Package ‘rCGH’

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Type Package

Title Comprehensive Pipeline for Analyzing and Visualizing Array-Based CGH Data

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URL https://github.com/fredcommo/rCGH

Description A comprehensive pipeline for analyzing and interactively visualizing genomic profiles generated through commercial or custom aCGH arrays. As inputs, rCGH supports Agilent dual-color Feature Extraction files (.txt), from 44 to 400K, Affymetrix SNP6.0 and cytoScanHD probeset.txt, cychp.txt, and cnchp.txt files exported from ChAS or Affymetrix Power Tools. rCGH also supports custom arrays, provided data complies with the expected format. This package takes over all the steps required for individual genomic profiles analysis, from reading files to profiles segmentation and gene annotations. This package also provides several visualization functions (static or interactive) which facilitate individual profiles interpretation.

Input files can be in compressed format, e.g. .bz2 or .gz.

License Artistic-2.0

biocViews aCGH, CopyNumberVariation, Preprocessing, FeatureExtraction

Depends R (>= 3.4), methods, stats, utils, graphics

Imports plyr, DNAcopy, lattice, ggplot2, grid, shiny (>= 0.11.1), limma, affy, mclust, TxDb.Hsapiens.UCSC.hg18.knownGene, TxDb.Hsapiens.UCSC.hg19.knownGene, TxDb.Hsapiens.UCSC.hg38.knownGene, org.Hs.eg.db, GenomicFeatures, GenomeInfoDb, GenomicRanges, AnnotationDbi, parallel, IRanges, grDevices, aCGH

Suggests BiocStyle, knitr, BiocGenerics, RUnit

VignetteBuilder knitr

LazyData true

NeedsCompilation no
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Description

A comprehensive pipeline for analyzing and interactively visualizing genomic profiles generated through commercial or custom aCGH arrays. As inputs, rCGH supports Agilent dual-color Feature Extraction files (.txt), from 44 to 400K, Affymetrix SNP6.0 and cytoScanHD probeset.txt, cychp.txt, and cnchp.txt files exported from ChAS or Affymetrix Power Tools. rCGH also supports custom arrays, provided data is in a suitable format. This package takes over all the steps required for individual genomic profiles analysis, from reading files to segmenting and annotating genes. This package provides several visualization functions (static or interactive) which facilitate individual profiles interpretation. Input files can be in compressed format, e.g. .bz2 or .gz.

Author(s)

Frederic Commo <frederic.commo@gustaveroussy.fr>

See Also

readAgilent, readAffySNP6, readAffyCytoScan, readGeneric

Examples

```r
filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2", package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffyScHD")

cgh <- adjustSignal(cgh, nCores=1)
cgh <- segmentCGH(cgh, nCores=1)
cgh <- EMnormalize(cgh)

# Static visualizations
plotDensity(cgh)
multiplot(cgh)

## Not run:
# Interactive visualizations
view(cgh)

## End(Not run)
```
adjustSignal

Array-based CGH Preprocessing

Description

This function performs several preprocessing steps: local regressions (loessFit) are used to correct cy3/cy5 and GC% bias, when Agilent dual-color hybridization are used only. In case of Affymetrix cychp.txt (or cnchp.txt) data are used, these steps have been already done in ChAS or Affymetrix Power Tools.

Usage

## S4 method for signature 'rCGH'

```r
adjustSignal(object, Scale=TRUE, Cy=TRUE, GC=TRUE, Ref="cy3",
  suppOutliers=TRUE, nCores=NULL, verbose=TRUE)
```

Arguments

- **object**: An object of class "rCGH"
- **Scale**: logical. If TRUE (default), Log2Ratios are standardized.
- **Cy**: logical. If TRUE (default), cy3/cy5 bias is corrected using a local regression (loessFit). For Agilent dual-color hybridization only. Notice that, in case of Affymetrix files (cychp.txt or cnchp.txt), this argument is automatically set to FALSE, since this step is managed when files are exported from ChAS or APT.
- **GC**: logical. If TRUE (default), the GC% bias is corrected using a local regression (loessFit). For Agilent dual-color hybridization only. Notice that, in case of Affymetrix files (cychp.txt or cnchp.txt), this argument is automatically set to FALSE, since this step is managed when files are exported from ChAS or APT.
- **Ref**: string. Which cyanine was used as the reference. Possible values are "cy3" (default) and "cy5". For Agilent dual-color hybridization only.
- **suppOutliers**: logical. If TRUE (default), outliers are removed using an Expectation-Maximization algorithm (EM). See details below.
- **nCores**: numeric. The number of cores to use in order to speed up the computation. When NULL (default), half of the available cores are used. If a value greater than the number of available cores is passed, this latter will be used. See `detectCores`.
- **verbose**: logical. When TRUE (default), progress is printed.

Details

When suppOutliers is TRUE (default), the Log2Ratios are splitted with respect to chromosomes. The main regions within each chromosome are identified using EM. Within each region $r_i$, $x[r_i]$ values are redefined according to the corresponding model parameters. as:

$$x[r_i] \sim N(\mu_i, \sigma_i)$$

Notice that this step may substantially increase the computation time.
### Value

An object of class "rCGH"

### Author(s)

Frederic Commo

### See Also

`detectCores`, `mclapply`

### Examples

```r
filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2", package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffyScHD")
cgh <- adjustSignal(cgh, nCores=1)
getParam(cgh)
```

---

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<th><em>aCGH Agilent Probes GC Fraction</em></th>
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### Description

A dataset containing the Agilent probe Ids, and their GC content. These data allow `rCGH` to support Agilent aCGH arrays, from 44K to 400K. See the source section. This information is used to correct the GC% bias. For Agilent data only.

### Usage

`agilentDB`

### Format

A data frame with 411056 rows and 2 columns:

- **ProbeID**: Official Agilent probe ids.
- **GC**: The GC content in each probe sequence, expressed as the GC fraction.

### Value

A dataset

### Note

Probe sequences are not used and have been removed after computing the GC fractions as GC = sum(G or C)/length(sequence), for each sequence in file.
Author(s)

Frederic Commo

Source

These data derive from the official Agilent Sequence List, SurePrint_G3_Human_CGH_Microarray 2x400K_021850_D_SequenceList_20111015.txt, freely available at: Agilent SureDesign
Access date: 3-2-2015
Notice that a User ID and Password are required to sign in.

AllAccessors "rCGH" Accessor Functions

Description

Methods for extracting information from an object of class "rCGH". Each of the below methods are simply convenience functions which extract the corresponding slots (as the name of each method suggests) from an object of class "rCGH".

Usage

## S4 method for signature 'rCGH'
getInfo(object, item = NULL)
## S4 method for signature 'rCGH'
getCNset(object)
## S4 method for signature 'rCGH'
getParam(object)
## S4 method for signature 'rCGH'
getSegTable(object, minLen = NULL)

Arguments

object : An object of class "rCGH"
item : character. Can be one, or a vector of items. When NULL, the full available information is returned. If item is specified, and exists, the corresponding value(s) only is(are) returned.
minLen : numeric. The minimal length for a segment, in Kb. When NULL (default), the segmentation table is exported, as it has been computed with segmentCGH, segments shorter than the specified value are re-merged otherwise.

Value

- getInfo(object, item = NULL): character.
- getCNset(object): a data frame.
- getParam(object): a list of parameters.
- getSegTable(object, minLen = NULL): a data frame.
Methods

"rCGH"

- getInfo(object, item = NULL): returns the values of the specified items, all the information otherwise.
- getCNset(object): returns the full by-probe dataset.
- getParam(object): returns the analysis parameters.
- getSegTable(object, minLen = NULL): returns the segmentation table - one row per segment.

Author(s)

Frederic Commo

See Also

setInfo, segmentCGH

Examples

filePath <- system.file("extdata", "Agilent4x180K.txt.bz2", package = "rCGH")
cgh <- readAgilent(filePath, sampleName = "Agilent4x180K", labName = "myLab")

# Getting all the information
getInfo(cgh)

# Getting specific items
getInfo(cgh, c("sampleName", "labName"))

###

byGeneTable

Converting a Segmentation Table Into a By-Gene Table

Description

This function creates a by-gene table by listing all the genes contained in each of the segments in the segmentation table. Gene annotations (symbol, location,...), segmented Log2Ratios, and segment length are reported in the final table.

A supplementary score is the relativeLog: the magnitude, in Log2, from the closest centromere.

Usage

byGeneTable(segTable, symbol = NULL,
            genome = c("hg19", "hg18", "hg38"), columns = NA, verbose = TRUE)
byGeneTable

Arguments

segTable : data frame. A segmentation table exported from an object of class "rCGH"

symbol : character. A valid HUGO symbol. When NULL the full gene table is returned, the corresponding gene information only o/w.

genome : string. The genome build to use. Supported genomes are hg18, hg19 (default), and hg38.

columns : string. what supplementary genes annotations to export. Allowed annotations are those supported by the select method from the AnnotationDbi bioconductor package. When NA (default), ' SYMBOL','ENTREZID', ' GENENAME' and ' MAP' are exported.

verbose : logical. When TRUE progress is printed.

Details

For gene annotations, Hg19/GRCh37 annotations downloaded from NCBI are considered.

Value

An object of class "rCGH"

Author(s)

Frederic Commo

See Also

getSegTable

Examples

filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2",
                      package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffyScHD")
cgh <- adjustSignal(cgh, nCores=1)
cgh <- segmentCGH(cgh, nCores=1)
cgh <- EMnormalize(cgh)
st <- getSegTable(cgh)
bygene <- byGeneTable(st)
head(bygene)
**EMnormalize**

**Genomic Profile Centralization**

**Description**

This function analyses the Log2Ratios as a mixture of several gaussian populations, using an Expectation-Maximization algorithm (EM). The `peakThresh` argument specifies what proportion of the main density peak is allowed for choosing a neutral 2-copies population. The mean of the chosen population is used for centralizing the profile.

See [Mclust](#).

**Usage**

```r
## S4 method for signature 'rCGH'
EMnormalize(object, G = 2:6, priorScale = 5, peakThresh = 0.5, mergeVal = 0.1, Title = NA, verbose = TRUE)
```

**Arguments**

- `object`: An object of class "rCGH"
- `G`: numeric. The number of groups to test during the gaussian mixture estimation. Default is from 2 to 6.
- `priorScale`: numeric. A scale value passed to `priorControl`. Default is 5.
- `peakThresh`: numeric. The proportion of the highest peak to consider as a peak selection threshold. Default is 0.5.
- `mergeVal`: numeric. Populations with means closer than `mergeVal` will be pooled together, default is 0.1. Set `mergeVal` to zero to not pool closed sub-populations.
- `Title`: character string. A title for the density plot. If NA (default), the sample name (when exists in object info) will be used.
- `verbose`: logical. When TRUE (default), progress is printed.

**Details**

Depending on `peakThresh`, the mean of the highest density, or a lower value, is chosen for centering the genomic profile. To do so, L2R are modeled for each segment $s_i$, with respect to $n_i$ (the number of probes included in segment i), $\mu_i$ and $\sigma_i$. The mixture of L2Rs is then analysed as a mixture of gaussian populations.

When a `peakThresh` value is specified, heights of density peaks are compared: the lowest peak mean among the peaks respecting the criteria: $\text{peakHeight} > \max(\text{peaks}) \times \text{peakThresh}$, is chosen for centralizing the data. See References

**Value**

An object of same class as the input.
Author(s)
Frederic Commo

References

See Also
plotDensity, mclust

Examples
filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2", package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffySchD")
cgh <- adjustSignal(cgh, nCores=1)
cgh <- segmentCGH(cgh, nCores=1)
cgh <- EMnormalize(cgh)
getParam(cgh)

hg18

Hg18 Chromosome Lengths and Centromere Locations

Description
A data set containing lengths and centromere locations for each of the 24 chromosomes, according to Hg18.

Usage
hg18

Format
A data set with 24 rows and 5 columns:
- chrom: chromosome number.
- length: chromosome length.
- centromerStart: centromere start position.
- centromerEnd: centromere start position.
- cumlen: cumulative length (where the previous chromosome ends).

Value
a data set.
**Author(s)**
Frederic Commo

**Source**
These data derived from the Hg18 gap UCSC table, freely available at: UCSC
Access date: 10-10-2015
Within the browser, select:
group: All Tables
database: hg18	table: gap

**Examples**

```
# For users convenience, we provide a prebuilt dataset
# containing the Hg18 chr lengths, and centromeres location.
hg18

# The same dataset can be obtained as follow:
## Not run:
library(BSgenome)
library(rtracklayer)

getChrLength <- function(genome){
  genome <- sprintf("BSgenome.Hsapiens.UCSC.
  g <- getBSgenome(genome, masked=FALSE)
  data.frame(chrom=1:24, length=seqlengths(g)[1:24])
}

.chrAsNum <- function(tbl){
  tbl$chrom <- gsub("chr", "", tbl$chrom)
  tbl$chrom[tbl$chrom=="X"] <- 23
  tbl$chrom[tbl$chrom=="Y"] <- 24
  tbl$chrom <- as.numeric(tbl$chrom)
  tbl[order(tbl$chrom),]
}

gGetCentromeres <- function(genome){
  mySession <- try(browserSession("UCSC"), silent=TRUE)
  # In case it fails, use another mirror
  if(inherits(mySession, "try-error"))
    mySession <- browserSession("UCSC",
      url="http://genome-euro.ucsc.edu/cgi-bin/")
  genome(mySession) <- genome
  obj <- ucsctableQuery(mySession, table="gap")
  tbl <- getTable(obj)
  tbl <- tbl[tbl$type=="centromeres", c("chrom", "chromStart", "chromEnd")]
  colnames(tbl)[2:3] <- c("centromerStart", "centromerEnd")
  .chrAsNum(tbl)
}

makeHg <- function(genome){
  chrL <- getChrLength(genome)
  ctm <- getCentromeres(genome)
  ```
tbl <- merge(chrL, ctm, by="chrom")
cumlen <- c(0, cumsum(as.numeric(tbl$length))[-nrow(tbl)])
cbind.data.frame(tbl, cumlen=cumlen)
}
hg18 <- makeHg("hg18")
hg18

## End(Not run)

---

**hg19**

*Hg19 Chromosome Lengths and Centromere Locations*

**Description**

A data set containing lengths and centromere locations for each of the 24 chromosomes, according to Hg19.

**Usage**

hg19

**Format**

A data set with 24 rows and 5 columns:

- *chrom*: chromosome number.
- *length*: chromosome length.
- *centromerStart*: centromere start position.
- *centromerEnd*: centromere start position.
- *cumlen*: cumulative length (where the previous chromosome ends).

**Value**

a data set.

**Author(s)**

Frederic Commo

**Source**

These data derived from the Hg19 gap UCSC table, freely available at: [UCSC](#)

Access date: 1-31-2014

Within the browser, select:
group: All Tables
database: hg19
table: gap
Examples

# For users convenience, we provide a prebuilt dataset
# containing the Hg19 chr lengths, and centromeres location.
hg19

# The same dataset can be obtained as follow:
## Not run:
library(BSgenome)
library(rtracklayer)

g <- getBSgenome(genome = "BSgenome.Hsapiens.UCSC.hg19")
data.frame(chrom=1:24, length=seqlengths(g)[1:24])

#chr As Num <- function(tbl){
# tbl$chrom <- gsub("chr", "", tbl$chrom)
tbl$chrom[tbl$chrom=="X"] <- 23
tbl$chrom[tbl$chrom=="Y"] <- 24
tbl$chrom <- as.numeric(tbl$chrom)
tbl[order(tbl$chrom),]
}

g <- getChrLength()
#chr As Num(g)

c <- c(0, cumsum(as.numeric(tbl$length))[-nrow(tbl)])
cbind.data.frame(tbl, cumlen=cumlen)

hg19 <- makeHg19()
hg19

## End(Not run)

Hg38 Chromosome Lengths and Centromere Locations

Description

A data set containing lengths and centromere locations for each of the 24 chromosomes, according to Hg38.
Usage

hg38

Format

A data set with 24 rows and 5 columns:

• chrom: chromosome number.
• length: chromosome length.
• centromerStart: centromere start position.
• centromerEnd: centromere start position.
• cumlen: cumulative length (where the previous chromosome ends).

Value

a data set.

Author(s)

Frederic Commo

Source

These data derived from the Hg38 gap UCSC table, freely available at: UCSC
Access date: 10-10-2015
Within the browser, select:
group: All Tables
database: hg38
table: gap

Examples

# For users convenience, we provide a prebuilt dataset
# containing the Hg38 chr lengths, and centromeres location.
hg38

# The same dataset can be obtained as follow:
## Not run:
library(BSgenome)
library(rtracklayer)

getChrLength <- function(genome){
  genome <- sprintf("BSgenome.Hsapiens.UCSC.
  g <- getBSgenome(genome, masked=FALSE)
  data.frame(chrom=1:24, length=seqlengths(g)[1:24])
}

chrAsNum <- function(tbl){
  tbl$chrom <- gsub("chr", "", tbl$chrom)
  tbl$chrom[tbl$chrom=="X"] <- 23
  tbl$chrom[tbl$chrom=="Y"] <- 24
```r
multiplot <- function(object, symbol=NULL, gain=.5, loss=(-.5), minLen=10, pCol = "grey50", GLcol = c("blue", "red3"),
L=matrix(seq(1, 12)), p=c(1/2, 1/4, 1/4), Title=NULL, ylim=NULL) {
  # Not run

  ## End(Not run)
```

---

**multiplot**

**Static Genomic Profile and LOH Visualization**

### Description

This function displays a static view of the genomic profile and the allelic difference stored in an object of class "rCGH". If no allelic difference is available, the genomic profile only is displayed.

### Usage

```r
## S4 method for signature 'rCGH'
multiplot(object, symbol=NULL, gain=.5, loss=(-.5), minLen=10, pCol = "grey50", GLcol = c("blue", "red3"),
L=matrix(seq(1, 12)), p=c(1/2, 1/4, 1/4), Title=NULL, ylim=NULL)
```
Arguments

object : An object of class "rCGH"
symbol : character. A valid HUGO symbol (case insensitive).
gain : numeric. A gain threshold value (in Log2(Ratio)). Segments greater, or equal to, this value will be colored, as specified by GLcol.
loss : numeric. A loss threshold value (in Log2(Ratio)). Segments lower, or equal to, this value will be colored, as specified by GLcol.
minLen : numeric. The minimal length for a segment, expressed in Kb. When NULL (default), segments are reported as they have been computed by segmentCGH. Segments shorter than the specified value are re-merged otherwise.
pCol : string. The probe points color. Default is "grey50".
GLCol : vector. A vector of 2 colors: the gained and lost segments colors, respectively. Default is "blue" for gains and "red3" for losses.
L : matrix. A matrix defining the layout. Default is 12 lines.
p : numeric. The proportion of each plot within the plot window. Default is 1/2, 1/4, 1/4, which corresponds to 6-4-4 lines for the genomic profile in Log2R, in copy number, and the LOH plot, respectively, and given a 12-line layout.
Title : character string. A title for the plot. If NULL (default), the sample name (when exists) is used.
ylim : numeric. A vector of two values specifying the y-axis range. See plotProfile.

Value

None.

Note

If no allelic difference is available, the genomic profile only is displayed.

Author(s)

Frederic Commo

See Also

plotDensity, plotProfile, plotLOH, view

Examples

filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2",
          package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffyScHD")
cgh <- adjustSignal(cgh, nCores=1)
cgh <- segmentCGH(cgh, nCores=1)
cgh <- EMnormalize(cgh)

# Static visualizations
plotDensity

multiplot(cgh, symbol = "erbb2")

plotDensity

Visualizing the Log2Ratios Density and Centralization Decision

Description

This function display the distribution of the Log2Ratios, as well as how the "EMnormalize" step estimates the mixture of gaussian populations, and choose a centralization value.

Usage

## S4 method for signature 'rCGH'
plotDensity(object, breaks=NULL, Title=NULL,...)

Arguments

object : An object of class "rCGH"
breaks : The number of breaks to use. See hist. When NULL (default), breaks is arbitrarily defined from the number of values to draw.
Title : character string. A title for the density plot. If NULL (default), the sample name (when exists) will be used.
... : Other graphical parameters supported by par.

Value

None.

Author(s)

Frederic Commo

See Also

plotProfile, plotLOH, multiplot, view

Examples

filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2",
                  package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffySchD")
cgh <- adjustSignal(cgh, nCores=1)
cgh <- segmentCGH(cgh, nCores=1)
cgh <- EMnormalize(cgh)
plotDensity(cgh)
plotLOH

Allelic Differences Visualization

Description

This function display a static view of the allele differences, when available.

Usage

## S4 method for signature 'rCGH'
plotLOH(object, Title=NULL)

Arguments

object : An object of class "rCGH"
Title : character string. A title for the density plot. If NULL (default), the sample name (when exists) is used.

Value

None.

Author(s)

Frederic Commo

See Also

plotDensity, plotProfile, multiplot, view

Examples

filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2", package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffySchD")
cgh <- adjustSignal(cgh, nCores=1)
cgh <- segmentCGH(cgh, nCores=1)
cgh <- EMnormalize(cgh)

# Static visualizations
plotLOH(cgh)
Description

This function displays a static view of the genomic profile stored in an object of class "rCGH".

Usage

```r
## S4 method for signature 'rCGH'
plotProfile(object, showCopy=FALSE, symbol=NULL, 
            gain=.5, loss=(-.5), minLen = 10, pCol = "grey50", 
            GLcol = c("blue", "red3"), Title=NULL, ylim=NULL)
```

Arguments

- `object` : An object of class "rCGH"
- `showCopy` : logical. To show the estimated copy numbers instead of the Log2Ratios. default is FALSE.
- `symbol` : character. A valid HUGO symbol (case insensitive).
- `gain` : numeric. A gain threshold value (in Log2(Ratio)) from where gained segments will be shown, in blue.
- `loss` : numeric. A loss threshold value (in Log2(Ratio)) from where lossed segments will be shown, in red.
- `minLen` : numeric. The minimal length for a segment, in Kb. When NULL (default), segments are reported as they have been computed with `segmentCGH`, segments shorter than the specified value are re-merged otherwise.
- `pCol` : string. The probe points color. Default is "grey50".
- `GLcol` : vector. A vector of 2 colors: the gained and lost segments colors, respectively. Default is "blue" for gains and "red3" for losses.
- `Title` : character string. A title for the density plot. If NULL (default), the sample name (when exists) is used.
- `ylim` : numeric. A vector of two values specifying a range for the y-axis. If NULL (default), the range of Log2Ratio is used.

Value

None.

Author(s)

Frederic Commo

See Also

`plotDensity, plotLOH, multiplot, view`
Examples

```r
filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2", package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffyScHD")
cgh <- adjustSignal(cgh, nCores=1)
cgh <- segmentCGH(cgh, nCores=1)
cgh <- EMnormalize(cgh)

# Static visualization using Log2Ratios
plotProfile(cgh, symbol = "erbb2")

# Static visualization using estimated copy numbers
plotProfile(cgh, showCopy = TRUE, symbol = "erbb2")
```

---

**rCGH-Agilent-class**

*Class "rCGH-Agilent"

---

**Description**

An instance of class "rCGH-Agilent", which inherits from the superclass "rCGH". Slots described below are used to store sample information, analysis parameters, and segmentation results. All are accessible through specific "Accessors" functions.

**Objects from the Class**

Objects can be created by calls of the form `new("rCGH-Agilent", ...)`. 

**Slots**

- `info`: Object of class "character": where sample information can be stored. See `getInfo` and `setInfo`.
- `cnSet`: Object of class "data.frame": the full data set. See `getCNset`.
- `param`: Object of class "list": the analysis parameters stored for traceability. `getParam`.
- `segTable`: Object of class "data.frame": the segmentation table. `getSegTable`.

**Extends**

Class "rCGH", directly.

**Methods**

No methods defined with class "rCGH-Agilent" in the signature.

**Author(s)**

Frederic Commo
See Also

"rCGH", "rCGH-cytoScan", "rCGH-SNP6", "rCGH-generic"

Examples

showClass("rCGH-Agilent")

rCGH-class

Class "rCGH"

Description

Class "rCGH" is a superclass living on top of "rCGH-Agilent", "rCGH-SNP6", "rCGH-cytoScan", "rCGH-oncoScan", and "rCGH-generic". These objects inherit most of the properties of the superclass, and allow specific parameterizations used during the analysis process.

Objects are created by platform-specific read functions: "readAgilent", "readAffySNP6", and "readAffyCytoScan", each corresponding to their matched file format.

A supplementary "readGeneric" allows the user to create a "rCGH" object from custom arrays.

Slots described below are used to store sample information and analysis parameters, as well as segmentation results. All are accessible through specific "Accessors" functions.

Objects from the Class

Objects can be created by calls of the form new("rCGH", ...).

Slots content are updated at each different analysis step, and are accessible through specific get functions.

Slots

info: Object of class "character": where sample information can be stored. See "getInfo" and "setInfo".

cnSet: Object of class "data.frame": the full data set. See "getCNset".

param: Object of class "list": the analysis parameters stored for traceability. See "getParam".

segTable: Object of class "data.frame": the segmentation table. See "getSegTable".

Methods

show signature(object = "rCGH"): ...

Author(s)

Frederic Commo

See Also

"rCGH-Agilent", "rCGH-SNP6", "rCGH-cytoScan", "rCGH-generic"
Examples

```
showClass("rCGH")
```

---

**rCGH-cytoScan-class**

**Class** "rCGH-cytoScan"

**Description**

An instance of class "rCGH-cytoScan", which inherits from the superclass "rCGH". Slots described below are used to store sample information, analysis parameters, and segmentation results. All are accessible through specific "Accessors" functions.

**Objects from the Class**

Objects can be created by calls of the form `new("rCGH-cytoScan", ...)`.

**Slots**

- `info`: Object of class "character": where sample information can be stored. See `getInfo` and `setInfo`.
- `cnSet`: Object of class "data.frame": the full data set. See `getCNset`.
- `param`: Object of class "list": the analysis parameters stored for traceability. `getParam`.
- `segTable`: Object of class "data.frame": the segmentation table. `getSegTable`.

**Extends**

Class "rCGH", directly.

**Methods**

No methods defined with class "rCGH-cytoScan" in the signature.

**Author(s)**

Frederic Commo

**See Also**

"rCGH","rCGH-Agilent","rCGH-SNP6","rCGH-generic"

**Examples**

```
showClass("rCGH-cytoScan")
```
rCGH-generic-class

Class "rCGH-generic"

Description

An instance of class "rCGH-generic", which inherits from the superclass "rCGH". Slots described below are used to store sample information, analysis parameters, and segmentation results. All are accessible through specific "Accessors" functions.

Objects from the Class

Objects can be created by calls of the form new("rCGH-generic", ...).

Slots

info: Object of class "character": where sample information can be stored. See getInfo and setInfo.

cnSet: Object of class "data.frame": the full data set. See getCNset.

param: Object of class "list": the analysis parameters stored for traceability. getParam.

segTable: Object of class "data.frame": the segmentation table. getSegTable.

Extends

Class "rCGH", directly.

Methods

No methods defined with class "rCGH-generic" in the signature.

Author(s)

Frederic Commo

See Also

"rCGH","rCGH-Agilent","rCGH-SNP6","rCGH-cytoScan"

Examples

showClass("rCGH-generic")
Description

An instance of class "rCGH-oncoScan", which inherits from the superclass "rCGH". Slots described below are used to store sample information, analysis parameters, and segmentation results. All are accessible through specific “Accessors” functions.

Objects from the Class

Objects can be created by calls of the form new("rCGH-oncoScan", ...).

Slots

info: Object of class "character": where sample information can be stored. See `getInfo` and `setInfo`.

cnSet: Object of class "data.frame": the full data set. See `getCNset`.

param: Object of class "list": the analysis parameters stored for traceability. `getParam`.

segTable: Object of class "data.frame": the segmentation table. `getSegTable`.

Extends

Class "rCGH", directly.

Methods

No methods defined with class "rCGH-oncoScan" in the signature.

Author(s)

Frederic Commo

See Also

"rCGH","rCGH-Agilent","rCGH-SNP6","rCGH-cytoScan","rCGH-generic"

Examples

```
showClass("rCGH-oncoScan")
```
rCGH-SNP6-class

Description

An instance of class "rCGH-SNP6", which inherits from the superclass "rCGH". Slots described below are used to store sample information, analysis parameters, and segmentation results. All are accessible through specific "Accessors" functions.

Objects from the Class

Objects can be created by calls of the form new("rCGH-SNP6", ...).

Slots

- info: Object of class "character": where sample information can be stored. See getInfo and setInfo.
- cnSet: Object of class "data.frame": the full data set. See getCNset.
- param: Object of class "list": the analysis parameters stored for traceability. getParam.
- segTable: Object of class "data.frame": the segmentation table. getSegTable.

Extends

Class "rCGH", directly.

Methods

No methods defined with class "rCGH-SNP6" in the signature.

Author(s)

Frederic Commo

See Also

"rCGH", "rCGH-Agilent", "rCGH-cytoScan"

Examples

showClass("rCGH-SNP6")
Description

A constructor function which takes an Affymetrix cytoScanHD cychp.txt (or cnchp.txt) file as input, possibly in a compressed format (.bz2 or .gz).
These files are exported from Chromosome Analysis Suite (ChAS) or Affymetrix Power Tools (see References section).

Usage

```r
readAffyCytoScan(filePath, sampleName=NA, labName=NA, useProbes=c("snp", "cn", "all"), genome = c("hg19", "hg18", "hg38"), ploidy = 2, verbose=TRUE)
```

Arguments

- `filePath`: string. A path to an Affymetrix cytoScanHD cychp.txt (or cnchp.txt) file.
- `sampleName`: string. A sample Id. Optional.
- `labName`: string. A lab Id. Optional.
- `useProbes`: character. What probes to consider. Possible choices are SNP probes only ("snp", default), CN probes only ("cn"), or all the probes ("all").
- `genome`: string. The genome build to use. Supported genomes are hg18, hg19 (default), and hg38.
- `ploidy`: numeric. A priori plody value, when known, to adjust the estimation of copy numbers. Default is 2.
- `verbose`: logical. When TRUE (default), progress is printed.

Details

When available in the file preambule, several array information will be stored in `Object@info`:
scanning date, grid version,...
Any other useful item can be stored using `setInfo`.

Value

An object of class "rCGH"

Author(s)

Frederic Commo

References

Affymetrix Power Tools
readAffyOncoScan

See Also

readAgilent, readAffySNP6, readGeneric, readAffyOncoScan, setInfo, getInfo

Examples

```r
filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2",
  package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffyScHD")
cgh
```

---

readAffyOncoScan

**Affymetrix OncoScan "rCGH-oncoScan" Constructor**

**Description**

A constructor function which takes an Affymetrix oncoScan tabulated file as input, possibly in a compressed format (.bz2 or .gz).

This can be either a 'ProbeSets,CopyNumber.tsv' alone, or merged with its corresponding 'ProbeSets,AllelicData.tsv' file. See the details section.

**Usage**

```r
readAffyOncoScan(filePath, sampleName=NA, labName=NA,
  genome = c("hg19", "hg18", "hg38"),
  ploidy = 2, verbose=TRUE)
```

**Arguments**

- `sampleName`: string. A sample Id. Optional.
- `labName`: string. A lab Id. Optional.
- `genome`: string. The genome build to use. Supported genomes are hg19, hg18 (default), and hg38.
- `ploidy`: numeric. A priori ploidy value, when known, to adjust the estimation of copy numbers. Default is 2.
- `verbose`: logical. When TRUE (default), progress is printed.

**Details**

The Affymetrix Power Tools apt-copynumber-onco-ssa script produces 2 files: 'ProbeSets,CopyNumber.tsv' and 'ProbeSets,AllelicData.tsv'. Merging these 2 files may produce a unique file containing both probes Log2Ratio and AllelicDifference.

**Value**

An object of class "rCGH"
Author(s)
Frederic Commo

References
Affymetrix Power Tools

See Also
readAgilent, readAffySNP6, readGeneric, readAffyCytoScan, setInfo, getInfo

Examples
# Just a toy file
filePath <- system.file("extdata", "oncoscan.tsv.bz2", package = "rCGH")
cgh <- readAffyOncoScan(filePath, sampleName = "AffyOncoScan")
cgh

readAffySNP6

Affymetrix SNP6 "rCGH-SNP6" Constructor

Description
A constructor function which takes an Affymetrix SNP6 cychp.txt (or cnchp.txt) file as input, possibly in a compressed format (.bz2 or .gz). These files are exported from Chromosome Analysis Suite (ChAS) or Affymetrix Power Tools (APT) (see the References section).

Usage
readAffySNP6(filePath, sampleName = NA, labName = NA, useProbes = c("snp", "cn", "all"), genome = c("hg19", "hg18", "hg38"), ploidy = 2, verbose = TRUE)

Arguments
filePath : string. A path to an Affymetrix SNP6 cychp.txt (or cnchp.txt) file.

sampleName : string. A sample Id. Optional.

labName : string. A lab Id. Optional.

useProbes : character. What probes to consider. Possible choices are SNP probes only ("snp", default), CN probes only ("cn"), or all the probes ("all").

genome : string. The genome build to use. Supported genomes are hg18, hg19 (default), and hg38.

ploidy : numeric. A priori ploidy value, when known, to adjust the estimation of copy numbers. Default is 2.

verbose : logical. When TRUE (default), progress is printed.
Details

When available in the file preambule, several array information will be stored in Object@info:
scanning date, grid version,...
Any other useful item can be stored using setInfo.

Value

An object of class "rCGH"

Author(s)

Frederic Commo

References

Affymetrix Power Tools

See Also

readAgilent, readAffyCytoScan, readGeneric, readAffyOncoScan, setInfo, getInfo

Examples

filePath <- system.file("extdata", "Affy_snp6_cnchp.txt.bz2", package = "rCGH")
cgh <- readAffySNP6(filePath, sampleName = "AffySNP6")
cgh
Arguments
filePath : string. A path to an Agilent FE (.txt) file.
sampleName : string. A sample Id. Optional.
labName : string. A lab Id. Optional.
supFlags : should the flagged probes be suppressed. Default is TRUE.
genome : string. The genome build to use. Supported genomes are hg18, hg19 (default), and hg38.
ploidy : numeric. A priori ploidy value, when known, to adjust the estimation of copy numbers. Default is 2.
verbose : logical. if TRUE (default), progress is printed.

Details
When available in the file preambule, several array information will be stored in Object@info:
scanning date, grid version,...
Any other useful item can be stored using setInfo.

Value
An object of class "rCGH"

Author(s)
Frederic Commo

See Also
readAffyCytoScan, readAffySNP6, readGeneric, readAffyOncoScan, setInfo, getInfo

Examples
filePath <- system.file("extdata", "Agilent4x180K.txt.bz2", package = "rCGH")
cgh <- readAgilent(filePath, sampleName = "Agilent4x180K", labName = "myLab")
cgh

readGeneric

Generic rCGH object "rCGH-generic" Constructor

Description
A constructor function which takes a tabulated .txt file as input, possibly in a compressed format (.bz2 or .gz). Notice that precise column names are mandatory, see the details section.
readGeneric

Usage

readGeneric(filePath, sampleName=NA, labName=NA,
            genome = c("hg19", "hg18", "hg38"), ploidy = 2, verbose=TRUE)

Arguments

sampleName : string. A sample Id. Optional.
labName : string. A lab Id. Optional.
genome : string. The genome build to use. Supported genomes are hg18, hg19 (default),
        and hg38.
ploidy : numeric. A priori ploidy value, when known, to adjust the estimation of copy
        numbers. Default is 2.
verbose : logical. When TRUE (default), progress is printed.

Details

This generic constructor does not expect any preamble. Mandatory columns are:

ProbeName: Character strings. Typically the probe ids.
ChrNum: numeric. The chromosome numbers. In case Chr X and Y are used and named as "X" and
        "Y", these notations will be converted into 23 and 24, respectively.
ChrStart: numeric. The chromosomal probes locations.
Log2Ratio: numeric. The corresponding Log2Ratios.

Value

An object of class "rCGH"

Author(s)

Frederic Commo

See Also

readAgilent, readAffySNP6, readAffyCytoScan, readAffyOncoScan, setInfo, getInfo

Examples

filePath <- system.file("extdata", "generic.txt.bz2", package = "rCGH")
cgh <- readGeneric(filePath, package = "rCGH")
cgh
Description

This function allows the user to recenter a genomic profile stored in an object of class "rCGH". Peaks are indexed from 1 to k, from left to right, as they appear on the \texttt{plotDensity} after the \texttt{EMnormalize} step.

Usage

```r
# S4 replacement method for signature 'rCGH'
recenter(object) <- value
```

Arguments

- \texttt{object}: An object of class "rCGH"
- \texttt{value}: numeric. What peak number to choose to recenter the genomic profile.

Value

An object of class "rCGH"

Note

When a profile is recentered, the stored workflow parameters are updated. see \texttt{getParam}.

Author(s)

Frederic Commo

See Also

\texttt{EMnormalize,plotDensity}

Examples

```r
filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2", package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffyScHD")
cgh <- adjustSignal(cgh, nCores=1)
cgh <- segmentCGH(cgh, nCores=1)
cgh <- EMnormalize(cgh)

# Default peak choice center the profile on the 1st peak
plotDensity(cgh)

# Recentering on the 2nd density peak
recenter(cgh) <- 2
```
segmentCGH

Description

A function for performing the Log2Ratio segmentation on an object of class "rCGH". See the details section below.

Usage

```r
## S4 method for signature 'rCGH'
segmentCGH(object, Smooth=TRUE, UndoSD = NULL,
minLen = 10, nCores=NULL, verbose = TRUE)
```

Arguments

- `object`: An object of class "rCGH"
- `Smooth`: logical. Should the LRR be smoothed before being segmented. See DNAcopy for details.
- `UndoSD`: numeric. When not specified (default is NULL), the UndoSD value is estimated from the Log2Ratios. See DNAcopy for details.
- `minLen`: numeric. The minimal length for a segment, in Kb. Shorter segments will be merged to the closest adjacent one. Default value is 10(Kb).
- `nCores`: numeric. The number of cores to use in order to speed up the computation. When NULL (default), half of the available cores are used. See mclapply.
- `verbose`: logical. if TRUE (default), progress is printed.

Details

This function is a wrapper for the DNAcopy, CNA and segment functions, which allows parallelization and data-driven parameterization.

In addition to the usual DNAcopy output, the segmentation table contains the probes Log2Ratio standard deviation for each segment, as well as there length, in Kb.

Value

An object of class "rCGH"

Author(s)

Frederic Commo
setInfo<-.methods

Adding Information In An Object Of Class "rCGH"

Description
This function allows the user to store any type of supplementary information in an object of class "rCGH".

Usage
## S4 replacement method for signature 'rCGH'
setInfo(object, item = NULL) <- value

Arguments

<table>
<thead>
<tr>
<th>argument</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>object</td>
<td>An object of class &quot;rCGH&quot;</td>
</tr>
<tr>
<td>item</td>
<td>character. An item name to store. Default is NULL.</td>
</tr>
<tr>
<td>value</td>
<td>any. A value to store.</td>
</tr>
</tbody>
</table>

Value
An object of class "rCGH"

Warning: When either item or value is NULL, an error is returned.

Author(s)
Frederic Commo

References

See Also
CNA, segment, mclapply

Examples
filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2",
                          package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffyScHD")
cgh <- adjustSignal(cgh, nCores=1)
cgh <- segmentCGH(cgh, nCores=1)
st <- getSegTable(cgh)
head(st)
show-methods

See Also

getInfo

Examples

```r
filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2", 
  package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffyScHD")

# When supplementary information is added,
# numerical, logical, or strings are supported
setInfo(cgh, "someItem1") <- 35
setInfo(cgh, "someItem2") <- TRUE
setInfo(cgh, "someItem3") <- "someComment"
getInfo(cgh)

# or to get back specific items
getInfo(cgh, c("someItem1", "someItem3"))
```

Description

A method for visualizing an object of class "rCGH"

Methods

```r
signature(object = "rCGH")
```

Author(s)

Frederic Commo

view

Interactive Genomic Profile Visualization

Description

This function is build on top of shiny, and provides an iterative way for visualizing a genomic profile, and exploring the list of genes.
From a command panel, the user can interact with the graph in different ways. See details.

Usage

```r
## S4 method for signature 'rCGH'
view(object, browser = TRUE, ...)
```
Arguments

object : An object of class "rCGH"

browser : logical. When TRUE (default), the system’s default web browser will be launched automatically.

... : Optional parameters used by runApp.

Details

The left command panel allows the user several actions:

- displaying a specific gene by calling its HUGO symbol.
- showing all or one unique chromosome.
- merging segments shorter than a specified value, in Kb.
- recentering the entire profile.
- rescaling the y-axis.
- specifying the Log2Ratio cut offs for defining gains and losses.
- specifying a segment length cut off, in Mb.
- exporting the genomic plot.
- exporting the genes list.

Some actions, such as showing one unique chromosome or specifying cut offs (gain, loss, segment length), automatically update the gene table available in the "Genes table" tab.

Value

None.

Author(s)

Frederic Commo

See Also

plotProfile, plotLOH, multiplot, runApp

Examples

filePath <- system.file("extdata", "Affy_cytoScan.cyhd.CN5.CNCHP.txt.bz2", package = "rCGH")
cgh <- readAffyCytoScan(filePath, sampleName = "AffyScHD")
cgh <- adjustSignal(cgh, nCores=1)
cgh <- segmentCGH(cgh, nCores=1)
cgh <- EMnormalize(cgh)

## Not run:
# Interactive visualizations
view(cgh)
## End (Not run)
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