

# Package ‘blima’

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**Type** Package

**Title** Package for the preprocessing and analysis of the Illumina microarrays on the detector (bead) level.

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**Author** Vojtech Kulvait

**Maintainer** Vojtech Kulvait <kulvait@gmail.com>

**Description** Package blima includes several algorithms for the preprocessing of Illumina microarray data. It focuses to the bead level analysis and provides novel approach to the quantile normalization of the vectors of unequal lengths. It provides variety of the methods for background correction including background subtraction, RMA like convolution and background outlier removal. It also implements variance stabilizing transformation on the bead level. There are also implemented methods for data summarization. It also provides the methods for performing T-tests on the detector (bead) level and on the probe level for differential expression testing.

**License** GPL-3

**LazyLoad** yes

**Depends** R(>= 3.0.0)

**Imports** beadarray(>= 2.0.0), Biobase(>= 2.0.0), BiocGenerics, grDevices, stats, graphics

**Suggests** xtable, blimaTestingData, BiocStyle, illuminaHumanv4.db, lumi

**URL** <https://bitbucket.org/kulvait/blima>

**biocViews** Microarray, Preprocessing, Normalization

**NeedsCompilation** no

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blima-package	<i>Package for the preprocessing and analysis of the Illumina microarrays on the detector (bead) level.</i>
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## Description

Package blima includes several algorithms for the preprocessing of Illumina microarray data. It focuses to the bead level analysis and provides novel approach to the quantile normalization of the vectors of unequal lengths. It provides variety of the methods for background correction including background subtraction, RMA like convolution and background outlier removal. It also implements variance stabilizing transformation on the bead level. There are also implemented methods for data summarization. It also provides the methods for performing T-tests on the detector (bead) level and on the probe level for differential expression testing.

## Details

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Author: Vojtech Kulvait  
Maintainer: Vojtech Kulvait <kulvait@gmail.com>  
License: GPL-3  
LazyLoad: yes  
Depends: R(>= 3.0.0)  
Imports: beadarray(>= 2.0.0), Biobase(>= 2.0.0), BiocGenerics, grDevices, stats, graphics  
Suggests: xtable, blimaTestingData, BiocStyle, illuminaHumanv4.db, lumi  
URL: <https://bitbucket.org/kulvait/blima>  
biocViews: Microarray, Preprocessing, Normalization

## Author(s)

Vojtech Kulvait

---

aggregateAndPreprocess	<i>Aggregate data</i>
------------------------	-----------------------

---

**Description**

This function is not intended to direct use. It helps perform work of doProbeTTests function. For each probe it prints mean and sd of an quality.

**Usage**

```
aggregateAndPreprocess(x, quality = "qua", transformation = NULL)
```

**Arguments**

**x** Two column matrix to agregate with columns "ProbeID" and quality.  
**quality** Quality to analyze, default is "qua".  
**transformation** Function of input data trasformation, default is NULL. Any function which for input value returns transformed value may be supplied. T-test then will be evaluated on transformed data, consider use log2TranformPositive.

**Author(s)**

Vojtech Kulvait

---

backgroundCorrect      *Data background correction.*

---

**Description**

Background correction procedure selecting beads with background Intensity  $I_b$   $|mean - I_b| > k * SD(I_{bs})$  for exclusion.

**Usage**

```
backgroundCorrect(b, normalizationMod = NULL, channelBackground = "GrnB",
  k = 3, channelBackgroundFilter = "bgf", channelAndVector = NULL)
```

**Arguments**

**b** List of beadLevelData objects (or single object).  
**normalizationMod** NULL for normalization of all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b or list of such vectors if b is a list of beadLevelData classes.  
**channelBackground** Name of channel to normalize.  
**k** Parameter of method stringency (default is 3).  
**channelBackgroundFilter** Filtered beads will have weight 0 and non filtered weight 1.  
**channelAndVector** Represents vector to bitwise multiple to the channelBackgroundFilter vector.

**Author(s)**

Vojtech Kulvait

**Examples**

```

if(require("blimaTestingData") && interactive())
{
  #To perform background correction on blimatesting object for two groups. Background correction is followed by
  data(blimatesting)
  #Prepare logical vectors corresponding to conditions A and E.
  groups1 = "A";
  groups2 = "E";
  sampleNames = list()
  c = list()
  for(i in 1:length(blimatesting))
  {
    p = pData(blimatesting[[i]]@experimentData$phenoData)
    c[[i]] = p$Group %in% c(groups1, groups2);
    sampleNames[[i]] = p$Name
  }
  #Background correction and quantile normalization followed by testing including log2TransformPositive transfo
  blimatesting = backgroundCorrect(blimatesting, normalizationMod=c, channelBackgroundFilter="bgf")
  blimatesting = nonPositiveCorrect(blimatesting, normalizationMod=c, channelCorrect="GrnF", channelBackground
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('bl
}

```

---

backgroundCorrectSingleArray

*Data background correction.*


---

**Description**

Background correction procedure selecting beads with background Intensity  $I_b$   $lmean - I_b | > k * SD(I_{bs})$  for exclusion, internal.

**Usage**

```
backgroundCorrectSingleArray(b, normalizationMod = NULL, channelBackground = "GrnB",
  k = 3, channelBackgroundFilter = "bgf", channelAndVector = NULL)
```

**Arguments**

**b** List of beadLevelData objects (or single object).

**normalizationMod** NULL for normalization of all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b or list of such vectors if b is a list of beadLevelData classes.

channelBackground  
Name of channel to normalize.

k  
Parameter of method stringency (default is 3).

channelBackgroundFilter  
Filtered beads will have weight 0 and non filtered weight 1.

channelAndVector  
Represents vector to bitwise multiple to the channelBackgroundFilter vector.

**Author(s)**

Vojtech Kulvait

---

backgroundChannelSubtract  
*Background channel subtraction*

---

**Description**

Function to subtract one channel from another producing new channel. Standard graphic subtraction.

**Usage**

```
backgroundChannelSubtract(b, normalizationMod = NULL, channelSubtractFrom = "GrnF",
  channelSubtractWhat = "GrnB", channelResult = "Grn")
```

**Arguments**

b  
List of beadLevelData objects (or single object).

normalizationMod  
NULL for performing on all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b or list of such vectors if b is a list of beadLevelData classes.

channelSubtractFrom  
Name of channel to subtract from.

channelSubtractWhat  
Name of channel to subtract.

channelResult  
Result channel, if this channel exists it will be overwritten.

**Author(s)**

Vojtech Kulvait

**Examples**

```

if(require("blimaTestingData") && interactive())
{
  #To perform background correction on blimatesting object for two groups. Background correction is followed by
  data(blimatesting)
  #Prepare logical vectors corresponding to conditions A and E.
  groups1 = "A";
  groups2 = "E";
  sampleNames = list()
  c = list()
  for(i in 1:length(blimatesting))
  {
    p = pData(blimatesting[[i]]@experimentData$phenoData)
    c[[i]] = p$Group %in% c(groups1, groups2);
    sampleNames[[i]] = p$Name
  }
  #Background correction and quantile normalization followed by testing including log2TransformPositive transfo
  blimatesting = bacgroundCorrect(blimatesting, normalizationMod=c, channelBackgroundFilter="bgf")
  blimatesting = nonPositiveCorrect(blimatesting, normalizationMod=c, channelCorrect="GrnF", channelBackground
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('bl
}

```

---

backgroundChannelSubtractSingleArray

*Background channel subtraction*


---

**Description**

INTERNAL FUNCTION Correction for positive values only

**Usage**

```

backgroundChannelSubtractSingleArray(b, normalizationMod = NULL,
  channelSubtractFrom = "GrnF", channelSubtractWhat = "GrnB",
  channelResult = "Grn")

```

**Arguments**

**b** List of beadLevelData objects (or single object).

**normalizationMod** NULL for normalization of all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b or list of such vectors if b is a list of beadLevelData classes.

**channelSubtractFrom** Name of channel to subtract from.

**channelSubtractWhat** Name of channel to subtract.

**channelResult** Result channel, if this channel exists it will be overwritten.

**Author(s)**

Vojtech Kulvait

---

channelExistsIntegrityWithLogicalVectorList  
*Internal function*

---

**Description**

Test existence of channel slot based on vector list

**Usage**

```
channelExistsIntegrityWithLogicalVectorList(b, spotsToCheck = NULL,
      slotToCheck, action = c("returnText", "warn", "error"))
```

**Arguments**

b	List of beadLevelData objects.
spotsToCheck	NULL for check all spots from b. Otherwise specifies logical vector of the length equals to the number of arrays in b with TRUE for checking.
slotToCheck	Slot name to check
action	What type of action is required in case of invalid object structure. Either return text different from TRUE, warn or error.

**Author(s)**

Vojtech Kulvait

---

checkIntegrity      *Internal function*

---

**Description**

Check integrity of the list of beadLevelData objects or single beadLevelData object returns waslist.

**Usage**

```
checkIntegrity(b, action = c("warn", "error"))
```

**Arguments**

b	List of beadLevelData objects or single.
action	What type of action is required in case of invalid object structure. Either return text different from TRUE, warn or error.



**Value**

Returns value if the object was list or not before calling this function.

**Author(s)**

Vojtech Kulvait

---

`checkIntegrityLogical` *Internal function*

---

**Description**

Check integrity of the list of logical objects, internal.

**Usage**

```
checkIntegrityLogical(xx, b, action = c("returnText", "warn",  
  "error"))
```

**Arguments**

<code>xx</code>	List of logical objects compatible with a list <code>b</code> .
<code>b</code>	List of <code>beadLevelData</code> objects.
<code>action</code>	What type of action is required in case of invalid object structure. Either return text different from TRUE, warn or error.

**Author(s)**

Vojtech Kulvait

---

`checkIntegrityOfListOfBeadLevelDataObjects`  
*Internal function*

---

**Description**

Check integrity of the list of `beadLevelData` objects, internal.

**Usage**

```
checkIntegrityOfListOfBeadLevelDataObjects(listb, action = c("returnText",  
  "warn", "error"))
```

**Arguments**

listb	List of beadLevelData objects.
action	What type of action is required in case of invalid object structure. Either return text different from TRUE, warn or error.

**Author(s)**

Vojtech Kulvait

---

checkIntegrityOfSingleBeadLevelDataObject  
*Internal function*

---

**Description**

Check integrity of single beadLevelData object, internal.

**Usage**

```
checkIntegrityOfSingleBeadLevelDataObject(b, action = c("returnText",
  "warn", "error"))
```

**Arguments**

b	beadLevelData object.
action	What type of action is required in case of invalid object structure. Either return text different from TRUE, warn or error.

**Author(s)**

Vojtech Kulvait

---

chipArrayStatistics *Statistics of beadLevelData*

---

**Description**

This function returns table with statistics of single beadLevelData object indexed by order of spots. It prints number of beads on each array spot mean foreground intensity and optionally mean background intensity, mean number of beads in probe set and unbiased estimate of standard deviations of these parameters. Optionally you can also obtain percentage of removed beads within excludeOnSDMultiple multiple of standard deviations from the background value.

**Usage**

```
chipArrayStatistics(b, includeBeadStatistic = TRUE, channelForeground = "GrnF",
  channelBackground = "GrnB", includeBackground = TRUE, excludedOnSDMultiple = NA)
```

**Arguments**

**b** Single beadLevelData object.

**includeBeadStatistic** Include number of beads per probe in output.

**channelForeground** Name of channel of foreground.

**channelBackground** Name of channel of background.

**includeBackground** Whether to output background data.

**excludedOnSDMultiple** If positive number, print how much percents of the background lies more than excludedOnSDMultiple multipliers of standard deviation estimate away from background mean.

**Author(s)**

Vojtech Kulvait

**Examples**

```
if(require("blimaTestingData") && interactive())
{
  #To print basic statistic data about blimatesting[[1]] object.
  data(blimatesting)
  array1stats = chipArrayStatistics(blimatesting[[1]], includeBeadStatistic=TRUE,
    excludedOnSDMultiple=3)
  array1pheno = pData(blimatesting[[1]]@experimentData$phenoData)
  array1stats = data.frame(array1pheno$Name, array1stats)
  colnames(array1stats)[1] <- "Array";
  print(array1stats);
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('bl.
}")
```

---

```
createSummarizedMatrix
```

*Summarized value matrix.*

---

**Description**

This function creates summarized matrix of values of certain type.

**Usage**

```
createSummarizedMatrix(b, spotsToProcess = NULL, quality = "qua",
  channelInclude = "bgf", annotationTag = NULL)
```

**Arguments**

**b** List of beadLevelData objects (or single object).

**spotsToProcess** NULL for processing all spots in b. Otherwise specifies logical vector of the length equals to the number of arrays in b.

**quality** Quality to matelize.

**channelInclude** This field allows user to set channel with weights which have to be from 0,1. All zero weighted items are excluded from summarization. You can turn this off by setting this NULL. This option may be used together with backgroundCorrect method or/and with beadarray QC (defaults to "bgf").

**annotationTag** Tag from annotation file which to use in resulting matrix as colname.

**Author(s)**

Vojtech Kulvait

**Examples**

```
if(require("blimaTestingData") && require("illuminaHumanv4.db") && interactive())
{
  #Create summarization of nonnormalized data from GrnF column.
  data(blimatesting)
  blimatesting = backgroundCorrect(blimatesting, channelBackgroundFilter="bgf")
  blimatesting = nonPositiveCorrect(blimatesting, channelCorrect="GrnF", channelBackgroundFilter="bgf", channelWeights="GrnF")
  #Prepare logical vectors corresponding to conditions A(groups1Mod), E(groups2Mod) and both(processingMod).
  nonnormalized = createSummarizedMatrix(blimatesting, quality="GrnF", channelInclude="bgf",
    annotationTag="Name")
  head(nonnormalized)
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('blimaTestingData')")
}
```

---

doAction

*Internal function*

---

**Description**

Performs action of certain type

**Usage**

```
doAction(message, action = c("returnText", "warn", "error"))
```

**Arguments**

message	Text message.
action	What type of action is required in case of invalid object structure. Either return text different from TRUE, warn or error.

**Author(s)**

Vojtech Kulvait

---

doProbeTTests	<i>T-test for probe level data.</i>
---------------	-------------------------------------

---

**Description**

This function does aggregated probe level t-tests on the data provided by the object beadLevelData from package beadarray.

**Usage**

```
doProbeTTests(b, c1, c2, quality = "qua", channelInclude = "bgf",
              correction = "BY", transformation = NULL)
```

**Arguments**

b	List of beadLevelData objects (or single object).
c1	List of logical vectors of data to assign to the first group (or single vector).
c2	List of logical vectors of data to assign to the second group (or single vector).
quality	Quality to analyze, default is "qua".
channelInclude	This field allows user to set channel with weights which have to be 0,1. All zero weighted items are excluded from t-test. You can turn this off by setting this NULL. This option may be used together with backgroundCorrect method or/and with beadarray QC (defaults to "bgf").
correction	Multiple testing adjustment method as defined by p.adjust function, default is "BY".
transformation	Function of input data transformation, default is NULL. Any function which for input value returns transformed value may be supplied. T-test then will be evaluated on transformed data, consider use log2TranformPositive.

**Author(s)**

Vojtech Kulvait

## Examples

```

if(require("blimaTestingData") && require("illuminaHumanv4.db") && interactive())
{
  #To perform background correction, variance stabilization and quantile normalization then test on probe level
  data(blimatesting)
  #Prepare logical vectors corresponding to conditions A(groups1Mod), E(groups2Mod) and both(processingMod).
  groups1 = "A";
  groups2 = "E";
  sampleNames = list()
  groups1Mod = list()
  groups2Mod = list()
  processingMod = list()
  for(i in 1:length(blimatesting))
  {
    p = pData(blimatesting[[i]]@experimentData$phenoData)
    groups1Mod[[i]] = p$Group %in% groups1;
    groups2Mod[[i]] = p$Group %in% groups2;
    processingMod[[i]] = p$Group %in% c(groups1, groups2);
    sampleNames[[i]] = p$Name
  }
  #Background correction and quantile normalization followed by testing including log2TransformPositive transform
  blimatesting = backgroundCorrect(blimatesting, normalizationMod =processingMod, channelBackgroundFilter="bgf")
  blimatesting = nonPositiveCorrect(blimatesting, normalizationMod=processingMod, channelCorrect="GrnF", channelQuality="GrnF", channelInclude="bgf", channelOutput="vst")
  blimatesting = varianceBeadStabilise(blimatesting, normalizationMod = processingMod,
    quality="GrnF", channelInclude="bgf", channelOutput="vst")
  blimatesting = quantileNormalize(blimatesting, normalizationMod = processingMod,
    channelNormalize="vst", channelOutput="qua", channelInclude="bgf")
  beadTest = doTTests(blimatesting, groups1Mod, groups2Mod, "qua", "bgf")
  probeTest = doProbeTTests(blimatesting, groups1Mod, groups2Mod, "qua", "bgf")
  adrToSymbol <- merge(toTable(illuminaHumanv4ARRAYADDRESS), toTable(illuminaHumanv4SYMBOLREANNOTATED))
  adrToSymbol <- adrToSymbol[,c("ArrayAddress", "SymbolReannotated") ]
  colnames(adrToSymbol) <- c("Array_Address_Id", "Symbol")
  probeTestID = probeTest[, "ProbeID"]
  beadTestID = beadTest[, "ProbeID"]
  probeTestFC = abs(probeTest[, "mean1"]-probeTest[, "mean2"])
  beadTestFC = abs(beadTest[, "mean1"]-beadTest[, "mean2"])
  probeTestP = probeTest[, "adjustedp"]
  beadTestP = beadTest[, "adjustedp"]
  probeTestMeasure = (1-probeTestP)*probeTestFC
  beadTestMeasure = (1-beadTestP)*beadTestFC
  probeTest = cbind(probeTestID, probeTestMeasure)
  beadTest = cbind(beadTestID, beadTestMeasure)
  colnames(probeTest) <- c("ArrayAddressID", "difexPL")
  colnames(beadTest) <- c("ArrayAddressID", "difexBL")
  tocmp <- merge(probeTest, beadTest)
  tocmp = merge(tocmp, adrToSymbol, by.x="ArrayAddressID", by.y="Array_Address_Id")
  tocmp = tocmp[, c("ArrayAddressID", "Symbol", "difexPL", "difexBL")]
  sortPL = sort(-tocmp[, "difexPL"], index.return=TRUE)$ix
  sortBL = sort(-tocmp[, "difexBL"], index.return=TRUE)$ix
  beadTop10 = tocmp[sortBL[1:10],]
  probeTop10 = tocmp[sortPL[1:10],]
  print(beadTop10)
}

```

```

    print(probeTop10)
  }else
  {
    print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('bl.
  }

```

doTTests

*T-test for bead (detector) level data.***Description**

This function does t-tests on the data provided by the object beadLevelData from package beadarray.

**Usage**

```
doTTests(b, c1, c2, quality = "qua", channelInclude = "bgf",
         correction = "BY", transformation = NULL)
```

**Arguments**

b	List of beadLevelData objects (or single object).
c1	List of logical vectors of data to assign to the first group (or single vector).
c2	List of logical vectors of data to assign to the second group (or single vector).
quality	Quality to analyze, default is "qua".
channelInclude	This field allows user to set channel with weights which have to be 0,1. All zero weighted items are excluded from t-test. You can turn this off by setting this NULL. This option may be used together with bacgroundCorrect method or/and with beadarray QC (defaults to "bgf").
correction	Multiple testing adjustment method as defined by p.adjust function, default is "BY".
transformation	Function of input data trasformation, default is NULL. Any function which for input value returns transformed value may be supplied. T-test then will be evaluated on transformed data, consider use log2TransformPositive.

**Author(s)**

Vojtech Kulvait

**Examples**

```

if(require("blimaTestingData") && require("illuminaHumanv4.db") && interactive())
{
  #To perform background correction, variance stabilization and quantile normalization then test on probe level
  data(blimatesting)
  #Prepare logical vectors corresponding to conditions A(groups1Mod), E(groups2Mod) and both(processingMod).
  groups1 = "A";
  groups2 = "E";

```

```

sampleNames = list()
groups1Mod = list()
groups2Mod = list()
processingMod = list()
for(i in 1:length(blimatesting))
{
  p = pData(blimatesting[[i]]@experimentData$phenoData)
  groups1Mod[[i]] = p$Group %in% groups1;
  groups2Mod[[i]] = p$Group %in% groups2;
  processingMod[[i]] = p$Group %in% c(groups1, groups2);
  sampleNames[[i]] = p$Name
}
#Background correction and quantile normalization followed by testing including log2TransformPositive transform
blimatesting = bacgroundCorrect(blimatesting, normalizationMod =processingMod, channelBackgroundFilter="bgf")
blimatesting = nonPositiveCorrect(blimatesting, normalizationMod=processingMod, channelCorrect="GrnF", channelBackgroundFilter="bgf")
blimatesting = varianceBeadStabilise(blimatesting, normalizationMod = processingMod,
  quality="GrnF", channelInclude="bgf", channelOutput="vst")
blimatesting = quantileNormalize(blimatesting, normalizationMod = processingMod,
  channelNormalize="vst", channelOutput="qua", channelInclude="bgf")
beadTest = doTTests(blimatesting, groups1Mod, groups2Mod, "qua", "bgf")
probeTest = doProbeTTests(blimatesting, groups1Mod, groups2Mod, "qua", "bgf")
adrToSymbol <- merge(toTable(illuminaHumanv4ARRAYADDRESS), toTable(illuminaHumanv4SYMBOLREANNOTATED))
adrToSymbol <- adrToSymbol[,c("ArrayAddress", "SymbolReannotated") ]
colnames(adrToSymbol) <- c("Array_Address_Id", "Symbol")
probeTestID = probeTest[, "ProbeID"]
beadTestID = beadTest[, "ProbeID"]
probeTestFC = abs(probeTest[, "mean1"]-probeTest[, "mean2"])
beadTestFC = abs(beadTest[, "mean1"]-beadTest[, "mean2"])
probeTestP = probeTest[, "adjustedp"]
beadTestP = beadTest[, "adjustedp"]
probeTestMeasure = (1-probeTestP)*probeTestFC
beadTestMeasure = (1-beadTestP)*beadTestFC
probeTest = cbind(probeTestID, probeTestMeasure)
beadTest = cbind(beadTestID, beadTestMeasure)
colnames(probeTest) <- c("ArrayAddressID", "difexPL")
colnames(beadTest) <- c("ArrayAddressID", "difexBL")
tocmp <- merge(probeTest, beadTest)
tocmp = merge(tocmp, adrToSymbol, by.x="ArrayAddressID", by.y="Array_Address_Id")
tocmp = tocmp[, c("ArrayAddressID", "Symbol", "difexPL", "difexBL")]
sortPL = sort(-tocmp[, "difexPL"], index.return=TRUE)$ix
sortBL = sort(-tocmp[, "difexBL"], index.return=TRUE)$ix
beadTop10 = tocmp[sortBL[1:10],]
probeTop10 = tocmp[sortPL[1:10],]
print(beadTop10)
print(probeTop10)
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('blimaTestingData')")
}

```

---



filterBg *Bg correct vector*

---

**Description**

Background correction procedure selecting beads with background Intensity  $I_b$   $|mean - I_b| > k * SD(I_b)$  for exclusion, internal.

**Usage**

```
filterBg(x, k = 3)
```

**Arguments**

x	Vector to correct
k	Parameter of method stringency (default is 3).

**Author(s)**

Vojtech Kulvait

---

getNextVector *Support probe and beadl level testing.*

---

**Description**

Internal function supporting probe and beadl level testing.

**Usage**

```
getNextVector(what, from, length)
```

**Arguments**

what	Two column sorted matrix with probe values.
from	Index to start on
length	nrow(what)

**Author(s)**

Vojtech Kulvait

---

initMeanDistribution    *initMeanDistribution*

---

**Description**

This is internal function not intended to direct use which initializes mean distribution.

**Usage**

```
initMeanDistribution(srt, prvku)
```

**Arguments**

srt	vector of sorted values
prvku	number of items in meanDistribution

**Author(s)**

Vojtech Kulvait

---

insertColumn    *Internal function to support chipArrayStatistics*

---

**Description**

Internal

**Usage**

```
insertColumn(matrix, column, name)
```

**Arguments**

matrix	Object to insert column to
column	Column to insert
name	Name of column to assign.

**Author(s)**

Vojtech Kulvait

---

log2TransformPositive *Log2 transform of numbers >1.*

---

### Description

Transformation function are popular in beadarray package. Here this is similar concept. This function allow user to perform log transformation before doing t-tests.

### Usage

```
log2TransformPositive(x)
```

### Arguments

x                    Number to transform.

### Value

This function returns logarithm of base 2 for numbers  $\geq 1$  and zero for numbers  $< 1$ .

### Author(s)

Vojtech Kulvait

### Examples

```
if(require("blimaTestingData") && require("illuminaHumanv4.db") && interactive())
{
  #To perform background correction, quantile normalization and then bead level t-test on log data run. Vst is no
  data(blimatesting)
  #Prepare logical vectors corresponding to conditions A(groups1Mod), E(groups2Mod) and both(c).
  groups1 = "A";
  groups2 = "E";
  sampleNames = list()
  groups1Mod = list()
  groups2Mod = list()
  c = list()
  for(i in 1:length(blimatesting))
  {
    p = pData(blimatesting[[i]]@experimentData$phenoData)
    groups1Mod[[i]] = p$Group %in% groups1;
    groups2Mod[[i]] = p$Group %in% groups2;
    c[[i]] = p$Group %in% c(groups1, groups2);
    sampleNames[[i]] = p$Name
  }
  #Background correction and quantile normalization followed by testing including log2TransformPositive transfo
  blimatesting = bacgroundCorrect(blimatesting, normalizationMod =c, channelBackgroundFilter="bgf")
  blimatesting = nonPositiveCorrect(blimatesting, normalizationMod=c, channelCorrect="GrnF", channelBackground
  blimatesting = quantileNormalize(blimatesting, normalizationMod=c, channelNormalize="GrnF", channelOutput="q
```

```

beadTest <- doTTests(blimatesting, groups1Mod, groups2Mod,
                    transformation=log2TransformPositive, quality="qua", channelInclude="bgf")
symbol2address <- merge(toTable(illuminaHumanv4ARRAYADDRESS), toTable(illuminaHumanv4SYMBOLREANNOTATED))
symbol2address <- symbol2address[,c("SymbolReannotated", "ArrayAddress") ]
colnames(symbol2address) <- c("Symbol", "ArrayAddressID")
beadTest = merge(beadTest, symbol2address, by.x="ProbeID", by.y="ArrayAddressID")
beadTestID = beadTest[,c("ProbeID", "Symbol")]
beadTestFC = abs(beadTest[, "mean1"]-beadTest[, "mean2"])
beadTestP = beadTest[, "adjustedp"]
beadTestMeasure = (1-beadTestP)*beadTestFC
beadTest = cbind(beadTestID, beadTestMeasure)
colnames(beadTest) <- c("ArrayAddressID", "Symbol", "difexBL")
sortBL = sort(-beadTest[, "difexBL"], index.return=TRUE)$ix
beadTop10 = beadTest[sortBL[1:10],]
print(beadTop10)
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('bl
}

```

---

meanDistribution

*Produce sorted double vector with mean distribution.*


---

## Description

This function processes arrays in the object `beadLevelData` from package `beadarray` and returns sorted double vector. The vector has length `prvku`. And the distribution of this vector is a "mean" of all distributions of `distributionChannel` quantity in arrays. In case that probe numbers are different from `prvku` it does some averaging.

## Usage

```
meanDistribution(b, normalizationMod = NULL, distributionChannel = "Grn",
               channelInclude = NULL, prvku)
```

## Arguments

**b** Object `beadLevelData` from package `beadarray` or list of these objects

**normalizationMod** NULL for normalization of all input `b`. Otherwise specifies logical vector of the length equals to the number of arrays in `b` or list of such vectors if `b` is a list of `beadLevelData` classes (defaults to NULL).

**distributionChannel** Channel to do mean distribution from (defaults to "Grn").

**channelInclude** This field allows user to set channel with weights which have to be in 0,1. All zero weighted items are excluded from quantile normalization and the value assigned to such probes is a close to value which would be assigned to them if not being excluded. You can turn this off by setting this NULL. This option

may be used together with backgroundCorrect method or/and with beadarray QC (defaults to NULL).

prvku Number of items in a resulting double vector. Prvku must not be more than minimal number of included items in any distributionChannel.

#### Author(s)

Vojtech Kulvait

---

nonParametricEstimator

*INTERNAL FUNCTION Xie background correct.*

---

#### Description

INTERNAL This function is not intended for direct use. Background correction according to non parametric estimator in Xie, Yang, Xinlei Wang, and Michael Story. "Statistical Methods of Background Correction for Illumina BeadArray Data." Bioinformatics 25, no. 6 (March 15, 2009): 751-57. doi:10.1093/bioinformatics/btp040. The method is applied on the bead level.

#### Usage

```
nonParametricEstimator(toCorrectAll, toCorrectNeg)
```

#### Arguments

toCorrectAll

toCorrectNeg

#### Author(s)

Vojtech Kulvait

---

nonPositiveCorrect

*Correct non positive*

---

#### Description

Correction for positive values only

#### Usage

```
nonPositiveCorrect(b, normalizationMod = NULL, channelCorrect = "GrnF",
  channelBackgroundFilter = "bgf", channelAndVector = NULL)
```

**Arguments**

**b** List of beadLevelData objects (or single object).

**normalizationMod** NULL for normalization of all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b or list of such vectors if b is a list of beadLevelData classes.

**channelCorrect** Name of channel to correct.

**channelBackgroundFilter** Filtered beads will have weight 0 and non filtered weight 1.

**channelAndVector** Represents vector to bitwise multiple to the channelBackgroundFilter vector.

**Author(s)**

Vojtech Kulvait

**Examples**

```

if(require("blimaTestingData") && interactive())
{
  #To perform background correction on blimatesting object for two groups. Background correction is followed by
  data(blimatesting)
  #Prepare logical vectors corresponding to conditions A and E.
  groups1 = "A";
  groups2 = "E";
  sampleNames = list()
  c = list()
  for(i in 1:length(blimatesting))
  {
    p = pData(blimatesting[[i]]@experimentData$phenoData)
    c[[i]] = p$Group %in% c(groups1, groups2);
    sampleNames[[i]] = p$Name
  }
  #Background correction and quantile normalization followed by testing including log2TransformPositive transfo
  blimatesting = bacgroundCorrect(blimatesting, normalizationMod=c, channelBackgroundFilter="bgf")
  blimatesting = nonPositiveCorrect(blimatesting, normalizationMod=c, channelCorrect="GrnF", channelBackground
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('bl
}

```

---

nonPositiveCorrectSingleArray

*Correct non positive*

---

**Description**

INTERNAL FUNCTION Correction for positive values only

**Usage**

```
nonPositiveCorrectSingleArray(b, normalizationMod = NULL, channelCorrect = "GrnF",  
channelBackgroundFilter = "bgf", channelAndVector = NULL)
```

**Arguments**

**b** List of beadLevelData objects (or single object).

**normalizationMod** NULL for normalization of all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b or list of such vectors if b is a list of beadLevelData classes.

**channelCorrect** Name of channel to correct.

**channelBackgroundFilter** Filtered beads will have weight 0 and non filtered weight 1.

**channelAndVector** Represents vector to bitwise multiple to the channelBackgroundFilter vector.

**Author(s)**

Vojtech Kulvait

---

numberOfDistributionElements  
*Internal*

---

**Description**

Internal function

**Usage**

```
numberOfDistributionElements(b, normalizationMod = NULL, channelInclude = NULL)
```

**Arguments**

**b** Object beadLevelData from package beadarray or list of these objects

**normalizationMod** NULL for normalization of all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b or list of such vectors if b is a list of beadLevelData classes.

**channelInclude**

**Author(s)**

Vojtech Kulvait

---

`performXieCorrection` *INTERNAL FUNCTION Xie background correct.*

---

**Description**

INTERNAL This function is not intended for direct use. Background correction according to non parametric estimator in Xie, Yang, Xinlei Wang, and Michael Story. "Statistical Methods of Background Correction for Illumina BeadArray Data." *Bioinformatics* 25, no. 6 (March 15, 2009): 751-57. doi:10.1093/bioinformatics/btp040. ###The method is applied on the bead level.

**Usage**

```
performXieCorrection(value, alpha, mu, sigma)
```

**Arguments**

value  
alpha  
mu  
sigma

**Author(s)**

Vojtech Kulvait

---

`plotBackgroundImageAfterCorrection`  
*Plot background image after correction*

---

**Description**

This function plots image of background distribution versus to foreground after background subtraction.

**Usage**

```
plotBackgroundImageAfterCorrection(b, index, channelForeground = "GrnF",  
channelBackground = "GrnB", SDMultiple = 3, includePearson = FALSE)
```



**Arguments**

b	Single beadLevelData object.
index	Index of spot to generate.
channelForeground	Name of channel of foreground.
channelBackground	Name of channel of background.
SDMultiple	Correct on this level.
includePearson	Include Pearson correlation.

**Author(s)**

Vojtech Kulvait

**Examples**

```
if(require("blimaTestingData") && interactive())
{
  #Write background images after correction. This function prints graph for condition D4. Call dev.off() to close
  data(blimatesting)
  p = pData(blimatesting[[2]]@experimentData$phenoData)
  index = base::match("D4", p$Name)
  plotBackgroundImageAfterCorrection(blimatesting[[2]], index)
}
else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('blimaTestingData')")
}
```

---

plotBackgroundImageBeforeCorrection

*Plot background image before correction*

---

**Description**

This function plots image of background distribution versus to foreground before background subtraction.

**Usage**

```
plotBackgroundImageBeforeCorrection(b, index, channelForeground = "GrnF",
  channelBackground = "GrnB", includePearson = FALSE)
```

**Arguments**

**b** Single beadLevelData object.  
**index** Index of spot to generate.  
**channelForeground** Name of channel of foreground.  
**channelBackground** Name of channel of background.  
**includePearson** Include Pearson correlation.

**Author(s)**

Vojtech Kulvait

**Examples**

```

if(require("blimaTestingData") && interactive())
{
  #Write background images before correction. This function prints graph for condition D4. Call dev.off() to close plot.
  data(blimatesting)
  p = pData(blimatesting[[2]]@experimentData$phenoData)
  index = base::match("D4", p$Name)
  plotBackgroundImageBeforeCorrection(blimatesting[[2]], index)
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('blimaTestingData')")
}

```

---

quantileNormalize      *Bead level quantile normalization.*

---

**Description**

This function does quantile normalization of object beadLevelData from package beadarray.

**Usage**

```

quantileNormalize(b, normalizationMod = NULL, channelNormalize = "Grn",
  channelOutput = "qua", channelInclude = NULL, dst)

```

**Arguments**

**b** Object beadLevelData from package beadarray or list of these objects  
**normalizationMod** NULL for normalization of all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b or list of such vectors if b is a list of beadLevelData classes.

channelNormalize	Name of channel to normalize.
channelOutput	Name of output normalized channel.
channelInclude	This field allows user to set channel with weights which have to be in 0,1. All zero weighted items are excluded from quantile normalization and the value assigned to such probes is a close to value which would be assigned to them if not being excluded. You can turn this off by setting this NULL. This option may be used together with backgroundCorrect method or/and with beadarray QC (defaults to NULL).
dst	User can specify sorted vector which represents distribution that should be assigned to items.

**Author(s)**

Vojtech Kulvait

**Examples**

```

if(require("blimaTestingData") && interactive())
{
  #To perform background correction, variance stabilization and quantile normalization.
  data(blimatesting)
  #Prepare logical vectors corresponding to conditions A(groups1Mod), E(groups2Mod) and both(c).
  groups1 = "A";
  groups2 = "E";
  sampleNames = list()
  processingMod = list()
  for(i in 1:length(blimatesting))
  {
    p = pData(blimatesting[[i]]@experimentData$phenoData)
    processingMod[[i]] = p$Group %in% c(groups1, groups2);
    sampleNames[[i]] = p$Name
  }
  #Background correction and quantile normalization followed by testing including log2TransformPositive transfo
  blimatesting = bacgroundCorrect(blimatesting, normalizationMod = processingMod, channelBackgroundFilter="bgf"
  blimatesting = nonPositiveCorrect(blimatesting, normalizationMod = processingMod, channelCorrect="GrnF", cha
  blimatesting = varianceBeadStabilise(blimatesting, normalizationMod = processingMod,
    quality="GrnF", channelInclude="bgf", channelOutput="vst")
  blimatesting = quantileNormalize(blimatesting, normalizationMod = processingMod,
    channelNormalize="vst", channelOutput="qua", channelInclude="bgf")
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('bl
}

```

---

readToVector	<i>Support doTTests function.</i>
--------------	-----------------------------------

---

**Description**

Internal function supporting doTTests function.

**Usage**

```
readToVector(what, from, length, quality)
```

**Arguments**

what	Item to read.
from	From index.
length	Length of vector.
quality	Column.

**Author(s)**

Vojtech Kulvait

---

selectedChannelTransform	<i>Channel transformation</i>
--------------------------	-------------------------------

---

**Description**

Function to transform channel data.

**Usage**

```
selectedChannelTransform(b, normalizationMod = NULL, channelTransformFrom,  
channelResult, transformation = NULL)
```

**Arguments**

b	List of beadLevelData objects (or single object).
normalizationMod	NULL for performing on all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b or list of such vectors if b is a list of beadLevelData classes.
channelTransformFrom	Name of channel to transform.

**channelResult** Result channel, if this channel exists it will be overwritten.

**transformation** Function of input data transformation, default is NULL. Any function which for input value returns transformed value may be supplied. T-test then will be evaluated on transformed data, consider use log2TranformPositive.

### Author(s)

Vojtech Kulvait

### Examples

```
if(require("blimaTestingData") && interactive())
{
  #To perform background correction on blimatesting object for two groups. Background correction is followed by
  data(blimatesting)
  #Prepare logical vectors corresponding to conditions A and E.
  groups1 = "A";
  groups2 = "E";
  sampleNames = list()
  c = list()
  for(i in 1:length(blimatesting))
  {
    p = pData(blimatesting[[i]]@experimentData$phenoData)
    c[[i]] = p$Group %in% c(groups1, groups2);
    sampleNames[[i]] = p$Name
  }
  #Background correction and quantile normalization followed by testing including log2TransformPositive transfo
  blimatesting = bacgroundCorrect(blimatesting, normalizationMod=c, channelBackgroundFilter="bgf")
  blimatesting = nonPositiveCorrect(blimatesting, normalizationMod=c, channelCorrect="GrnF", channelBackground
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('bl
}
```

---

selectedChannelTransformSingleArray  
*Channel transformation*

---

### Description

Function to transform channel data.

### Usage

```
selectedChannelTransformSingleArray(b, normalizationMod = NULL,
  channelTransformFrom, channelResult, transformation)
```

**Arguments**

b	List of beadLevelData objects (or single object).
normalizationMod	NULL for performing on all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b or list of such vectors if b is a list of beadLevelData classes.
channelTransformFrom	Name of channel to transform.
channelResult	Result channel, if this channel exists it will be overwritten.
transformation	Function of input data transformation, default is NULL. Any function which for input value returns transformed value may be supplied. T-test then will be evaluated on transformed data, consider use log2TranformPositive.

**Author(s)**

Vojtech Kulvait

---

singleArrayNormalize *Bead level quantile normalization.*

---

**Description**

This function does quantile normalization of object beadLevelData from package beadarray. Internal function not intended to direct use. Please use quantileNormalize.

**Usage**

```
singleArrayNormalize(b, normalizationMod = NULL, channelNormalize = "Grn",
  channelOutput = "qua", channelInclude = NULL, dst)
```

**Arguments**

b	Object beadLevelData from package beadarray
normalizationMod	NULL for normalization of all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b.
channelNormalize	Name of channel to normalize.
channelOutput	Name of output normalized channel.
channelInclude	This field allows user to set channel with weights which have to be in 0,1. All zero weighted items are excluded from quantile normalization and the value assigned to such probes is a close to value which would be assigned to them if not being excluded. You can turn this off by setting this NULL. This option may be used together with backgroundCorrect method or/and with beadarray QC (defaults to NULL).
dst	This field must be sorted. It is a distribution of values to assign to ports. By default this distribution is computed using meanDistribution function.

**Author(s)**

Vojtech Kulvait

---

singleChannelExistsIntegrityWithLogicalVector  
*Internal function*

---

**Description**

Test existence of channel slot based on logical list

**Usage**

```
singleChannelExistsIntegrityWithLogicalVector(b, spotsToCheck = NULL,  
slotToCheck, action = c("returnText", "warn", "error"))
```

**Arguments**

b	single beadLevelData object
spotsToCheck	NULL for check all spots from b. Otherwise specifies logical vector of the length equals to the number of arrays in b with TRUE for checking.
slotToCheck	Slot name to check
action	What type of action is required in case of invalid object structure. Either return text different from TRUE, warn or error.

**Author(s)**

Vojtech Kulvait

---

singleCheckIntegrityLogicalVector  
*Internal function*

---

**Description**

Check integrity of the logical object, internal.

**Usage**

```
singleCheckIntegrityLogicalVector(xx, b, action = c("returnText",  
"warn", "error"))
```

**Arguments**

<code>xx</code>	Logical object compatible with <code>b</code> .
<code>b</code>	Single <code>beadLevelData</code> object.
<code>action</code>	What type of action is required in case of invalid object structure. Either return text different from <code>TRUE</code> , <code>warn</code> or <code>error</code> .

**Author(s)**

Vojtech Kulvait

---

`singleNumberOfDistributionElements`  
*Internal*

---

**Description**

Internal function

**Usage**

```
singleNumberOfDistributionElements(b, normalizationMod = NULL,  
  channelInclude = NULL)
```

**Arguments**

<code>b</code>	Object <code>beadLevelData</code> from package <code>beadarray</code>
<code>normalizationMod</code>	<code>NULL</code> for normalization of all input <code>b</code> . Otherwise specifies logical vector of the length equals to the number of arrays in <code>b</code> or list of such vectors if <code>b</code> is a list of <code>beadLevelData</code> classes.
<code>channelInclude</code>	

**Author(s)**

Vojtech Kulvait



---

```
updateMeanDistribution
      updateMeanDistribution
```

---

**Description**

This is internal function not intended to direct use. Updates mean distribution.

**Usage**

```
updateMeanDistribution(meanDistribution, srt, arraysUsed)
```

**Arguments**

meanDistribution

srt                    vector of sorted values

arraysUsed            number of arrays already used to create distribution

**Author(s)**

Vojtech Kulvait

---

```
varianceBeadStabilise Bead level VST.
```

---

**Description**

This function does variance stabilising step on bead level.

**Usage**

```
varianceBeadStabilise(b, normalizationMod = NULL, quality = "qua",
  channelInclude = "bgf", channelOutput = "vst")
```

**Arguments**

b                      List of beadLevelData objects (or single object).

normalizationMod

NULL for normalization of all input b. Otherwise specifies logical vector of the length equal to the number of arrays in b or list of such vectors if b is a list of beadLevelData classes.

quality                Quality to analyze, default is "qua".

- channelInclude This field allows user to set channel with weights which have to be in 0,1. All zero weighted items are excluded from t-test. You can turn this off by setting this NULL. This option may be used together with bacgroundCorrect method or/and with beadarray QC (defaults to "bgf").
- channelOutput Output from VST.

**Author(s)**

Vojtech Kulvait

**Examples**

```

if(require("blimaTestingData") && interactive())
{
  #To perform background correction, variance stabilization and quantile normalization.
  data(blimatesting)
  #Prepare logical vectors corresponding to conditions A(groups1Mod), E(groups2Mod) and both(c).
  groups1 = "A";
  groups2 = "E";
  sampleNames = list()
  processingMod = list()
  for(i in 1:length(blimatesting))
  {
    p = pData(blimatesting[[i]]@experimentData$phenoData)
    processingMod[[i]] = p$Group %in% c(groups1, groups2);
    sampleNames[[i]] = p$Name
  }
  #Background correction and quantile normalization followed by testing including log2TransformPositive transfo
  blimatesting = bacgroundCorrect(blimatesting, normalizationMod = processingMod, channelBackgroundFilter="bgf"
  blimatesting = nonPositiveCorrect(blimatesting, normalizationMod = processingMod, channelCorrect="GrnF", cha
  blimatesting = varianceBeadStabilise(blimatesting, normalizationMod = processingMod,
    quality="GrnF", channelInclude="bgf", channelOutput="vst")
  blimatesting = quantileNormalize(blimatesting, normalizationMod = processingMod,
    channelNormalize="vst", channelOutput="qua", channelInclude="bgf")
}
else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('bl
}

```

---

varianceBeadStabiliseSingleArray

*Bead level VST.*

---

**Description**

This function is not intended to direct use it takes single beadLevelData object and do bead level variance stabilisation.

**Usage**

```
varianceBeadStabiliseSingleArray(b, normalizationMod = NULL,
  quality = "qua", channelInclude = "bgf", channelOutput = "vst")
```

**Arguments**

b	Object beadLevelData.
normalizationMod	NULL for normalization of all input b. Otherwise specifies logical vector of the length equals to the number of arrays in b.
quality	Quality to analyze, default is "qua".
channelInclude	This field allows user to set channel with weights which have to be in 0,1. All zero weighted items are excluded from t-test. You can turn this off by setting this NULL. This option may be used together with bacgroundCorrect method or/and with beadarray QC (defaults to "bgf").
channelOutput	Output from VST.

**Author(s)**

Vojtech Kulvait

---

vstFromLumi

*Function from LGPL lumi package 2.16.0*


---

**Description**

This function is derived from copy and paste of lumi::vst function. Since lumi package has extensive imports I decided to hardcode this function to the blima instead of importing lumi package.

**Usage**

```
vstFromLumi(u, std, nSupport = min(length(u), 500), backgroundStd = NULL,
  lowCutoff = 1/3)
```

**Arguments**

u	The mean of probe beads
std	The standard deviation of the probe beads
nSupport	Something for c3 guess.
backgroundStd	Estimate the background variance c3. Input should be variance according to article, not SD.
lowCutoff	Something for c3 guess.

**Author(s)**

authors are Pan Du, Simon Lin, the function was edited by Vojtech Kulvait

**References**

<http://www.bioconductor.org/packages/release/bioc/html/lumi.html>

---

writeBackgroundImages *Write Background Images*

---

**Description**

This function writes images with background distribution according to foreground before and after background subtraction.

**Usage**

```
writeBackgroundImages(b, spotsToGenerate = NULL, imageType = c("jpg",
  "png", "eps"), channelForeground = "GrnF", channelBackground = "GrnB",
  SDMmultiple = 3, includePearson = FALSE, outputDir = getwd(),
  width = 505, height = 505)
```

**Arguments**

b	Single beadLevelData object.
spotsToGenerate	NULL for generate images for all spots from b. Otherwise specifies logical vector of the length equals to the number of arrays in b with TRUE for images to generate.
imageType	Type of images produced, either jpg, png or eps
channelForeground	Name of channel of foreground.
channelBackground	Name of channel of background.
SDMultiple	Correct on this level.
includePearson	Include Pearson correlation.
outputDir	Directory where to output images.
width	Width of image (default 505 fits well for 86mm 150dpi illustration in Bioinformatics journal:)
height	Height of image

**Author(s)**

Vojtech Kulvait

**Examples**

```

if(require("blimaTestingData") && interactive())
{
  #Write background images before and after correction for background into /tmp directory. This function creates
  data(blimatesting)
  p = pData(blimatesting[[2]]@experimentData$phenoData)
  spotsToGenerate = p$Group %in% "D";
  writeBackgroundImages(blimatesting[[2]], imageType="jpg", spotsToGenerate=spotsToGenerate, includePearson=FALSE)
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('blimaTestingData')")
}

```

---

```
xieBackgroundCorrect  Xie background correct.
```

---

**Description**

Background correction according to non parametric estimator in Xie, Yang, Xinlei Wang, and Michael Story. "Statistical Methods of Background Correction for Illumina BeadArray Data." *Bioinformatics* 25, no. 6 (March 15, 2009): 751-57. doi:10.1093/bioinformatics/btp040.###The method is applied on the bead level.

**Usage**

```
xieBackgroundCorrect(b, normalizationMod = NULL, negativeArrayAddresses,
  channelCorrect, channelResult, channelInclude = NULL)
```

**Arguments**

**b** List of beadLevelData objects (or single object).

**normalizationMod** NULL for processing all spots in b. Otherwise specifies logical vector of the length equals to the number of arrays in b.

**negativeArrayAddresses** Vector of addresses of negative control probes on array

**channelCorrect** Slot to perform convolution correction.

**channelResult** Result channel, if this channel exists it will be overwritten.

**channelInclude** This field allows user to set channel with weights which have to be from 0,1. All zero weighted items are excluded from summarization. You can turn this off by setting this NULL. This option may be used together with backgroundCorrect method or/and with beadarray QC (defaults to NULL).

**Author(s)**

Vojtech Kulvait

**Examples**

```

if(require("blimaTestingData") && exists("annotationHumanHT12V4") && interactive())
{
  #Create vector of negative array addresses.
  negAdr = unique(annotationHumanHT12V4$Controls[annotationHumanHT12V4$Controls$Reporter_Group_Name=="negative"])
  #Create summarization of nonnormalized data from GrnF column.
  data(blimatesting)
  blimatesting = backgroundCorrect(blimatesting, channelBackgroundFilter="bgf")
  blimatesting = nonPositiveCorrect(blimatesting, channelCorrect="GrnF", channelBackgroundFilter="bgf", channelInclude="GrnF")
  blimatesting = xieBackgroundCorrect(blimatesting, negativeArrayAddresses=negAdr, channelCorrect="GrnF", channelInclude="GrnF")
  #Prepare logical vectors corresponding to conditions A(groups1Mod), E(groups2Mod) and both(processingMod).
  xiecorrected = createSummarizedMatrix(blimatesting, quality="GrnFXIE", channelInclude="bgf",
    annotationTag="Name")
  head(xiecorrected)
}else
{
  print("To run this example, please install blimaTestingData package from bioconductor by running biocLite('blimaTestingData')")
}

```

---

```
xieBackgroundCorrectSingleArray
```

*INTERNAL FUNCTION Xie background correct.*

---

**Description**

**INTERNAL** This function is not intended for direct use. Background correction according to non parametric estimator in Xie, Yang, Xinlei Wang, and Michael Story. "Statistical Methods of Background Correction for Illumina BeadArray Data." *Bioinformatics* 25, no. 6 (March 15, 2009): 751-57. doi:10.1093/bioinformatics/btp040. The method is applied on the bead level.

**Usage**

```
xieBackgroundCorrectSingleArray(b, normalizationMod = NULL, negativeArrayAddresses,
  channelCorrect, channelResult, channelInclude = NULL)
```

**Arguments**

**b** Single beadLevelData object.

**normalizationMod** NULL for processing all spots in b. Otherwise specifies logical vector of the length equals to the number of arrays in b.

**negativeArrayAddresses** Vector of addresses of negative control probes on array

**channelCorrect** Slot to perform convolution correction.

**channelResult** Result channel, if this channel exists it will be overwritten.

`channelInclude` This field allows user to set channel with weights which have to be from 0,1. All zero weighted items are excluded from summarization. You can turn this off by setting this NULL. This option may be used together with `backgroundCorrect` method or/and with `beadarray QC` (defaults to NULL).

**Author(s)**

Vojtech Kulvait

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