GenomicRanges object. Function featuresg returns a GRangesList object containing exon ranges for each gene. Functions featuresb and featuresj, returns GRanges object for all bins and junctions.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

Examples

```
# Get data from an ASpliFeatures object

features <- aspliFeaturesExample()

fg <- featuresg( features )
fb <- featuresb( features )
fj <- featuresj( features )


# Set data to an ASpliFeatures object

featuresg( features ) <- fg
featuresb( features ) <- fb
featuresj( features ) <- fj
```

---

filterDU *Filtering ASpliDU objects*

Description

ASpliDU object can be filtered to retain genes, bins or junction according to their fdr corrected p-value estimated and log-fold-change.

Usage

```
filterDU(
  du ,
  what = c( 'genes','bins','junctions'),
  fdr = 1,
  logFC = 0,
  absLogFC = TRUE,
  logFCgreater = TRUE
)
```

Arguments

du	An ASpliDU object
what	A character vector that specifies the kind of features that will be filtered. Accepted values are 'genes', 'bins', 'junctions'. Multiple values can be passed at the same time. The default value is c('genes','bins', 'junctions')
fdr	A double value representing the maximum accepted value of fdr corrected p-value to pass the filter. The default value is 1, the neutral value for fdr filtering operation.
logFC	A double value representing the cut-off for accepted values of log-fold-change to pass the filter. The default value is 0, the neutral value for logFC filtering operation if logFCgreater and absLocFC arguments are both TRUE.
absLogFC	A logical value that specifies that the absolute value of log-fold-change will be used in the filter operation. The default value is TRUE.
logFCgreater	A logical value that specifies that the log-fold-change value (or abs(log-fold-change) if absLogFC argument is TRUE) of features must be greater than the cut-off value to pass the filter. The default value is TRUE.

Value

A new ASpliDU object with the results of the filtering operations. The elements of features that were not specified to be filtered are kept from the input ASpliDU object.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

DUreport.norm, DUreport.offset, jDUreport, gbDUreport,

Examples

```
# Create a transcript DB from gff/gtf annotation file.
 # Warnings in this examples can be ignored.
 #library(GenomicFeatures)
 #genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
 #                                package="ASpli") )

 # Create an ASpliFeatures object from TxDb
 #features <- binGenome( genomeTxDb )

 # Define bam files, sample names and experimental factors for targets.
 #bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
 #                   "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )
 #targets <- data.frame(
 #             row.names = paste0('Sample_',c(1:6)),
 #             bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
 #             factor1 = c( 'C','C','C','D','D','D') )
```

```
# Load reads from bam files
#bams <- loadBAM( targets )

# Read counts from bam files
#counts   <- readCounts( features, bams, targets, cores = 1, readLength = 100,
#                        maxISize = 50000 )

# Calculate differential usage of junctions only
#du       <- DUreport.norm( counts, targets )

# Filter by FDR
#duFiltered1 <- filterDU( du, what=c('genes','bins'),
#   fdr = 0.01 )


# Filter by logFC, only those that were up-regulated
#duFiltered2 <- filterDU( du, what=c('genes','bins'),
#   logFC = log( 1.5, 2 ),  absLogFC = FALSE )
```

`filterSignals` *Filter signals*

Description

Filter signals

Usage

```
filterSignals( sr,
               bin.FC = 3,
               bin.fdr = 0.05,
               nonunif = 1,
               bin.inclussion = 0.1,
               bjs.inclussion = 0.2,
               bjs.fdr = 0.1,
               a.inclussion = 0.3,
               a.fdr = 0.05,
               l.inclussion = 0.3,
               l.fdr = 0.05,
               bDetectionSummary = FALSE)
```

Arguments

`sr`	An object of class `ASpliSplicingReport`
`bin.FC`	Description TODO
`bin.fdr`	Description TODO
`nonunif`	Description TODO

`bin.inclussion` Description TODO

`bjs.inclussion` Description TODO

`bjs.fdr` Description TODO

`a.inclussion` Description TODO

`a.fdr` Description TODO

`l.inclussion` Description TODO

`l.fdr` Description TODO

`bDetectionSummary`
Description TODO

Value

TODO

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

ASpliSplicingReport

Examples

```
# Create a transcript DB from gff/gtf annotation file.
# Warnings in this examples can be ignored.

#as <- new("ASpliAS")
#targets <- 1
#a <- junctionDUreportExt(as, targets)
```

---

gbCounts *Summarize read overlaps*

Description

Summarize read overlaps against all feature levels

Usage

```
gbCounts( features, targets, minReadLength,
          maxISize, minAnchor = 10, libType="SE",
          strandMode=0, alignFastq = FALSE, dropBAM = FALSE)
```

Arguments

features	An object of class ASpliFeatures. It is a list of GRanges at gene, bin and junction level
targets	A dataframe containing sample, bam and experimental factors columns
minReadLength	Minimum read length of sequenced library. It is used for computing E1I and IE2 read summarization. Make sure this number is smaller than the maximum read length in every bam file, otherwise no E1I or IE2 will be found.
maxISize	Maximum intron expected size. Junctions longer than this size will be dicarded
minAnchor	Minimum percentage of read that should be aligned to an exon-intron boundary.
libType	Defines how reads will be treated according their sequencing lybrary type (paired (PE, default) or single end (SE))
strandMode	controls the behavior of the strand getter. It indicates how the strand of a pair should be inferred from the strand of the first and last alignments in the pair. 0: strand of the pair is always *. 1: strand of the pair is strand of its first alignment. This mode should be used when the paired-end data was generated using one of the following stranded protocols: Directional Illumina (Ligation), Standard SOLiD. 2: strand of the pair is strand of its last alignment. This mode should be used when the paired-end data was generated using one of the following stranded protocols: dUTP, NSR, NNSR, Illumina stranded TruSeq PE protocol. For more information see ?strandMode
alignFastq	Experimental (that means it's highly recommended to, leave the default, FALSE): executes an alignment step previous to Bam summarization. Useful if not enough space on local disks for beans so fasts can be aligned on the fly, even from a remote machine, and then the BAMs can be deleted after each summarization. If set to TRUE, targets data frame must have a column named alignerCall with complete call to aligner for each sample. ie: STAR –runMode alignReads –outSAMtype BAM SortedByCoordinate –readFilesCommand zcat –genomeDir /path/to/STAR/genome/folder -runThreadN 4 –outFileNamePrefix sample_name –readFilesIn /path/to/R1 /path/to/R2. Output must match bam files provided in targets.
dropBAM	Experimental (that means it's highly recommended to leave the default, FALSE): If alignFastq is TRUE, deletes BAMs after sumarization. Used in conjunction with alignFastq to delete BAMs when there's not enough free space on disk. Use with caution as it will delete all files in "bam" column in targets dataframe.

Value

An object of class ASpliCounts. Each slot is a dataframe containing features metadata and read counts. Summarization is reported at gene, bin, junction and intron flanking regions (E1I, IE2).

countsg	symbol: gene symbol locus_overlap: other genes overlaping this locus gene_coordinates: gene coordinates start: gene start end: gene end length: gene length effective_length: gene effective lengh From effective_length to the end, gene counts for all samples
countsb	feature: bin type event: type of event asigned by ASpli when bining. locus: gene locus locus_overlap: genes overlaping the same locus symbol: gene symbol

gene_coordinates: gene coordinates start: bin start end: bin end length: bin length From length to the end, bin counts for all samples

`countsj` junction: annotated junction matching the current junction. gene: gene matching the current junction. strand: gene strand for the current junction in case a gene matches with the junction. multipleHit: semicolon separated list of junctions matching the current junction. symbol: gene symbol. gene_coordinates: gene coordinates. bin_spanned: semicolon separated list of all the bins spaned by this junction. j_within_bin: other junctions in the bins. From j_within_bin to the end, junction counts for all samples.

`countse1i` event: type of event asigned by ASpli when bining. locus: gene locus locus_overlap: genes overlaping the same locus symbol: gene symbol gene_coordinates: gene coordinates start: bin start end: bin end length: bin length From length to the end, bin counts for all samples

`countsie2` event: type of event asigned by ASpli when bining. locus: gene locus locus_overlap: genes overlaping the same locus symbol: gene symbol gene_coordinates: gene coordinates start: bin start end: bin end length: bin length From length to the end, bin counts for all samples

`rdsg` symbol: gene symbol locus_overlap: other genes overlaping this locus gene_coordinates: gene coordinates start: gene start end: gene end length: gene length effective_length: gene effective lengh From effective_length to the end, gene counts/effective_length for all samples

`countsb` feature: bin type event: type of event asigned by ASpli when bining. locus: gene locus locus_overlap: genes overlaping the same locus symbol: gene symbol gene_coordinates: gene coordinates start: bin start end: bin end length: bin length From length to the end, bin counts/length for all samples

`condition.order`
The order in which ASpli is reading the conditions. This is useful for contrast tests, in order to make sure which conditions are being contrasted.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

Accesors: `countsg`, `countsb`, `countsj`, `countse1i`, `countsie2`, `rdsg`, `rdsb`, `condition.order`,
Export: `writeCounts`

Examples

```
# Create a transcript DB from gff/gtf annotation file.
# Warnings in this examples can be ignored.
library(GenomicFeatures)
genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
                                package="ASpli") )

# Create an ASpliFeatures object from TxDb
features <- binGenome( genomeTxDb )
```

```
# Define bam files, sample names and experimental factors for targets.
bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
                   "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )

targets <- data.frame(
             row.names = paste0('Sample_',c(1:6)),
             bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
             factor1 = c( 'C','C','C','D','D','D'),
             subject = c(0, 1, 2, 0, 1, 2))

# Read counts from bam files
gbcounts  <- gbCounts( features = features,
                         targets = targets,
                         minReadLength = 100, maxISize = 50000,
                         libType="SE",
                         strandMode=0)
# Access summary and gene and bin counts and display them
gbcounts
countsg(gbcounts)
countsb(gbcounts)

# Export data
writeCounts( gbcounts, output.dir = paste0(tempdir(), "/only_counts") )
```

---

gbDUreport *Differential gene expression and differential bin usage estimation*

Description

Estimate differential expression at gene level and differential usage at bin level using diffSpliceDGE function from edgeR package.

Usage

```
gbDUreport( counts,
            minGenReads = 10,
            minBinReads = 5,
            minRds = 0.05,
            contrast = NULL,
            ignoreExternal = TRUE,
            ignoreIo = TRUE,
            ignoreI = FALSE,
            filterWithContrasted = TRUE,
            verbose = TRUE,
            formula = NULL,
            coef = NULL)
```

Arguments

counts	An object of class ASpliCounts
minGenReads	Genes with at least an average of minGenReads reads for any condition are included into the differential expression test. Bins from genes with at least an average of minGenReads reads for all conditions are included into the differential bin usage test. Default value is 10 reads.
minBinReads	Bins with at least an average of minGenReads reads for any condition are included into the differential bin usage test. Default value is 5 reads.
minRds	Genes with at least an average of minRds read density for any condition are included into the differential expression test. Bins from genes with at least an average of minRds read density for all conditions are included into the differential bin usage test. Bins with at least an average of minRds read density for any condition are included into the differential bin usage test. Default value is 0.05.
ignoreExternal	Ignore Exon Bins at the beginning or end of the transcript. Default value is TRUE.
ignoreIo	Ignore original introns. Default TRUE
ignoreI	Ignore intron bins, test is performed only for exons. Default FALSE
contrast	Either a formula or a contrast can be tested. If contrast is used, it defines the comparison between conditions to be tested. contrast should be a vector with length equal to the number of experimental conditions defined by targets. The values of this vector are the coefficients that will be used to weight each condition, the order of the values corresponds to the order given by getConditions function. When contrast is NULL, defaults to a vector containing -1, as the first value, 1 as the second an zero for all the remaining values, this corresponds to a pair comparison where the first condition is assumed to be a control and the second condition is the treatment, all other conditions are ignored. Default = NULL
filterWithContrasted	A logical value specifying if bins, genes and junction will be filtered by read quantity and read density using data from those conditions that will be used in the comparison, i.e. those which coefficients in contrast argument are different from zero. The default value is TRUE, it is strongly recommended to do not change this value.
verbose	A logical value that indicates that detailed information about each step in the analysis will be presented to the user.
formula	Either a formula or a contrast can be tested. If formula is used, complex tests can be run. formula should be a formula specifying which experimental conditions defined by targets to test. If coef is specified, then that coefficient will be tested. If not, it defaults to the last term in the formula.
coef	For formula only. The coefficient to be tested. If null the test defaults to the last term in the formula

Value

An ASpliDU object with results at genes, bins level.

genesDE — symbol: gene symbol locus_overlap: genes overlaping the same locus gene_coordinates: gene coordinates start: gene start end: gene end length: gene length effective_length: gene effective length logFC: gene log2 fold change between conditions pvalue: p-value gen.fdr: fdr corrected p-value for multiple testing

binsDU — feature: bin type event: type of event asigned by ASpli when bining. locus: gene locus locus_overlap: genes overlaping the same locus symbol: gene symbol gene_coordinates: gene coordinates start: bin start end: bin end length: bin length logFC: bin log2 fold change between conditions pvalue: p-value bin.fdr: fdr corrected p-value for multiple testing

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

edgeR, jDUreport Accessors: genesDE, binsDU Export: writeDU

Examples

```
  # Create a transcript DB from gff/gtf annotation file.
  # Warnings in this examples can be ignored.
  library(GenomicFeatures)
  genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
                                package="ASpli") )

  # Create an ASpliFeatures object from TxDb
  features <- binGenome( genomeTxDb )

  # Define bam files, sample names and experimental factors for targets.
  bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
                     "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )

  targets <- data.frame(
              row.names = paste0('Sample_',c(1:6)),
              bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
              factor1 = c( 'C','C','C','D','D','D'),
              subject = c(0, 1, 2, 0, 1, 2))

  # Read counts from bam files
   gbcounts  <- gbCounts( features = features,
                          targets = targets,
                          minReadLength = 100,
                          maxISize = 50000,
                          libType="SE",
                          strandMode=0)

# Test for factor1
  # Test for factor1 controlling for paired subject
  gbPaired   <- gbDUreport(gbcounts, formula = formula(~subject+factor1))
```

```
# Show all genes and bins ordered by FDR
genesDE(gbPaired)
binsDU(gbPaired)

# Test for factor1 without controlling for paired subject.
# Must change conditions inside gbcounts object to accommodate the contrast.
gbcounts@targets$condition <- targets$factor1
gbcounts@condition.order   <- c("C", "D")
gbContrast <- gbDUreport(gbcounts, contrast = c(1, -1))

# Show all genes and bins ordered by FDR
genesDE(gbContrast)
binsDU(gbContrast)

# Export results
writeDU( du = gbPaired, output.dir = paste0(tempdir(), "/gbPaired") )
writeDU( du = gbContrast, output.dir = paste0(tempdir(), "/gbContrast") )
```

`getConditions` *Retrieve condition names from a targets data frame.*

Description

Targets data frame contains experimental factors values for each sample. This function generates a simple name for each unique condition resulting from the combination of all experimental factors. The order of the conditions given by `getConditions` is the same that in `contrast` argument of `DUreport.norm` function.

Usage

```
getConditions( targets )
```

Arguments

`targets`	A dataframe containing sample, bam and experimental factors columns

Value

A character vector with the names of the conditions derived from experimental factors.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

`DUreport.norm`, `DUreport.offset`

Examples

```
# Define bam files, sample names and experimental factors for targets.
#bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
#                   "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )
#targets <- data.frame(
#             row.names = paste0('Sample_',c(1:6)),
#             bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
#             factor1 = c( 'C','C','C','D','D','D') )

# Load reads from bam files.
# Return value is c('C', 'D') in this example.
#conditions <- getConditions(targets)


# Define bam files, sample names and experimental factors for targets.
#bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam", "A_C_3.bam",
#                   "A_D_0.bam", "A_D_1.bam", "A_D_2.bam", "A_D_3.bam"  )
#targets <- data.frame(
#             row.names = paste0('Sample_',c(1:8)),
#             bam = file.path( 'extdata', bamFileNames, package="ASpli" ),
#             factor1 = c( 'C','C','C','C','D','D','D','D'),
#             factor2 = c( 'E','E','F','F','E','E','F','F')  )

# Load reads from bam files.
# Return value is c("C_E", "C_F", "D_E", "D_F") in this example.
#conditions <- getConditions(targets)
```

---

integratedSignals accessors

Accessors for ASpliIntegratedSignals object

Description

Accessors for ASpliIntegratedSignals object

Usage

```
signals( x )
filters( x )
```

Arguments

x	An ASpliIntegratedSignals object

Value

Returns dataframes

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

---

`integrateSignals` *Integrate signals*

Description

Integrates differential usage signals from different sources using overlaping regions. See vignette for more details

Usage

```
integrateSignals(sr = NULL, asd = NULL, bin.FC = 3, bin.fdr = 0.05,
                nonunif = 1, usenonunif = FALSE, bin.inclussion = 0.2,
                bjs.inclussion = 10.3, bjs.fdr = 0.01, a.inclussion =
                0.3, a.fdr = 0.01, l.inclussion = 0.3, l.fdr = 0.01,
                otherSources = NULL, overlapType = "any")
```

Arguments

`sr`	An object of class `ASpliSplicingReport`
`asd`	An object of class `ASpliDU`
`bin.FC`	Filter bin signals by fold change. Actually, log2 fold change is return, so default would return only bin signlas with bin.fc > log2(3).
`bin.fdr`	Filter bin signals by fdr.
`nonunif`	Filter intronic bins with non uniform support (nonunif « 1 is uniform)
`usenonunif`	Use non uniformity as filter.
`bin.inclussion`	Filter bin signals by junction support with dPIR or dPSI accordingly.
`bjs.inclussion`	Filter annotated junction signals by junction inclussion with dPIR or dPSI accordingly.
`bjs.fdr`	Filter annotated junction signals by fdr.
`a.inclussion`	Filter anchor junction signals by junction inclussion with dPIR.
`a.fdr`	Filter anchor junction signals by fdr.
`l.inclussion`	Filter locale junction signals by junction inclussion with dPSI.
`l.fdr`	Filter locale junction signals by fdr.
`otherSources`	If user wants to compare ASpli results with results from other methods, otherSources must be a GenomicRange object with all the regions found with the other methods. It will be integrated with a new column next to signals information.
`overlapType`	Type of regions overlap matching between the different signals. Defaults to "any" and can be any of the following: "any", "start", "end", "within", "equal".

Value

It returns A ASpliIntegratedSignals with all overlaping signals present in the region filtered by different parameters.

Author(s)

Andres Rabinovich, Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

Accesors: signals, filters, Export: exportIntegratedSignals gbDUreport, jDUreport, ASpliSplicingReport, splicingReport, ASpliIntegratedSignals

Examples

```
  # Create a transcript DB from gff/gtf annotation file.
  # Warnings in this examples can be ignored.
  library(GenomicFeatures)
  genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
                                package="ASpli") )

  # Create an ASpliFeatures object from TxDb
  features <- binGenome( genomeTxDb )

  # Define bam files, sample names and experimental factors for targets.
  bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
                     "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )

  targets <- data.frame(
               row.names = paste0('Sample_',c(1:6)),
               bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
               factor1 = c( 'C','C','C','D','D','D'),
               subject = c(0, 1, 2, 0, 1, 2))

  # Read counts from bam files
gbcounts  <- gbCounts( features = features,
                           targets = targets,
                           minReadLength = 100, maxISize = 50000,
                           libType="SE",
                           strandMode=0)
jcounts   <- jCounts(counts = gbcounts,
                     features = features,
                     minReadLength = 100,
                     libType="SE",
                     strandMode=0)


  # Test for factor1 controlling for paired subject
  gbPaired <- gbDUreport(gbcounts, formula = formula(~subject+factor1))
  jPaired  <- jDUreport(jcounts, formula = formula(~subject+factor1))

  # Generate a splicing report merging bins and junctions DU
```

```
sr       <- splicingReport(gbPaired, jPaired, gbcounts)
is       <- integrateSignals(sr, jcounts)

# Show integrate signals results and filters used
signals(is)
filters(is)
```

---

jCounts *Report PSI, PJU and PIR using experimental junctions*

Description

Summarize read overlaps against junctions. Report PSI, PJU, PIR and counts for experimental junctions. PSI or PIR metrics are calculated for each bin and experimental condition. The selection of which metric is used is based on the kind of splicing event associated with each bin.

Usage

```
jCounts( counts, features, minReadLength,
         threshold = 5, minAnchor = 10, libType="SE",
         strandMode=0, alignFastq = FALSE, dropBAM = FALSE )
```

Arguments

counts	An object of class ASpliCounts.
features	An object of class ASpliFeatures.
minReadLength	Minimum read length of sequenced library. It is used for computing E1I and IE2 read summarization. Make sure this number is smaller than the maximum read length in every bam file, otherwise no junctions will be found.
threshold	Minimum number of reads supporting junctions. Default=5
minAnchor	An intronic junction must overlap completely and at least an minAnchor% into the exon region and the intron region. The regions can be exon1-intron or intron-exon2.
libType	Defines how reads will be treated according their sequencing lybrary type (paired (PE, default) or single end (SE))
strandMode	controls the behavior of the strand getter. It indicates how the strand of a pair should be inferred from the strand of the first and last alignments in the pair. 0: strand of the pair is always *. 1: strand of the pair is strand of its first alignment. This mode should be used when the paired-end data was generated using one of the following stranded protocols: Directional Illumina (Ligation), Standard SOLiD. 2: strand of the pair is strand of its last alignment. This mode should be used when the paired-end data was generated using one of the following stranded protocols: dUTP, NSR, NNSR, Illumina stranded TruSeq PE protocol. For more information see ?strandMode

`alignFastq` Experimental (that means it's highly recommended to, leave the default, FALSE): executes an alignment step previous to Bam summarization. Useful if not enough space on local disks for beans so fasts can be aligned on the fly, even from a remote machine, and then the BAMs can be deleted after each summarization. If set to TRUE, targets data frame must have a column named alignerCall with complete call to aligner for each sample. ie: STAR –runMode alignReads –outSAMtype BAM SortedByCoordinate –readFilesCommand zcat –genomeDir /path/to/STAR/genome/folder -runThreadN 4 –outFileNamePrefix sample-name –readFilesIn /path/to/R1 /path/to/R2. Output must match bam files provided in targets.

`dropBAM` Experimental (that means it's highly recommended to leave the default, FALSE): If alignFastq is TRUE, deletes BAMs after sumarization. Used in conjunction with alignFastq to delete BAMs when there's not enough free space on disk. Use with caution as it will delete all files in "bam" column in targets dataframe.

Value

An object of class ASpliAS. Accesors: irPIR, esPSI, altPSI, junctionsPIR, junctionsPJU

`irPIR` event: Type of event asigned by ASpli when bining. J1: Semicolon separated list of all the junctions with an end matching the start of the intron. J2: Semicolon separated list of all the junctions with an end matching the end of the intron. J3: Semicolon separated list of all the junctions overlaping the intron. All the columns from J1 to J2 represent the J1 counts in the different samples for each bin. The counts are the sum of all the J1 junctions. All the columns from J2 to J3 represent the J2 counts in the different samples for each bin. The counts are the sum of all the J2 junctions. All the columns from J3 to the first condition represent the J3 counts in the different samples for each bin. The counts are the sum of all the J3 junctions. The last columns are the PIR metrics calculated for each condition. The PIR metric is calculated as:

$$PIR = \frac{J1 + J2}{J1 + J2 + 2 * J3}$$

Where the junctions are the sum by condition.

`altPSI` event: Type of event asigned by ASpli when bining. J1(J2): Semicolon separated list of all the junctions with an end matching the end of alt5'SS(alt3'SS). J3: Semicolon separated list of all the junctions with an end matching the start of alt5'SS or the start of alt3'SS. All the columns from J1 to J2 represent the J1 counts in the different samples for each bin. The counts are the sum of all the J1 junctions. All the columns from J2 to J3 represent the J2 counts in the different samples for each bin. The counts are the sum of all the J2 junctions. All the columns from J3 to the first condition represent the J3 counts in the different samples for each bin. The counts are the sum of all the J3 junctions. The last columns are the PSI metrics calculated for each condition. The PSI metric is calculated as:

$$PSI = \frac{J12}{J12 + J3}$$

Where J12 is J1 if it's an alt 5' event or J2 if it's an alt 3' event and the junctions are the sum by condition.

`esPSI` event: Type of event asigned by ASpli when bining J1: Semicolon separated list of all the junctions with an end on the alternative exon. J2: Semicolon separated list of all the junctions with an end on the alternative exon. J3: Semicolon separated list of all the junctions overlaping the alternative exon. All the columns from J1 to J2 represent the J1 counts in the different samples for each bin. The counts are the sum of all the J1 junctions. All the columns from J2 to J3 represent the J2 counts in the different samples for each bin. The counts are the sum of all the J2 junctions. All the columns from J3 to the first condition represent the J3 counts in the different samples for each bin. The counts are the sum of all the J3 junctions. The PSI metric is calculated as:

$$PSI = \frac{J1 + J2}{J1 + J2 + 2 * J3}$$

Where the junctions are the sum by condition.

`junctionsPIR` PIR metric for each experimental junction using e1i and ie2 counts. Exclusion junction is the junction itself. This output helps to discover new introns as well as new retention events. hitIntron: If the junction matches a bin, the bin is shown here. hitIntronEvent: If the junction matches a bin, the type of event asigned by ASpli to this bin. All the columns from hitIntronEvent up to the first repetition of the samples names in the columns, represent the J1 counts in the different samples for each region. From there to the next time the names of the columns repeat themselves, the J2 counts and from there to the first condition, the J3 counts. The last columns are the PIR metrics calculated for each condition. The PIR metric is calculated as:

$$PIR = \frac{J1 + J2}{J1 + J2 + 2 * J3}$$

Where the junctions are the sum by condition.

`junctionsPJU` Given a junction, it is possible to analyze if it shares start, end or both with another junction. If so, it is because there is alternative splicing. Junction: name of the junction. gene: gene it belongs to. strand: gene strand. multipleHit: if other gene overlaps the gene the junction belongs to. symbol: gene symbol. gene_coordinates: gene coordinates. bin_spanned: semicolon separated list of all the bins spaned by this junction. j_within_bin: other junctions in the bins. StartHit: all the junctions sharing the start with this junction and $PJU_{J1} = J3/(J1 + J3)$ for each condition, EndHit: all the junctions sharing the end with this junction and $PJU_{J2} = J3/(J2 + J3)$ for each condition. All the columns between j_within_bin and StartHit are the counts for J3 in the different samples for each region. From there to EndHit, the J1 counts and $PJU_{J1} = J3/(J1 + J3)$ for each condition. Then after EndHit, the J2 counts and $PJU_{J2} = J3/(J2 + J3)$. Rownames are J3 range. StartHit is J1 range and EndHit is J2 range.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky and Ariel Chernomoretz

See Also

Accesors: irPIR, altPSI, esPSI, junctionsPIR, junctionsPJU

Export: writeAS

Examples

```
  # Create a transcript DB from gff/gtf annotation file.
  # Warnings in this examples can be ignored.
  library(GenomicFeatures)
  genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
                                package="ASpli") )

  # Create an ASpliFeatures object from TxDb
  features <- binGenome( genomeTxDb )

  # Define bam files, sample names and experimental factors for targets.
  bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
                     "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )

  targets <- data.frame(
              row.names = paste0('Sample_',c(1:6)),
              bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
              factor1 = c( 'C','C','C','D','D','D'),
              subject = c(0, 1, 2, 0, 1, 2))

  # Read counts from bam files
gbcounts  <- gbCounts( features = features,
                           targets = targets,
                           minReadLength = 100, maxISize = 50000,
                           libType="SE",
                           strandMode=0)

jcounts   <- jCounts(counts = gbcounts,
                     features = features,
                     minReadLength = 100,
                     libType="SE",
                     strandMode=0)

  # Access summary and gene and bin counts and display them
  gbcounts
  countsg(gbcounts)
  countsb(gbcounts)

  # Access summary and junction counts and display them
  jcounts
  irPIR(jcounts)
  esPSI(jcounts)
  altPSI(jcounts)
  junctionsPIR(jcounts)
  junctionsPJU(jcounts)
```

```
# Export data
writeAS( as = jcounts, output.dir = paste0(tempdir(), "/only_as") )
```

JDU accessors *Accessors for ASpliJDU object*

Description

Accessors for ASpliJDU object

Usage

```
anchorc( x )
anchorj( x )
localec( x )
localej( x )
jir( x )
jes( x )
jalt( x )
```

Arguments

x	An ASpliJDU object

Value

Returns dataframes

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

---

jDUreport *Differential junction usage estimation*

Description

This function estimates the differential usage of junctions combining different types of evidence

Differential junction usage is estimated using a combination of evidences

Usage

```
jDUreport(asd,
          minAvgCounts                      = 5,
          contrast                          = NULL,
          filterWithContrasted              = TRUE,
          runUniformityTest                 = FALSE,
          mergedBams                        = NULL,
          maxPValForUniformityCheck         = 0.2,
          strongFilter                      = TRUE,
          maxConditionsForDispersionEstimate = 24,
          formula                           = NULL,
          coef                              = NULL,
          maxFDRForParticipation            = 0.05,
          useSubset                         = FALSE)
```

Arguments

`asd`	An object of class `ASpliAS` with results of PSI and PIR using experimental junctions
`minAvgCounts`	Minimum average counts for filtering
`contrast`	Define the comparison between conditions to be tested. `contrast` should be a vector with length equal to the number of experimental conditions defined by `targets`. The values of this vector are the coefficients that will be used to weight each condition, the order of the values corresponds to the order given by `getConditions` function. When `contrast` is NULL, defaults to a vector containing -1, as the first value, 1 as the second an zero for all the remaining values, this corresponds to a pair comparison where the first condition is assumed to be a control and the second condition is the treatment, all other conditions are ignored. If NULL must provide a formula.
`filterWithContrasted`	A logical value specifying if bins, genes and junction will be filtered by read quantity and read density using data from those conditions that will be used in the comparison, i.e. those which coefficients in contrast argument are different from zero. The default value is TRUE, it is strongly recommended to do not change this value.
`runUniformityTest`	Run uniformity test on Intron Retention. Sometimes Mutually Exclusive Exons (MEX) events can be confused with Intron Retention events. This test compares the standard deviation of the inner intron region (11 bases from both ends) to the mean of both intron ends. Numbers closer to 0 mean the event is more probably an Intron Retention event than an MEX event. The test takes some time to run so it defaults to FALSE.
`mergedBams`	Path to merged bams for each testing condition. If no merged bams exist (for example, paired samples without replicates), use the same bams as targets.
`maxPValForUniformityCheck`	To speed up uniformity test only check junctions with pval < maxPValForUniformityCheck

`strongFilter` If strongFilter is TRUE, then we remove all events with at least one junction that doesn't pass the filter.

`maxConditionsForDispersionEstimate` In order to reduce resource usage, estimate dispersion for statistics tests with a reduced number of conditions.

`formula` Either a formula or a contrast can be tested. If formula is used, complex tests can be run. `formula` should be a formula specifying which experimental conditions defined by `targets` to test. If coef is specified, then that coefficient will be tested. If not, it defaults to the last term in the formula.

`coef` For formula only. The coefficient to be tested. If null the test defaults to the last term in the formula

`maxFDRForParticipation` In order to calculate junctionPSI participation, only use significant junctions (ie junctions with FDR < maxFDRForParticipation).

`useSubset` Experimental. It is strongly recomended to leave the default, FALSE.

Details

Estimation is made at junction level using diffSpliceDGE function from edgeR package. Junctions belonging to the same AS event comprises the event "set". Each junction is tested against this "set" in a similar fashion that bins are tested against their gene in diffSpliceDGE. Localec are clusters made of junctions that share an end with at least another junction in the cluster.

Value

An `ASpliJDU` object with results of differential usage at `junctions` level.

`localec` size: number of junctions belonging to the cluster. cluster.LR: likelihood ratio of cluster differential usage. pvalue: pvalue of cluster differential usage. FDR: fdr of cluster differential usage. range: cluster location. participation: participation of the significant junction (FDR < maxFDRForParticipation) presenting maximal participation value inside the cluster dParticipation: delta participation of the significant junction (FDR < maxFDRForParticipation) presenting maximal participation value inside the cluster

`localej` cluster: name of the cluster the junction belongs to log.mean: log of mean counts accross all conditions for this junction logFC: log fold change of junction accross conditions pvalue: pvalue of junction FDR: FDR of junction annotated: is junction annotated or new participation: the maximal participation value observed across contrasted condictions dParticipation: delta participation of the maximal participation value observed across contrasted condictions From dParticipation to the end, junction counts for all samples

`anchorc` cluster.LR: likelihood ratio of cluster differential usage. pvalue: pvalue of cluster differential usage. FDR: fdr of cluster differential usage.

`anchorj` log.mean: log of mean counts accross all conditions for this junction logFC: log fold change of junction accross conditions LR: likelihood ratio of junction differential usage. pvalue: pvalue of junction FDR: FDR of junction J1.pvalue: pvalue of J1 junction J2.pvalue: pvalue of J2 junction NonUniformity: if non

uniformity test was performed, numbers closer to zero mean uniformity and closer to one mean non uniformity dPIR: junction delta PIR annotated: is junction annotated or new From annotated to the end, junction counts for all samples

`jir` J3: J3 junction/s logFC: log fold change of junction accross conditions log.mean: log of mean counts accross all conditions for this junction pvalue: pvalue of junction FDR: FDR of junction LR: likelihood ratio of junction differential usage. NonUniformity: if non uniformity test was performed, numbers closer to zero mean uniformity and closer to one mean non uniformity dPIR: junction delta PIR multiplicity: do multiple junctions cross the region From multiplicity to the end, junction counts for all samples

`jes` event: type of event J3: J3 junction/s logFC: log fold change of junction accross conditions log.mean: log of mean counts accross all conditions for this junction pvalue: pvalue of junction FDR: FDR of junction LR: likelihood ratio of junction differential usage. dPSI: junction delta PSI multiplicity: do multiple junctions cross the region From multiplicity to the end, junction counts for all samples

`jalt` event: type of event J3: J3 junction/s logFC: log fold change of junction accross conditions log.mean: log of mean counts accross all conditions for this junction pvalue: pvalue of junction FDR: FDR of junction LR: likelihood ratio of junction differential usage. dPSI: junction delta PSI multiplicity: do multiple junctions cross the region From multiplicity to the end, junction counts for all samples

`contrast` Conditions contrasted by ASpli

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

Accesors: `localec`, `localej`, `anchorc`, `anchorj`, `jir`, `jes`, `jalt`, `junctionsDU`, Export: `writeJDU`, `writeDU`, `edgeR`, `ASpliAS`

Examples

```
# Create a transcript DB from gff/gtf annotation file.
# Warnings in this examples can be ignored.
library(GenomicFeatures)

genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
                                package="ASpli") )

# Create an ASpliFeatures object from TxDb
features <- binGenome( genomeTxDb )

# Define bam files, sample names and experimental factors for targets.
bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
                   "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )
```

```
  targets <- data.frame(
              row.names = paste0('Sample_',c(1:6)),
              bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
              factor1 = c( 'C','C','C','D','D','D'),
              subject = c(0, 1, 2, 0, 1, 2))

  # Read counts from bam files
 gbcounts  <- gbCounts( features = features,
                          targets = targets,
                          minReadLength = 100, maxISize = 50000,
                          libType="SE",
                          strandMode=0)
jcounts   <- jCounts(counts = gbcounts,
                     features = features,
                     minReadLength = 100,
                     libType="SE",
                     strandMode=0)



  # Test for factor1 controlling for paired subject
  jPaired <- jDUreport(jcounts, formula = formula(~subject+factor1))

  # Show junctions information
  jPaired
  localej(jPaired)
  localec(jPaired)
  anchorj(jPaired)
  anchorc(jPaired)
  jir(jPaired)
  jes(jPaired)
  jalt(jPaired)

  # Export results
  writeJDU( jPaired, output.dir = paste0(tempdir(), "/jPaired") )
```

`junctionDUreport` *Differential junction usage estimation*

Description

Estimate differential usage at junction level. When targets has only two conditions, and contrast is not set, the estimation of differential expression and usage is done with an exact test, otherwise is estimated using a generalized linear model.

Usage

```
junctionDUreport( counts,
                  targets,
```

```
                    appendTo = NULL,
                    minGenReads = 10,
                    minRds = 0.05,
                    threshold = 5,
                    offset = FALSE,
                    offsetUseFitGeneX = TRUE,
                    contrast = NULL,
                    forceGLM = FALSE)
```

Arguments

counts	An object of class ASpliCounts
targets	A dataframe containing sample, bam and experimental factor columns.
appendTo	An object of class ASpliDU to which append the results of junction differential usage. If appendTo is NULL a new ASpliDU is created
minGenReads	Junctions within genes with at least an average of minGenReads reads for all conditions are included into the differential junction usage test. Default value is 10 reads.
minRds	Junctions within genes with at least an average of minRds read density for all conditions are included into the differential bin usage test. Junctions with at least an average of minRds read density for any condition are included into the differential junction usage test. Default value is 0.05.
threshold	Junction with at least threshold counts are included into the differential usage test.
offset	Corrects junction counts using an offset matrix derived from gene expression data. Default = FALSE
offsetUseFitGeneX	Fit a GLM using gene counts to build the offset matrix. This argument is used only when 'offset' argument is set to TRUE. The default value is TRUE
contrast	Define the comparison between conditions to be tested. contrast should be a vector with length equal to the number of experimental conditions defined by targets. The values of this vector are the coefficients that will be used to weight each condition, the order of the values corresponds to the order given by getConditions function. When contrast is NULL, defaults to a vector containing -1, as the first value, 1 as the second an zero for all the remaining values, this corresponds to a pair comparison where the first condition is assumed to be a control and the second condition is the treatment, all other conditions are ignored. Default = NULL
forceGLM	Force the use of a generalized linear model to estimate differential expression and usage. Default = FALSE

Value

An ASpliDU object with results of differential usage of junctions

Author(s)

Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

edgeR, DUreport Accessors: junctionsDU Export: writeDU

Examples

```
#This function has been deprecated. Please see vignette for new pipeline.
```

---

loadBAM *Load BAM files*

Description

Load BAM files into R session using a targets specification.

Usage

```
loadBAM(targets, cores,  libType, strandMode)
```

Arguments

targets	A data frame containing sample, bam and experimental factors columns
cores	Number of processors to use
libType	Options are: "SE" or "PE"
strandMode	Options are: 0,1,2. See ?strandMode for more information

Value

A list of GAlignments or GAlignmentPairs . Each element of the list correspond to a samples BAM file.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

Examples

```
# Define bam files, sample names and experimental factors for targets.
#bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
#                   "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )

#targets <- data.frame(
#             row.names = paste0('Sample_',c(1:6)),
#             bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
#             factor1 = c( 'C','C','C','D','D','D') )

# Load reads from bam files
#bams <- loadBAM( targets )
```

mergeBinDUAS *Differential usage of bins and PSI/PIR.*

Description

This function merges the results of differential usage of bins, from an ASpliDU object, with PSI/PIR and junction information, from an ASpliAS object. Also, a delta PSI/PIR value is calculated from a contrast.

Usage

```
mergeBinDUAS( du,
              as,
              targets,
              contrast = NULL )
```

Arguments

du	An object of class ASpliDU
as	An object of class ASpliAS
targets	A data frame containing sample, bam files and experimental factor columns.
contrast	Define the comparison between conditions to be tested. contrast should be a vector with length equal to the number of experimental conditions defined by targets. The values of this vector are the coefficients that will be used to weight each condition, the order of the values corresponds to the order given by getConditions function. When contrast is NULL, defaults to a vector containing -1, as the first value, 1 as the second an zero for all the remaining values, this corresponds to a pair comparison where the first condition is assumed to be a control and the second condition is the treatment, all other conditions are ignored. The default value is NULL.

Value

A data frame containing feature, event, locus, locus_overlap, symbol, gene coordinates, start of bin, end of bin, bin length, log-Fold-Change value, p-value, fdr corrected p-value, J1 inclusion junction, J1 junction counts for each sample, J2 inclusion junction, J2 junction counts for each sample, J3 exclusion junction, J3 junction counts for each sample, PSI or PIR value for each bin, and delta PSI/PIR.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

ASpliDU , ASpliAS

Examples

```
# Create a transcript DB from gff/gtf annotation file.
# Warnings in this examples can be ignored.
#library(GenomicFeatures)
#genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
#                                package="ASpli") )

# Create an ASpliFeatures object from TxDb
#features <- binGenome( genomeTxDb )

# Define bam files, sample names and experimental factors for targets.
#bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
#                   "A_D_0.bam", "A_D_1.bam", "A_D_2.bam",
#                   "B_C_0.bam", "B_C_1.bam", "B_C_2.bam",
#                   "B_D_0.bam", "B_D_1.bam", "B_D_2.bam" )

#targets <- data.frame(
#             row.names = paste0('Sample_',c(1:12)),
#             bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
#             factor1 = c( 'A','A','A','A','A','A','B','B','B','B','B','B'),
#             factor2 = c( 'C','C','C','D','D','D','C','C','C','D','D','D') )

# Load reads from bam files
#bams <- loadBAM( targets )

# Read counts from bam files
#counts <- readCounts( features, bams, targets, cores = 1, readLength = 100,
#                        maxISize = 50000 )

# Calculate differential usage of genes and bins
#du <- DUreport.norm( counts, targets , contrast = c(1,-1,-1,1))

# Calculate PSI / PIR for bins and junction.
#as <- AsDiscover( counts, targets, features, bams, readLength = 100,
#                        threshold = 5, cores = 1 )

#mas <- mergeBinDUAS( du, as, targets, contrast =  c(1,-1,-1,1) )
```

`plotBins` *Draw plots of gene counts, bin counts, PSI/PIR value, inclusion and exclusion junctions for selected bins.*

Description

Creates a plot with gene counts, bin counts, PSI/PIR value, inclusion and exclusion junctions for selected bins and conditions.

Usage

```
plotBins( counts,
          as,
          bin,
          factorsAndValues,
          targets,
          main            = NULL,
          colors          = c( '#2F7955', '#79552F', '#465579',
                               '#A04935', '#752020', '#A07C35') ,
          panelTitleColors = '#000000',
          panelTitleCex   = 1,
          innerMargins    = c( 2.1, 3.1, 1.1, 1.1 ),
          outerMargins    = c( 0, 0, 2.4, 0 ),
          useBarplots     = NULL,
          barWidth        = 0.9,
          barSpacer       = 0.4,
          las.x           = 2,
          useHCColors     = FALSE,
          legendAtSide    = TRUE,
          outfolder       = NULL,
          outfileType     = c( 'png', 'bmp', 'jpeg', 'tiff', 'pdf')[1],
          deviceOpt       = NULL )
```

Arguments

counts	An object of class ASpliCounts
as	An object of class ASpliAS
bin	A character vector with the names of the bins to be plotted.
factorsAndValues	A list containing the factor and the values for each factor to be plotted. The order of the factors will modify how the conditions are grouped in the plot. factorsAndValues must be a named list, where the name of each element is a factor and the list element itself is a character vector of the values of this factor in the order to be plotted. See examples for more details.
targets	A data frame containing sample, bam files and experimental factor columns
main	Main title of the plot. If NULL the bin name is used as title.
colors	A vector of character colors for lines and bar plots.
panelTitleColors	A vector of character colors for the titles of each plot panel.
panelTitleCex	Character size expansion for panel titles.
innerMargins	A numerical vector of the form c(bottom, left, top, right) which gives the size of each plot panel margins. Defaults to c(2.1, 3.1, 1.1, 1.1)
outerMargins	A numerical vector of the form c(bottom, left, top, right) which gives the size of margins. Defaults to c(0, 0, 2.4, 0)

useBarplots	A logical value that indicates the type of plot to be used. If TRUE bar plots are used, if FALSE lines are used. If NULL the type is bar plot if there just two conditions and lines if there are more than two conditions.
barWidth	The width of the bars in bar plots. barWidth must be in (0,1] range. Default value is 0.9.
barSpacer	Fraction of barwidth used as spacer between bar plot groups. Defaule value is 0.4.
las.x	Text orientation of x-axis labels.
useHCColors	A logical value. If TRUE panelTitleColors

are not used, instead panel title are automatically chosen to have high contrast against colors.

legendAtSide	A logical value that forces panel title to be shown on the y-axis, instead of over the plot.
outfolder	Path to output folder to write plot images. Is NULL, plot are rendered on the default device
outfileType	File format of the output files used if outfolder is not NULL. Accepted values are 'png', 'jpeg', 'tiff', 'pdf'. Each value selects the graphic device of the same name. The name of the image file is the name of bin with the corresponding extension given by the chosen type
deviceOpt	A list of named options to be passed to the graphic device selected in outfileType

Value

Returns a png for each selected bin

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

plotGenomicRegions,

Examples

```
# Create a transcript DB from gff/gtf annotation file.
# Warnings in this examples can be ignored.
#library(GenomicFeatures)
#genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
#                                package="ASpli") )

# Create an ASpliFeatures object from TxDb
#features <- binGenome( genomeTxDb )

# Define bam files, sample names and experimental factors for targets.
#bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
#                   "A_D_0.bam", "A_D_1.bam", "A_D_2.bam",
#                   "B_C_0.bam", "B_C_1.bam", "B_C_2.bam",
```

```
#                   "B_D_0.bam", "B_D_1.bam", "B_D_2.bam" )

#targets <- data.frame(
#             row.names = paste0('Sample_',c(1:12)),
#             bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
#             factor1 = c( 'A','A','A','A','A','A','B','B','B','B','B','B'),
#             factor2 = c( 'C','C','C','D','D','D','C','C','C','D','D','D') )

# Load reads from bam files
#bams <- loadBAM( targets )

# Read counts from bam files
#counts   <- readCounts( features, bams, targets, cores = 1, readLength = 100,
#                        maxISize = 50000 )

# Calculate differential usage of genes, bins and junctions
#du       <- DUreport.norm( counts, targets , contrast = c(1,-1,-1,1))

# Calculate PSI / PIR for bins and junction.
#as       <- AsDiscover( counts, targets, features, bams, readLength = 100,
#                        threshold = 5, cores = 1 )

# Plot bin data. Factor2 is the main factor for graphic representation in
# this example as it is the first in factorsAndValues argument.
# This makes a bar plot comparing four conditions, grouped by factor1.
#plotBins( counts, as, 'GENE03:E002',
#  factorsAndValues = list(
#    factor2 = c('C','D'),
#    factor1 = c('A','B') ),
#  las.x = 1,
#  legendAtSide = TRUE,
#  useHCColors = TRUE,
#  targets = targets,
#  barWidth = 0.95,
#  innerMargins = c( 2.1, 4.1, 1.1, 1.1 ) )


# Redefine targets
#targets <- data.frame(
#             row.names = paste0('Sample_',c(1:12)),
#             bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
#             factor1 = c( 'A','A','B','B','C','C','D','D','E','E','F','F') )

#as       <- AsDiscover( counts, targets, features, bams, readLength = 100,
#                        threshold = 5, cores = 1 )

# This makes a line plot for six conditions, grouped by factor1.
#plotBins( counts, as, 'GENE03:E002',
#  factorsAndValues = list(
#    factor1 = c('A','B','C','D','E','F') ),
#  las.x = 1,
#  legendAtSide = FALSE,
#  targets = targets,
```

```
#  innerMargins = c( 2.1, 4.1, 1.1, 1.1 ) )
```

---

plotGenomicRegions *Create genomic regions coverage plots*

Description

Graphic representation of coverage and junctions is useful to complement the results of differential usage of bins and junction and differential expression analysis.

Function plotGenomicRegions allow to create plots for multiple conditions for bins and genes. Each individual plot can only correspond to a single gene or bin, but can contain many panels for different experimental conditions.

Usage

```
plotGenomicRegions( features, x, genomeTxDb, targets, xIsBin = TRUE,
  layout = 'auto', colors = 'auto', plotTitles = 'auto', sashimi = FALSE,
  zoomOnBins = FALSE, deviceOpt = NULL, highLightBin = TRUE, outfolder = NULL,
  outfileType = 'png', mainFontSize = 24, annotationHeight = 0.2,
 annotationCol = 'black', annotationFill = 'gray', annotationColTitle = 'black',
  preMergedBAMs = NULL, useTransparency = FALSE, tempFolder = 'tmp',
  avoidReMergeBams= FALSE, verbose = TRUE )
```

Arguments

features	An ASpliFeatures object, generated with binGenoms function.
x	A character vector with the names of bins or genes to plot. To plot into a window is recommended that the length of x be one.
genomeTxDb	A TxDb object with the annotation of reference genome.
targets	A data frame containing sample, bam files and experimental factor columns
xIsBin	A logical value that indicates if values in x corresponds to gene names or bin names.
layout	A character with value 'auto' or a character matrix with condition names arranged with the desired layout of the panels in plots. The dimensions of layout matrix, colors matrix and plotTitles matrices must be the same. Matrix can have NA values, however, the height of the panels corresponding to that column are modified to occupy the total height. The default value is 'auto'.
colors	A character containing value 'auto' or containing colors strings, or a character matrix with color names arranged with the layout specified in layout argument. The dimensions of layout matrix, colors matrix and plotTitles matrices must be the same. The default value is 'auto'.
plotTitles	A character containing value 'auto', or a character matrix with titles for each panel arranged with the layout specified in layout argument. The dimensions of layout matrix, colors matrix and plotTitles matrices must be the same. The default value is 'auto'.

`sashimi` A logical value that specifies that a sashimi plot for junctions must be included into each panel. The default value is FALSE.

`zoomOnBins` A FALSE logical value or a double value between 0 and 1. If value is FALSE then the genomic range to be plotted correspond to the complete gene, otherwise the genomic range is that the size of the bin corresponds to a fraction equals to zoomOnBins value of the total and is centered in the bin. Is used only when xIsBin is TRUE. The default value is FALSE.

`deviceOpt` A named list of arguments to be passed to the graphic device used to plot. This allow to further customization of the plot. The default value is an empty list.

`highLightBin` A logical value that indicates if the bin should be highlighted. The default value is TRUE.

`outfolder` NULL or a character vector representing a folder path that will be used to save the plot images. If the folder doesn't exists it is created. If NULL, the plot is made in a window. The default value is NULL. For each bin, a single image file is generated. The name of the file is the name of the bin, added with a '.gr.' string, and the file extension at the end. If the name of the bin contains invalid character for a file name, those will be replaced by an underscore character.

`outfileType` A character value the specifies the file format of the plot to be created. Is used only when outfolder is not NULL. Accepted values are 'png', 'jpeg', 'bmp', 'tiff', 'pdf'. Each value is the graphic device used to create the image. The default value is 'png'.

`mainFontSize` A numeric value specifying the size of the main title. The default value is 24.

`annotationHeight`
A double value specifying the proportion of the total height used to represent the gene model. The default value is 0.2.

`annotationCol` A character value that specifies the color of the borders of bars in gene model representation. The default value is 'black'.

`annotationFill` A character value that specifies the color of the filling of bars in gene model representation. The default value is 'gray'.

`annotationColTitle`
A character value that specifies the color of text in gene model representation. The default value is 'black'.

`preMergedBAMs` A one column data frame that associates a condition, specified in the row name, with a character value representing the path of bam file with the reads for that condition. This bam file is typically generated by merging the bam files of all replicates for that condition. The default value is NULL, this specifies that not merged bam files are used, instead on-the-fly read extraction and merging is done from the bam files specified in the targets argument.

`useTransparency`
A logical value that specifies if transparency will be used to generate the plots, this leads to better looking plot, however not all graphic devices support transparency. The default value is FALSE.

`tempFolder` A character value specifying the path to store intermediate files produced while extracting and merging reads from bam files. It is only used when preMergedBAMs arguments is NULL. The files created are not automatically removed

after plotting because can be reused to create a new plot of the same genes or bins with different graphic options. The default value is 'tmp', that means a new 'tmp' folder in the current working folder.

`avoidReMergeBams`
: A logical value specifying that extraction and merging of bam files will be avoided. This is only meaningful when the extraction and merging of the same set of genes and bins was done in the previous execution of plotGenomicRegions function. The default value is FALSE.

`verbose`
: A logical value specifying that detailed information about the execution will be informed to the user. The default value is TRUE.

Value

Returns a png for each selected bin

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

Devices, pdf, png, bmp, jpeg, tiff

Examples

```
# Create a transcript DB from gff/gtf annotation file.
# Warnings in this examples can be ignored.
#library(GenomicFeatures)
#genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
#                                package="ASpli") )

# Create an ASpliFeatures object from TxDb
#features <- binGenome( genomeTxDb )

# Define bam files, sample names and experimental factors for targets.
#bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
#                   "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )
#targets <- data.frame(
#             row.names = paste0('Sample_',c(1:6)),
#             bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
#             factor1 = c( 'C','C','C','D','D','D'),
#             stringsAsFactors = FALSE )

# Plot a single bin to a window
#plotGenomicRegions(
#  features,
#  'GENE01:E002',
#  genomeTxDb,
#  targets,
#  sashimi = FALSE,
#  colors = '#AA4444',
```

```
#  annotationHeight = 0.1,
#  tempFolder = 'tmp',
#  verbose = TRUE ,
#  avoidReMergeBams = FALSE,
#  useTransparency = FALSE )
#
# plot two bins to pdf files.
#plotGenomicRegions(
#  features, c( 'GENE01:E002', 'GENE02:E002' ),
#  genomeTxDb,
#  targets,
#  layout = matrix( c( 'C', 'D'), ncol = 1),
#  colors = matrix( c( '#663243', '#363273'), ncol = 1),
#  plotTitles = matrix( c( 'C condition', 'D condition'), ncol = 1),
#  sashimi = FALSE,
#  mainFontSize = 12,
#  annotationHeight = 0.1,
#  tempFolder = 'tmp',
#  verbose = TRUE ,
#  avoidReMergeBams = FALSE,
#  useTransparency = TRUE,
#  outfolder = '.',
#  outfileType = 'pdf',
#  deviceOpt = list( height = 6, width = 5, paper = 'a4r' ) )
```

`rds` *Read density of gene and bins*

Description

Read density of gene and bins is the quotient between the number of read counts and the length of the feature. The results are appended into an ASpliCounts object that must be given as argument. The explicit calculation of read densities is usually not required because is automatically performed by `readCounts` function.

Usage

```
rds( counts, targets )
```

Arguments

`counts`	An ASpliCounts object
`targets`	A data frame containing sample, bam and experimental factors columns

Value

An ASpliCounts object containing read densities of genes and bins.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

Examples

```
  # Create a transcript DB from gff/gtf annotation file.
# Warnings in this examples can be ignored.
#library(GenomicFeatures)
#genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
#                               package="ASpli") )
#
## Create an ASpliFeatures object from TxDb
#features <- binGenome( genomeTxDb )
#
#  # Define bam files, sample names and experimental factors for targets.
#  bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
#                     "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )
#  targets <- data.frame(
#               row.names = paste0('Sample_',c(1:6)),
#               bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
#               factor1 = c( 'C','C','C','D','D','D') )
#
#  # Load reads from bam files
#  bams <- loadBAM( targets )
#
#  # Read counts from bam files
#  counts   <- readCounts( features, bams, targets, cores = 1, readLength = 100,
#                          maxISize = 50000 )
#
#  # Calculates read densities
#  counts <- rds( counts, targets )
```

`show-methods` *Display a summary of data contained in ASpliObjects*

Description

Display a summary of data contained in ASpliObjects

Details

Display a summary of data contained in ASpliObjects

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

splicingReport *Splicing report*

Description

This function integrates bin and junction usage in a comprehensive report

Usage

```
splicingReport(bdu, jdu, counts)
```

Arguments

bdu	An object of class ASpliDU
jdu	An object of class ASpliJDU
counts	An object of class ASpliCounts

Value

An ASpliSplicingReport object with junction differential usage report. See vignette for more details

Author(s)

Andres Rabinovich, Estefania Mancini, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

Accesors: binbased, localebased, anchorbased, Export: writeSplicingReport gbDUreport, jDUreport, ASpliSplicingReport, splicingReport

Examples

```
# Create a transcript DB from gff/gtf annotation file.
# Warnings in this examples can be ignored.
library(GenomicFeatures)
genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
                                  package="ASpli") )

# Create an ASpliFeatures object from TxDb
features <- binGenome( genomeTxDb )

# Define bam files, sample names and experimental factors for targets.
bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
                     "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )

targets <- data.frame(
               row.names = paste0('Sample_',c(1:6)),
```

```
                bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
                factor1 = c( 'C','C','C','D','D','D'),
                subject = c(0, 1, 2, 0, 1, 2))

# Read counts from bam files
gbcounts  <- gbCounts( features = features,
                           targets = targets,
                           minReadLength = 100, maxISize = 50000,
                           libType="SE",
                           strandMode=0)
jcounts   <- jCounts(counts = gbcounts,
                     features = features,
                     minReadLength = 100,
                     libType="SE",
                     strandMode=0)


# Test for factor1 controlling for paired subject
gbPaired <- gbDUreport(gbcounts, formula = formula(~subject+factor1))
jPaired  <- jDUreport(jcounts, formula = formula(~subject+factor1))

# Generate a splicing report merging bins and junctions DU
sr              <- splicingReport(gbPaired, jPaired, gbcounts)

# Access splicing report elements
sr
localebased(sr)
anchorbased(sr)
binbased(sr)
```

`splicingReport accessors`

Accessors for ASpliSplicingReport object

Description

Accessors for ASpliSplicingReport object

Usage

```
binbased( x )
localebased( x )
anchorbased( x )
```

Arguments

x	An ASpliSplicingReport object

Value

Returns dataframes

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

---

`Subset ASpli objects` *Subset ASpli objects*

Description

ASpli provides utility functions to easy subset ASpliCounts objects, ASpliAS objects, targets data frame and lists GAlignments generated with loadBAM function. The subset can be done selecting some of the experimental conditions or samples names (but not both).

Usage

```
subset( x, ... )
subsetBams( x, targets, select )
subsetTargets( targets, select, removeRedundantExpFactors )
```

Arguments

`x`	An ASpliCount or ASpliAS object for subset function, or list of GAlignments for subsetrBams function.
`targets`	A dataframe containing sample, bam and experimental factor columns.
`select`	A character vector specifying the conditions or samples to be kept after subset operation. It's assumed that condition names are different from sample names.
`removeRedundantExpFactors`	When sub-setting the targets data frame, one or more experimental factors can have only one value. If this argument is TRUE those experimental factors are absent in the resulting target data frame.
`...`	Subsetting ASpliCounts and ASpliAS objects sub subset method requires a targets argument and a select argument with the same specifications that the arguments with the same name in subsetBams and subsetTargets functions

Value

A data frame similar to x (or targets for subsetTargets) with only the containing only the selected elements.

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

Examples

```
# Create a transcript DB from gff/gtf annotation file.
# Warnings in this examples can be ignored.
#library(GenomicFeatures)
#genomeTxDb <- txdbmaker::makeTxDbFromGFF( system.file('extdata','genes.mini.gtf',
#                                package="ASpli") )
#
# Create an ASpliFeatures object from TxDb
#features <- binGenome( genomeTxDb )
#
# Define bam files, sample names and experimental factors for targets.
#bamFileNames <- c( "A_C_0.bam", "A_C_1.bam", "A_C_2.bam",
#                   "A_D_0.bam", "A_D_1.bam", "A_D_2.bam" )
#targets <- data.frame(
#             row.names = paste0('Sample_',c(1:6)),
#             bam = system.file( 'extdata', bamFileNames, package="ASpli" ),
#             factor1 = c( 'C','C','C','D','D','D') )
#
# Load reads from bam files
#bams <- loadBAM( targets )
#
# Read counts from bam files
#counts   <- readCounts( features, bams, targets, cores = 1, readLength = 100,
#                        maxISize = 50000 )
#
# # Create ASpliAS object
#as       <- AsDiscover( counts, targets, features, bams, readLength = 100,
#                        threshold = 5, cores = 1 )
#
# Define selection
#select <- c('Sample_1', 'Sample_2', 'Sample_4', 'Sample_5')
#
# Subset target
#targets2 <- subsetTargets( targets, select )

# Subset bams
#bams2 <- subsetBams( bams, targets, select )

# Subset ASpliCounts object
#counts2 <- subset( counts, targets, select )

# Subset ASpliAS object
#as2 <- subset( as, targets, select )
```

`write` *Write results*

Description

Export tab delimited files in structured output

Usage

```
writeCounts(counts, output.dir="counts")
writeRds(counts, output.dir="rds")
writeDU(du, output.dir="du")
writeAS(as, output.dir="as")
writeJDU(jdu, output.dir="jdu")
writeSplicingReport(sr, output.dir="sr")
writeAll(counts, du, as, output.dir="output")
```

Arguments

counts	An ASpliCounts object
as	An ASpliAS object
du	An ASpliDU object
jdu	An ASpliJDU object
sr	An ASpliSplicingReport object
output.dir	Name of output folder (new or existing)

Value

Tab delimited files are exported in a tidy manner into output folder

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

jCounts, binGenome, DUreport.norm, DUreport.offset

---

write-methods *Write results*

Description

Export tab delimited files in structured output

Details

Tab delimited files are exported in a tidy manner into output folder

Author(s)

Estefania Mancini, Andres Rabinovich, Javier Iserte, Marcelo Yanovsky, Ariel Chernomoretz

See Also

jCounts, binGenome,DUreport.norm, DUreport.offset

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