

# Package ‘flagme’

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**Title** Analysis of Metabolomics GC/MS Data

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**Depends** gcpikelite, xcms, CAMERA

**Imports** gplots, graphics, MASS, methods, SparseM, stats, utils

**Description** Fragment-level analysis of gas chromatography - mass spectrometry metabolomics data

**License** LGPL (>= 2)

**Collate** 0classes.R clusterAlignment.R init.R multipleAlignment.R peaksAlignment.R progressiveAlignment.R betweenAlignment.R dp.R metrics.R parse.R peaksDataset.R gatherInfo.R plotFragments.R rmaFitUnit.R addXCMSPeaks.R

**biocViews** DifferentialExpression, MassSpectrometry

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addAMDISPeaks	<i>Add AMDIS peak detection results</i>
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---

### Description

Reads ASCII ELU-format files (output from AMDIS) and attaches them to an already created peaksDataset object

### Usage

```
addAMDISPeaks(object, fns=dir(,"[Eu][Ll][Uu]"), verbose=TRUE, ...)
```

### Arguments

object	a peaksDataset object.
fns	character vector of same length as object@rawdata (user ensures the order matches)
verbose	whether to give verbose output, default TRUE
...	arguments passed on to parseELU

### Details

Repeated calls to parseELU to add peak detection results to the original peaksDataset object.

### Value

peaksDataset object

### Author(s)

Mark Robinson

### References

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

**See Also**[parseELU](#), [peaksDataset](#)**Examples**

```
# need access to CDF (raw data) and ELU files
require(gcspikelite)
gcmsPath<-paste(find.package("gcspikelite"), "data", sep="/")

# full paths to file names
cdfFiles<-dir(gcmsPath, "CDF", full=TRUE)
eluFiles<-dir(gcmsPath, "ELU", full=TRUE)

# create a peaksDataset object and add AMDIS peaks to it
pd<-peaksDataset(cdfFiles[1], mz=seq(50, 550), rtrange=c(7.5, 8.5))
pd<-addAMDISPeaks(pd, eluFiles[1])
```

---

addChromaTOFPeaks	<i>Add ChromaTOF peak detection results</i>
-------------------	---

---

**Description**

Reads ASCII tab-delimited format files (output from ChromaTOF) and attaches them to an already created peaksDataset object

**Usage**

```
addChromaTOFPeaks(object, fns=dir(, "[Tt][Xx][Tx]"), rtDivide=60, verbose=TRUE, ...)
```

**Arguments**

object	a peaksDataset object.
fns	character vector of same length as object@rawdata (user ensures the order matches)
rtDivide	number giving the amount to divide the retention times by.
verbose	whether to give verbose output, default TRUE
...	arguments passed on to parseChromaTOF

**Details**

Repeated calls to parseChromaTOF to add peak detection results to the original peaksDataset object.

**Value**

peaksDataset object

**Author(s)**

Mark Robinson

**References**

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

**See Also**

[parseChromaTOF](#), [peaksDataset](#)

**Examples**

```
# need access to CDF (raw data) and ChromaTOF files
require(gcspikelite)
gcmsPath<-paste(find.package("gcspikelite"), "data", sep="/")

# full paths to file names
cdfFiles<-dir(gcmsPath, "CDF", full=TRUE)
# [not run] cTofFiles<-dir(gcmsPath, "txt", full=TRUE)

# create a peaksDataset object and add ChromaTOF peaks to it
pd<-peaksDataset(cdfFiles[1], mz=seq(50, 550), rtrange=c(7.5, 8.5))
# [not run] pd<-addChromTOFPeaks(pd, ...)
```

---

addXCMSPeaks

*Add xcms/CAMERA peak detection results*

---

**Description**

Reads the raw data using xcms, group each extracted ion according to their retention time using CAMERA and attaches them to an already created peaksDataset object

**Usage**

```
addXCMSPeaks(files, object, peakPicking=c(cwt,mF), ...)
```

**Arguments**

files	character vector of same length as object@rawdata (user ensures the order matches)
object	a peaksDataset object.
peakPicking	Methods to use for peak detection. See details.
...	arguments passed on to xcmsSet and annotate

**Details**

Repeated calls to `xcmsSet` and `annotate` to perform peak-picking and deconvolution. The peak detection results are added to the original `peaksDataset` object. Two peak detection algorithms are available: continuous wavelet transform (`peakPicking=c('cwt')`) and the matched filter approach (`peakPicking=c('mF')`) described by Smith et al (2006). For further information consult the `xcms` package manual.

**Value**

`peaksDataset` object

**Author(s)**

Riccardo Romoli <[riccardo.romoli@unifi.it](mailto:riccardo.romoli@unifi.it)>

**See Also**

[peaksDataset](#) [findPeaks.matchedFilter](#) [findPeaks.centWave](#) [xcmsRaw-class](#)

**Examples**

```
# need access to CDF (raw data)
require(gcspikelite)
gcmsPath <- paste(find.package("gcspikelite"), "data", sep="/")

# full paths to file names
cdfFiles <- dir(gcmsPath, "CDF", full=TRUE)

# create a peaksDataset object and add XCMS peaks to it
pd <- peaksDataset(cdfFiles[1], mz=seq(50,550), rtrange=c(7.5,8.5))
pd <- addXCMSPeaks(cdfFiles[1], pd, peakPicking=c(cwt))
```

---

betweenAlignment

*Data Structure for "between" alignment of many GCMS samples*

---

**Description**

This function creates a "between" alignment (i.e. comparing merged peaks)

**Usage**

```
betweenAlignment(pD,cAList,pAList,impList,filterMin=3,gap=0.7,D=10,usePeaks=TRUE,df=30,verbose=TRUE)
```

**Arguments**

pD	a peaksDataset object
cAList	list of clusterAlignment objects, one for each experimental group
pAList	list of progressiveAlignment objects, one for each experimental group
impList	list of imputation lists
filterMin	minimum number of peaks within a merged peak to be kept in the analysis
gap	gap parameter
D	retention time penalty parameter
usePeaks	logical, whether to use peaks (if TRUE) or the full 2D profile alignment (if FALSE)
df	distance from diagonal to calculate similarity
verbose	logical, whether to print information

**Details**

betweenAlignment objects gives the data structure which stores the result of an alignment across several "pseudo" datasets. These pseudo datasets are constructed by merging the "within" alignments.

**Value**

betweenAlignment object

**Author(s)**

Mark Robinson

**References**

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

**See Also**

[multipleAlignment](#)

**Examples**

```
require(gcspikelite)
# see multipleAlignment
```

---

calcTimeDiffs	<i>Calculate retention time shifts from profile alignments</i>
---------------	--

---

## Description

This function takes the set of all pairwise profile alignments and use these to estimate retention time shifts between each pair of samples. These will then be used to normalize the retention time penalty of the signal peak alignment.

## Usage

```
calcTimeDiffs(pd, ca.full, verbose=TRUE)
```

## Arguments

pd	a peaksDataset object
ca.full	a clusterAlignment object, fit with
verbose	logical, whether to print out information

## Details

Using the set of profile alignments,

## Value

list of same length as ca.full@alignments with the matrices giving the retention time penalties.

## Author(s)

Mark Robinson

## References

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

## See Also

[peaksAlignment](#), [clusterAlignment](#)

## Examples

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"), "data", sep="/")
cdfFiles<-dir(gcmsPath, "CDF", full=TRUE)
eluFiles<-dir(gcmsPath, "ELU", full=TRUE)
```

```
# read data, peak detection results
pd<-peaksDataset(cdfFiles[1:2],mz=seq(50,550),rtrange=c(7.5,8.5))
pd<-addAMDISPeaks(pd,eluFiles[1:2])

# pairwise alignment using all scans
fullca<-clusterAlignment(pd, usePeaks = FALSE, df = 100)

# calculate retention time shifts
timedf<-calcTimeDiffs(pd, fullca)
```

---

clusterAlignment	<i>Data Structure for a collection of all pairwise alignments of GCMS runs</i>
------------------	--

---

### Description

Store the raw data and optionally, information regarding signal peaks for a number of GCMS runs

### Usage

```
clusterAlignment(pD,runs=1:length(pD@rawdata),timedf=NULL,usePeaks=TRUE,verbose=TRUE,...)
```

### Arguments

pD	a peaksDataset object.
runs	vector of integers giving the samples to calculate set of pairwise alignments over.
timedf	list (length = the number of pairwise alignments) of matrices giving the expected time differences expected at each pair of peaks (used with usePeaks=TRUE, passed to peaksAlignment)
usePeaks	logical, TRUE uses peakdata list, FALSE uses rawdata list for computing similarity.
verbose	logical, whether to print out info.
...	other arguments passed to peaksAlignment

### Details

clusterAlignment computes the set of pairwise alignments.

### Value

clusterAlignment object

### Author(s)

Mark Robinson



**References**

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

**See Also**

[peaksDataset](#), [peaksAlignment](#)

**Examples**

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"),"data",sep="/")
cdfFiles<-dir(gcmsPath,"CDF",full=TRUE)
eluFiles<-dir(gcmsPath,"ELU",full=TRUE)

# read data, peak detection results
pd<-peaksDataset(cdfFiles[1:2],mz=seq(50,550),rtrange=c(7.5,8.5))
pd<-addAMDISPeaks(pd,eluFiles[1:2])

ca<-clusterAlignment(pd, gap = .5,D=.05,df=30)
```

---

compress

*Compress an alignment object*

---

**Description**

Many of the peaks are not similar. So, the set of pairwise similarity matrices can be compressed.

**Usage**

```
compress(object, verbose=TRUE, ...)
decompress(object, verbose=TRUE, ...)
```

**Arguments**

object	a peaksAlignment, peaksAlignment or peaksAlignment object to be compressed
verbose	logical, whether to print out information
...	further arguments

**Details**

Using sparse matrix representations, a significant compression can be achieved. Here, we use the `matrix.csc` class of the `SparseM` package.

**Value**

an object of the same type as the input object

**Author(s)**

Mark Robinson

**References**

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

**See Also**

[peaksAlignment](#), [clusterAlignment](#), [progressiveAlignment](#)

**Examples**

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"),"data",sep="/")
cdfFiles<-dir(gcmsPath,"CDF",full=TRUE)
eluFiles<-dir(gcmsPath,"ELU",full=TRUE)

# read data, peak detection results
pd<-peaksDataset(cdfFiles[1:2],mz=seq(50,550),rtrange=c(7.5,8.5))
pd<-addAMDISPeaks(pd,eluFiles[1:2])

# pairwise alignment (it is compressed by default)
ca<-clusterAlignment(pd, usePeaks = TRUE, df = 20)
object.size(ca)

# decompress
ca<-decompress(ca)
object.size(ca)
```

---

dp

*Dynamic programming algorithm, given a similarity matrix*

---

**Description**

This function calls C code for a bare-bones dynamic programming algorithm, finding the best cost path through a similarity matrix.

**Usage**

```
dp(M, gap=.5, big=1000000000, verbose=FALSE)
```

### Arguments

M	similarity matrix
gap	penalty for gaps
big	large value used for matrix margins
verbose	logical, whether to print out information

### Details

This is a pretty standard implementation of a bare-bones dynamic programming algorithm, with a single gap parameter and allowing only simple jumps through the matrix (up, right or diagonal).

### Value

list with element match with the set of pairwise matches.

### Author(s)

Mark Robinson

### References

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

### See Also

[normDotProduct](#)

### Examples

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"),"data",sep="/")
cdfFiles<-dir(gcmsPath,"CDF",full=TRUE)
eluFiles<-dir(gcmsPath,"ELU",full=TRUE)

# read data, peak detection results
pd<-peaksDataset(cdfFiles[1:2],mz=seq(50,550),rtrange=c(7.5,8.5))
pd<-addAMDISPeaks(pd,eluFiles[1:2])

# similarity matrix
r<-normDotProduct(pd@peaksdata[[1]],pd@peaksdata[[2]])

# dynamic-programming-based matching of peaks
v<-dp(r,gap=.5)
```

---

eitherMatrix-class      *The eitherMatrix class*

---

### Description

A container to store either matrix or matrix.csc objects

### Author(s)

Mark Robinson

### References

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

### See Also

[peaksAlignment](#)

---

gatherInfo      *Gathers abundance informations from an alignment*

---

### Description

Given an alignment table (indices of matched peaks across several samples) such as that within a `progressiveAlignment` or `multipleAlignment` object, this routines goes through the raw data and collects the abundance of each fragment peak, as well as the retention times across the samples.

### Usage

```
gatherInfo(pD, obj, newind = NULL, method = c("apex"), findmzind = TRUE, useTIC = FALSE, top = NULL, inte
```

### Arguments

pD	a peaksDataset object, to get the abundance data from
obj	either a multipleAlignment or progressiveAlignment object
newind	list giving the
method	method used to gather abundance information, only apex implemented currently.
findmzind	logical, whether to take a subset of all m/z indices
useTIC	logical, whether to use total ion current for abundance summaries
top	only use the top top peaks
intensity.cut	percentage of the maximum intensity

**Details**

This procedure loops through the the table of matched peaks and gathers the

**Value**

Returns a list (of lists) for each row in the alignment table. Each list has 3 elements:

mz	a numerical vector of the m/z fragments used
rt	a numerical vector for the exact retention time of each peak across all samples
data	matrix of fragment intensities. If useTIC=TRUE, this matrix will have a single row

**Author(s)**

Mark Robinson

**References**

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

**See Also**

[imputePeaks](#)

**Examples**

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"), "data", sep="/")
cdfFiles<-dir(gcmsPath, "CDF", full=TRUE)
eluFiles<-dir(gcmsPath, "ELU", full=TRUE)

# read data, peak detection results
pd<-peaksDataset(cdfFiles[1:2], mz=seq(50, 550), rtrange=c(7.5, 8.5))
pd<-addAMDISPeaks(pd, eluFiles[1:2])

# multiple alignment
ma<-multipleAlignment(pd, c(1, 1), wn.gap=0.5, wn.D=.05, bw.gap=0.6, bw.D=.2, usePeaks=TRUE, filterMin=1, df=50, verbose=FALSE)

# gather apex intensities
d<-gatherInfo(pd, ma)

# table of retention times
nm<-list(paste("MP", 1:length(d), sep=""), c("S1", "S2"))
rts<-matrix(unlist(sapply(d, .subset, "rt")), byrow=TRUE, nc=2, dimnames=nm)
```

---

`imputePeaks`*Imputation of locations of peaks that were undetected*

---

### Description

Using the information within the peaks that are matched across several runs, we can impute the location of the peaks that are undetected in a subset of runs

### Usage

```
imputePeaks(pD, obj, type = 1, obj2 = NULL, filterMin = 3, verbose = TRUE)
```

### Arguments

<code>pD</code>	a <code>peaksDataset</code> object
<code>obj</code>	the alignment object, either <code>multipleAlignment</code> or <code>progressiveAlignment</code> , that is used to infer the unmatched peak locations
<code>type</code>	type of imputation to do, 1 for simple linear interpolation (default), 2 only works if <code>obj2</code> is a <code>clusterAlignment</code> object
<code>obj2</code>	a <code>clusterAlignment</code> object
<code>filterMin</code>	minimum number of peaks within a merged peak to impute
<code>verbose</code>	logical, whether to print out information

### Details

If you are aligning several samples and for a (small) subset of the samples in question, a peak is undetected, there is information within the alignment that can be useful in determining where the undetected peak is, based on the surrounding matched peaks. Instead of moving forward with missing values into the data matrices, this procedure goes back to the raw data and imputes the location of the apex (as well as the start and end), so that we do not need to bother with post-hoc imputation or removing data because of missing components.

We realize that imputation is prone to error and prone to attributing intensity from neighbouring peaks to the unmatched peak. We argue that this is still better than having to deal with these in statistical models after that fact. This may be an area of future improvement.

### Value

list with 3 elements `apex`, `start` and `end`, each masked matrices giving the scan numbers of the imputed peaks.

### Author(s)

Mark Robinson

**References**

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

**See Also**

[multipleAlignment](#), [progressiveAlignment](#), [peaksDataset](#)

**Examples**

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"),"data",sep="/")
cdfFiles<-dir(gcmsPath,"CDF",full=TRUE)
eluFiles<-dir(gcmsPath,"ELU",full=TRUE)

# read data, peak detection results
pd<-peaksDataset(cdfFiles[1:3],mz=seq(50,550),rtrange=c(7.5,8.5))
pd<-addAMDISPeaks(pd,eluFiles[1:3])

# alignments
ca<-clusterAlignment(pd, gap = .5,D=.05,df=30)
pa<-progressiveAlignment(pd, ca, gap = .6, D=.1,df=30)

v<-imputePeaks(pd,pa,filterMin=1)
```

---

multipleAlignment-class

*Data Structure for multiple alignment of many GCMS samples*

---

**Description**

Store the raw data and optionally, information regarding signal peaks for a number of GCMS runs

**Usage**

```
multipleAlignment(pd,group,bw.gap=0.8,wn.gap=0.6,bw.D=.20,wn.D=.05,filterMin=3,lite=FALSE,usePeaks=
```

**Arguments**

pd	a peaksDataset object
group	factor variable of experiment groups, used to guide the alignment algorithm
bw.gap	gap parameter for "between" alignments
wn.gap	gap parameter for "within" alignments
bw.D	distance penalty for "between" alignments
wn.D	distance penalty for "within" alignments

filterMin	minimum number of peaks within a merged peak to be kept in the analysis
lite	logical, whether to keep "between" alignment details (default, FALSE)
usePeaks	logical, whether to use peaks (if TRUE) or the full 2D profile alignment (if FALSE)
df	distance from diagonal to calculate similarity
verbose	logical, whether to print information
timeAdjust	logical, whether to use the full 2D profile data to estimate retention time drifts (Note: time required)
doImpute	logical, whether to impute the location of unmatched peaks

### Details

multipleAlignment is the data structure giving the result of an alignment across several GCMS runs. Multiple alignments are done progressively. First, all samples with the same `tg$Group` label will be aligned (denoted a "within" alignment). Second, each group will be summarized into a pseudo-data set, essentially a spectrum and retention time for each matched peak of the within-alignment. Third, these "merged peaks" are aligned in the same progressive manner, here called a "between" alignment.

### Value

multipleAlignment object

### Author(s)

Mark Robinson

### References

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

### See Also

[peaksDataset](#), [betweenAlignment](#), [progressiveAlignment](#)

### Examples

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"),"data",sep="/")
cdfFiles<-dir(gcmsPath,"CDF",full=TRUE)
eluFiles<-dir(gcmsPath,"ELU",full=TRUE)

# read data, peak detection results
pd<-peaksDataset(cdfFiles[1:2],mz=seq(50,550),rtrange=c(7.5,8.5))
pd<-addAMDISPeaks(pd,eluFiles[1:2])

# multiple alignment
ma<-multipleAlignment(pd,c(1,1),wn.gap=0.5,wn.D=.05,bw.gap=0.6,bw.D=.2,usePeaks=TRUE,filterMin=1,df=50,verbose=
```



---

normDotProduct	<i>Normalized Dot Product</i>
----------------	-------------------------------

---

### Description

This function calculates the similarity of all pairs of peaks from 2 samples, using the spectra similarity

### Usage

```
normDotProduct(x1, x2, t1=NULL, t2=NULL, df=max(ncol(x1), ncol(x2)), D=100000, timedf=NULL, verbose=FALSE)
```

### Arguments

x1	data matrix for sample 1
x2	data matrix for sample 2
t1	vector of retention times for sample 1
t2	vector of retention times for sample 2
df	distance from diagonal to calculate similarity
D	retention time penalty
timedf	matrix of time differences to normalize to. if NULL, 0 is used.
verbose	logical, whether to print out information

### Details

Efficiently computes the normalized dot product between every pair of peak vectors and returns a similarity matrix. C code is called.

### Value

matrix of similarities

### Author(s)

Mark Robinson

### References

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

### See Also

[dp](#), [peaksAlignment](#)

**Examples**

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"), "data", sep="/")
cdfFiles<-dir(gcmsPath, "CDF", full=TRUE)
eluFiles<-dir(gcmsPath, "ELU", full=TRUE)

# read data, peak detection results
pd<-peaksDataset(cdfFiles[1:2], mz=seq(50, 550), rtrange=c(7.5, 8.5))
pd<-addAMDISPeaks(pd, eluFiles[1:2])

r<-normDotProduct(pd@peaksdata[[1]], pd@peaksdata[[2]])
```

---

 parseChromaTOF

*Parser for ChromaTOF files*


---

**Description**

Reads ASCII ChromaTOF-format files from AMDIS (Automated Mass Spectral Deconvolution and Identification System)

**Usage**

```
parseChromaTOF(fn, min.pc=.01, mz=seq(85, 500), rt.cut=.008, rtrange=NULL, skip=1, rtDivide=60)
```

**Arguments**

fn	ChromaTOF filename to read.
min.pc	minimum percent of maximum intensity.
mz	vector of mass-to-charge bins of raw data table.
rt.cut	the difference in retention time, below which peaks are merged together.
rtrange	retention time range to parse peaks from, can speed up parsing if only interested in a small region (must be numeric vector of length 2)
skip	number of rows to skip at beginning of the ChromaTOF
rtDivide	multiplier to divide the retention times by (default: 60)

**Details**

parseChromaTOF will typically be called by `addChromaTOFPeaks`, not called directly.

Peaks that are detected within `rt.cut` are merged together. This avoids peaks which are essentially overlapping.

Fragments that are less than `min.pc` of the maximum intensity fragment are discarded.

**Value**

list with components peaks (table of spectra – rows are mass-to-charge and columns are the different detected peaks) and tab (table of features for each detection), according to what is stored in the ChromaTOF file.

**Author(s)**

Mark Robinson

**References**

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

**See Also**

[addAMDISPeaks](#)

**Examples**

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"),"data",sep="/")
tofFiles<-dir(gcmsPath,"tof",full=TRUE)

# parse ChromaTOF file
cToFList<-parseChromaTOF(tofFiles[1])
```

---

parseELU

*Parser for ELU files*

---

**Description**

Reads ASCII ELU-format files from AMDIS (Automated Mass Spectral Deconvolution and Identification System)

**Usage**

```
parseELU(f,min.pc=.01,mz=seq(50,550),rt.cut=.008,rtrange=NULL)
```

**Arguments**

f	ELU filename to read.
min.pc	minimum percent of maximum intensity.
mz	vector of mass-to-charge bins of raw data table.
rt.cut	the difference in retention time, below which peaks are merged together.
rtrange	retention time range to parse peaks from, can speed up parsing if only interested in a small region (must be numeric vector of length 2)

## Details

parseELU will typically be called by [addAMDISPeaks](#), not called directly.

Peaks that are detected within `rt.cut` are merged together. This avoids peaks which are essentially overlapping.

Fragments that are less than `min.pc` of the maximum intensity fragment are discarded.

## Value

list with components `peaks` (table of spectra – rows are mass-to-charge and columns are the different detected peaks) and `tab` (table of features for each detection), according to what is stored in the ELU file.

## Author(s)

Mark Robinson

## References

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

## See Also

[addAMDISPeaks](#)

## Examples

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"),"data",sep="/")
eluFiles<-dir(gcmsPath,"ELU",full=TRUE)

# parse ELU file
eluList<-parseELU(eluFiles[1])
```

---

peaksAlignment-class *Data Structure for pairwise alignment of 2 GCMS samples*

---

## Description

Store the raw data and optionally, information regarding signal peaks for a number of GCMS runs

## Usage

```
peaksAlignment(d1,d2,t1,t2,gap=.5,D=1000,timedf=NULL,df=30,verbose=TRUE,usePeaks=TRUE,compress=TRUE)
```

**Arguments**

d1	matrix of MS intensities for 1st sample (if doing a peak alignment, this contains peak apexes/areas; if doing a profile alignment, this contains scan intensities. Rows are m/z bins, columns are peaks/scans.
d2	matrix of MS intensities for 2nd sample
t1	vector of retention times for 1st sample
t2	vector of retention times for 2nd sample
gap	gap penalty for dynamic programming algorithm
D	time penalty (on same scale as retention time differences, t1 and t2)
timedf	list (length = the number of pairwise alignments) of matrices giving the expected time differences expected at each pair of peaks (used with usePeaks=TRUE.
df	integer, how far from the diagonal to go to calculate the similarity of peaks. Smaller value should run faster, but be careful not to choose too low.
verbose	logical, whether to print out info.
usePeaks	logical, TRUE uses peakdata list, FALSE uses rawdata list for computing similarity.
compress	logical, whether to compress the similarity matrix into a sparse format.

**Details**

peaksAlignment is a hold-all data structure of the raw and peak detection data.

**Value**

peaksAlignment object

**Author(s)**

Mark Robinson

**References**

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

**See Also**

[peaksDataset](#), [clusterAlignment](#)

**Examples**

```
# see clusterAlignment, it calls peaksAlignment
```

---

peaksDataset

*Data Structure for raw GCMS data and peak detection results*

---

## Description

Store the raw data and optionally, information regarding signal peaks for a number of GCMS runs

## Usage

```
peaksDataset(fns=dir(,"[Cc][Dd][Ff]"),verbose=TRUE,mz=seq(50,550),rtDivide=60,rtrange=NULL)
```

## Arguments

fns	character vector, filenames of raw data in CDF format.
verbose	logical, if TRUE then iteration progress information is output.
mz	vector giving bins of raw data table.
rtDivide	number giving the amount to divide the retention times by.
rtrange	retention time range to limit data to (must be numeric vector of length 2)

## Details

peaksDataset is a hold-all data structure of the raw and peak detection data.

## Value

peaksDataset object

## Author(s)

Mark Robinson

## References

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

## Examples

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"),"data",sep="/")
cdfFiles<-dir(gcmsPath,"CDF",full=TRUE)
eluFiles<-dir(gcmsPath,"ELU",full=TRUE)

# read data
pd<-peaksDataset(cdfFiles[1:2],mz=seq(50,550),rtrange=c(7.5,8.5))
show(pd)
```

---

plot.peaksDataset      *Plotting functions for GCMS data objects*

---

### Description

Store the raw data and optionally, information regarding signal peaks for a number of GCMS runs

### Usage

```
.plotpD(object, runs=1:length(object@rawdata), mzind=1:nrow(object@rawdata[[1]]),
        mind=NULL, plotSampleLabels=TRUE, calcGlobalMax=FALSE, peakCex = 0.8, plotPeaks=TRUE,
        plotPeakBoundaries=FALSE, plotPeakLabels=FALSE, plotMergedPeakLabels=TRUE, mlwd=3,
        usePeaks=TRUE, plotAcrossRuns=FALSE, overlap=F, rtrange=NULL, cols=NULL, thin=1,
        max.near=median(object@rawrt[[1]]), how.near=50, scale.up=1, ...)

.plotpA(object, xlab="Peaks - run 1", ylab="Peaks - run 2", plotMatches=TRUE, matchPch=19, matchLwd=3,
        matchCex=.5, matchCol="black", col=colorpanel(50, "black", "blue", "white"),
        breaks=seq(0,1,length=51), ...)

.plotcA(object, alignment=1, ...)
```

### Arguments

object	a peaksDataset, peaksAlignment or clusterAlignment object.
runs	for peaksDataset only: set of run indices to plot
mzind	for peaksDataset only: set of mass-to-charge indices to sum over (default, all)
mind	for peaksDataset only: matrix of aligned indices
plotSampleLabels	for peaksDataset only: logical, whether to display sample labels
calcGlobalMax	for peaksDataset only: logical, whether to calculate an overall maximum for scaling
peakCex	character expansion factor for peak labels
plotPeaks	for peaksDataset only: logical, whether to plot hashes for each peak
plotPeakBoundaries	for peaksDataset only: logical, whether to display peak boundaries
plotPeakLabels	for peaksDataset only: logical, whether to display peak labels
plotMergedPeakLabels	for peaksDataset only: logical, whether to display 'merged' peak labels
mlwd	for peaksDataset only: line width of lines indicating the alignment
usePeaks	for peaksDataset only: logical, whether to plot alignment of peaks (otherwise, scans)
plotAcrossRuns	for peaksDataset only: logical, whether to plot across peaks when unmatched peak is given

<code>overlap</code>	for <code>peaksDataset</code> only: logical, whether to plot TIC/XICs overlapping
<code>rtrange</code>	for <code>peaksDataset</code> only: vector of length 2 giving start and end of the X-axis
<code>cols</code>	for <code>peaksDataset</code> only: vector of colours (same length as the length of runs)
<code>thin</code>	for <code>peaksDataset</code> only: when <code>usePeaks=FALSE</code> , plot the alignment lines every <code>thin</code> values
<code>max.near</code>	for <code>peaksDataset</code> only: where to look for maximum
<code>how.near</code>	for <code>peaksDataset</code> only: how far away from <code>max.near</code> to look
<code>scale.up</code>	for <code>peaksDataset</code> only: a constant factor to scale the TICs
<code>plotMatches</code>	for <code>peaksDataset</code> only: logical, whether to plot matches
<code>xlab</code>	for <code>peaksAlignment</code> and <code>clusterAlignment</code> only: x-axis label
<code>ylab</code>	for <code>peaksAlignment</code> and <code>clusterAlignment</code> only: y-axis label
<code>matchPch</code>	for <code>peaksAlignment</code> and <code>clusterAlignment</code> only: match plotting character
<code>matchLwd</code>	for <code>peaksAlignment</code> and <code>clusterAlignment</code> only: match line width
<code>matchCex</code>	for <code>peaksAlignment</code> and <code>clusterAlignment</code> only: match character expansion factor
<code>matchCol</code>	for <code>peaksAlignment</code> and <code>clusterAlignment</code> only: match colour
<code>col</code>	for <code>peaksAlignment</code> and <code>clusterAlignment</code> only: vector of colours for <code>colourscale</code>
<code>breaks</code>	for <code>peaksAlignment</code> and <code>clusterAlignment</code> only: vector of breaks for <code>colourscale</code>
<code>alignment</code>	for <code>peaksAlignment</code> and <code>clusterAlignment</code> only: the set of alignments to plot
<code>...</code>	further arguments passed to the plot or image command

### Details

For `peakDataset` objects, each TIC is scale to the maximum value (as specified by the `how.near` and `max.near` values). The many parameters gives considerable flexibility of how the TICs can be visualized.

For `peakAlignment` objects, the similarity matrix is plotted and optionally, the set of matching peaks. `clusterAlignment` objects are just a collection of all pairwise `peakAlignment` objects.

### Author(s)

Mark Robinson

### References

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

### See Also

[plotImage](#), [peaksDataset](#)



## Examples

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"), "data", sep="/")
cdfFiles<-dir(gcmsPath, "CDF", full=TRUE)
eluFiles<-dir(gcmsPath, "ELU", full=TRUE)

# read data
pd<-peaksDataset(cdfFiles[1:3], mz=seq(50, 550), rtrange=c(7.5, 8.5))

# image plot
plot(pd, rtrange=c(7.5, 8.5), plotPeaks=TRUE, plotPeakLabels=TRUE)
```

---

plotImage

*Plot of images of GCMS data*

---

## Description

Image plots (i.e. 2D heatmaps) of raw GCMS profile data

## Usage

```
plotImage(object, run=1, rtrange=c(11, 13), main=NULL, mzrange=c(50, 200), SCALE=log2, ...)
```

## Arguments

object	a peaksDataset object
run	index of the run to plot an image for
rtrange	vector of length 2 giving start and end of the X-axis (retention time)
main	main title (auto-constructed if not specified)
mzrange	vector of length 2 giving start and end of the Y-axis (mass-to-charge ratio)
SCALE	function called to scale the data (default: log2)
...	further arguments passed to the image command

## Details

For peakDataset objects, each TIC is scale to the maximum value (as specified by the how.near and max.near values). The many parameters gives considerable flexibility of how the TICs can be visualized.

For peakAlignment objects, the similarity matrix is plotted and optionally, the set of matching peaks. clusterAlignment objects are just a collection of all pairwise peakAlignment objects.

## Author(s)

Mark Robinson

**References**

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

**See Also**

[plot](#), [peaksDataset](#)

**Examples**

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"), "data", sep="/")
cdfFiles<-dir(gcmsPath, "CDF", full=TRUE)
eluFiles<-dir(gcmsPath, "ELU", full=TRUE)

# read data
pd<-peaksDataset(cdfFiles[1], mz=seq(50, 550), rtrange=c(7.5, 8.5))

# image plot
plotImage(pd, run=1, rtrange=c(7.5, 8.5), main="")
```

---

progressiveAlignment-class

*Data Structure for progressive alignment of many GCMS samples*

---

**Description**

Performs a progressive peak alignment (clustalw style) of multiple GCMS peak lists

**Usage**

```
progressiveAlignment(pd, cA, D=1000, gap=.5, verbose=TRUE, usePeaks=TRUE, df=30, compress=TRUE)
```

**Arguments**

pd	a peaksDataset object
cA	a clusterAlignment object
D	retention time penalty
gap	gap parameter
verbose	logical, whether to print information
usePeaks	logical, whether to use peaks (if TRUE) or the full 2D profile alignment (if FALSE)
df	distance from diagonal to calculate similarity
compress	logical, whether to store the similarity matrices in sparse form

## Details

The progressive peak alignment we implemented here for multiple GCMS peak lists is analogous to how `clustalw` takes a set of pairwise sequence alignments and progressively builds a multiple alignment. More details can be found in the reference below.

## Value

progressiveAlignment object

## Author(s)

Mark Robinson

## References

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

## See Also

[peaksDataset](#), [multipleAlignment](#)

## Examples

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"),"data",sep="/")
cdfFiles<-dir(gcmsPath,"CDF",full=TRUE)
eluFiles<-dir(gcmsPath,"ELU",full=TRUE)

# read data, peak detection results
pd<-peaksDataset(cdfFiles[1:2],mz=seq(50,550),rtrange=c(7.5,8.5))
pd<-addAMDISPeaks(pd,eluFiles[1:2])

ca<-clusterAlignment(pd, gap = .5,D=.05,df=30)
pa<-progressiveAlignment(pd, ca, gap = .6, D=.1,df=30)
```

---

rmaFitUnit

*Fits a robust linear model (RLM) for one metabolite*

---

## Description

Using `r1m` from MASS, this procedure fits a linear model using all the fragments

## Usage

```
rmaFitUnit(u,maxit=5,mzEffect=TRUE,cls=NULL,fitSample=TRUE,fitOrCoef=c("coef","fit"),TRANSFORM=log)
```

## Arguments

<code>u</code>	a metabolite unit (list object with vectors <code>mz</code> and <code>rt</code> for <code>m/z</code> and retention times, respectively and a data element giving the fragmentxsample intensity matrix)
<code>maxit</code>	maximum number of iterations (default: 5)
<code>mzEffect</code>	logical, whether to fit <code>m/z</code> effect (default: TRUE)
<code>cls</code>	class variable
<code>fitSample</code>	whether to fit individual samples (alternative is fit by group)
<code>fitOrCoef</code>	whether to return a vector of coefficients (default: "coef"), or an <code>rlm</code> object ("fit")
<code>TRANSFORM</code>	function to transform the raw data to before fitting (default: log2)

## Details

Fits a robust linear model.

## Value

list giving elements of fragment and sample coefficients (if `fitOrCoef="coef"`) or a list of elements from the fitting process (if `fitOrCoef="fit"`)

## Author(s)

Mark Robinson

## References

Mark D Robinson (2008). Methods for the analysis of gas chromatography - mass spectrometry data *PhD dissertation* University of Melbourne.

## See Also

[peaksAlignment](#), [clusterAlignment](#)

## Examples

```
require(gcspikelite)

# paths and files
gcmsPath<-paste(find.package("gcspikelite"),"data",sep="/")
cdfFiles<-dir(gcmsPath,"CDF",full=TRUE)
eluFiles<-dir(gcmsPath,"ELU",full=TRUE)

# read data, peak detection results
pd<-peaksDataset(cdfFiles[1:2],mz=seq(50,550),rtrange=c(7.5,8.5))
pd<-addAMDISPeaks(pd,eluFiles[1:2])

# pairwise alignment using all scans
fullca<-clusterAlignment(pd, usePeaks = FALSE, df = 100)
```

```
# calculate retention time shifts  
timedf<-calcTimeDiffs(pd, fullca)
```

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