

# Package ‘DIAAlignR’

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**Type** Package

**Title** Dynamic Programming Based Alignment of MS2 Chromatograms

**Version** 2.0.0

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## Description

To obtain unbiased proteome coverage from a biological sample, mass-spectrometer is operated in Data Independent Acquisition (DIA) mode. Alignment of these DIA runs establishes consistency and less missing values in complete data-matrix. This package implements dynamic programming with affine gap penalty based approach for pair-wise alignment of analytes. A hybrid approach of global alignment (through MS2 features) and local alignment (with MS2 chromatograms) is implemented in this tool.

**License** GPL-3

**Encoding** UTF-8

**LazyData** false

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**biocViews** MassSpectrometry, Metabolomics, Proteomics, Alignment, Software

**Depends** methods, stats, R (>= 4.0)

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**Suggests** knitr, akima, lattice, scales, gridExtra, latticeExtra, rmarkdown, BiocStyle, BiocParallel, testthat (>= 2.1.0)

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**BugReports** <https://github.com/shubham1637/DIAAlignR/issues>

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---

AffineAlignObj-class *An S4 object for class AffineAlignObj*

---

**Description**

*s* is a point-wise similarity matrix between signalA and signalB. Intermediate matrices M,A,B are calculated from *s* for affine-alignment. Each cell of the Traceback matrix has coordinate of its parent cell. path matrix is a binary matrix with ones indicating path of maximum cumulative score. GapOpen and GapExten are gap-opening and gap-extension penalties used by affine alignment algorithm. indexA\_aligned and indexB\_aligned are aligned indices of signalA and SignalB. The cumulative alignment score is in score vector.

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License: (c) Author (2019) + GPL-3 Date: 2019-12-14

**See Also**

[doAffineAlignmentCpp](#)

AffineAlignObjLight-class

*An S4 object for class AffineAlignObjLight It only contains aligned indices.*

**Description**

indexA\_aligned and indexB\_aligned are aligned indices of signalA and SignalB. The cumulative alignment score is in score vector.

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**See Also**

[doAffineAlignmentCpp](#)

AffineAlignObjMedium-class

*An S4 object for class AffineAlignObjMedium. It only contains similarity matrix and aligned indices.*

**Description**

s is a point-wise similarity matrix between signalA and signalB. path matrix is a binary matrix with ones indicating path of maximum cumulative score. GapOpen and GapExten are gap-opening and gap-extension penalties used by affine alignment algorithm. indexA\_aligned and indexB\_aligned are aligned indices of signalA and SignalB. The cumulative alignment score is in score vector.

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**See Also**

[doAffineAlignmentCpp](#)

---

alignChromatogramsCpp *Aligns MS2 extracted-ion chromatograms(XICs) pair.*

---

**Description**

Aligns MS2 extracted-ion chromatograms(XICs) pair.

**Usage**

```
alignChromatogramsCpp(  
  l1,  
  l2,  
  alignType,  
  tA,  
  tB,  
  normalization,  
  simType,  
  B1p = 0,  
  B2p = 0,  
  noBeef = 0L,  
  goFactor = 0.125,  
  geFactor = 40,  
  cosAngleThresh = 0.3,  
  OverlapAlignment = TRUE,  
  dotProdThresh = 0.96,  
  gapQuantile = 0.5,  
  kerLen = 9L,  
  hardConstrain = FALSE,  
  samples4gradient = 100,  
  objType = "heavy"  
)
```

**Arguments**

- l1 (list) A list of numeric vectors. l1 and l2 should have same length.
- l2 (list) A list of numeric vectors. l1 and l2 should have same length.

alignType	(char) A character string. Available alignment methods are "global", "local" and "hybrid".
tA	(numeric) A numeric vector. This vector has equally spaced timepoints of XIC A.
tB	(numeric) A numeric vector. This vector has equally spaced timepoints of XIC B.
normalization	(char) A character string. Normalization must be selected from (L2, mean or none).
simType	(char) A character string. Similarity type must be selected from (dotProductMasked, dotProduct, cosineAngle, cosine2Angle, euclideanDist, covariance, correlation, crossCorrelation). Mask = $s > \text{quantile}(s, \text{dotProdThresh})$ AllowDotProd = $[\text{Mask} \times \text{cosine2Angle} + (1 - \text{Mask})] > \text{cosAngleThresh}$ $s_{\text{new}} = s \times \text{AllowDotProd}$
B1p	(numeric) Timepoint mapped by global fit for tA[1].
B2p	(numeric) Timepoint mapped by global fit for tA[length(tA)].
noBeef	(integer) It defines the distance from the global fit, upto which no penalization is performed. The window length = $2 * \text{noBeef}$ .
goFactor	(numeric) Penalty for introducing first gap in alignment. This value is multiplied by base gap-penalty.
geFactor	(numeric) Penalty for introducing subsequent gaps in alignment. This value is multiplied by base gap-penalty.
cosAngleThresh	(numeric) In simType = dotProductMasked mode, angular similarity should be higher than cosAngleThresh otherwise similarity is forced to zero.
OverlapAlignment	(logical) An input for alignment with free end-gaps. False: Global alignment, True: overlap alignment.
dotProdThresh	(numeric) In simType = dotProductMasked mode, values in similarity matrix higher than dotProdThresh quantile are checked for angular similarity.
gapQuantile	(numeric) Must be between 0 and 1. This is used to calculate base gap-penalty from similarity distribution.
kerLen	(integer) In simType = crossCorrelation, length of the kernel used to sum similarity score. Must be an odd number.
hardConstrain	(logical) if false; indices farther from noBeef distance are filled with distance from linear fit line.
samples4gradient	(numeric) This parameter modulates penalization of masked indices.
objType	(char) A character string. Must be either light, medium or heavy.

**Value**

affineAlignObj (S4class) A S4class object from C++ AffineAlignObj struct.

**Author(s)**

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**Examples**

```
data(XIC_QFNNTDIVLLEDFQK_3_DIAAlignR, package="DIAAlignR")
XICs <- XIC_QFNNTDIVLLEDFQK_3_DIAAlignR
data(oswFiles_DIAAlignR, package="DIAAlignR")
oswFiles <- oswFiles_DIAAlignR
XICs.ref <- XICs[["hroest_K120809_Strep0%PlasmaBiolRep12_R04_SW_filt"]][["4618"]]
XICs.exp <- XICs[["hroest_K120809_Strep10%PlasmaBiolRep12_R04_SW_filt"]][["4618"]]
tVec.ref <- XICs.ref[[1]][["time"]] # Extracting time component
tVec.exp <- XICs.exp[[1]][["time"]] # Extracting time component
B1p <- 4964.752
B2p <- 5565.462
noBeef <- 77.82315/3.414
l1 <- lapply(XICs.ref, `[`, 2)
l2 <- lapply(XICs.exp, `[`, 2)
AlignObj <- alignChromatogramsCpp(l1, l2, alignType = "hybrid", tA = tVec.ref, tB = tVec.exp,
normalization = "mean", simType = "dotProductMasked", B1p = B1p, B2p = B2p, noBeef = noBeef,
goFactor = 0.125, geFactor = 40, cosAngleThresh = 0.3, OverlapAlignment = TRUE,
dotProdThresh = 0.96, gapQuantile = 0.5, hardConstrain = FALSE, samples4gradient = 100,
objType = "light")
```

---

AlignObj-class

*An S4 object for class AlignObj*


---

**Description**

s is a point-wise similarity matrix between signalA and signalB. Intermediate matrices M is calculated from s for alignment. Each cell of the Traceback matrix has coordinate of its parent cell. path matrix is a binary matrix with ones indicating path of maximum cumulative score. GapOpen and GapExten are gap-opening and gap-extension penalties used by alignment algorithm. They must be the same. indexA\_aligned and indexB\_aligned are aligned indices of signalA and SignalB. The cumulative alignment score is in score vector.

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**See Also**

[doAlignmentCpp](#)

---

alignObj\_DIAAlignR      *Alignment object of a peptide.*

---

### Description

Aligned XICs of peptide (ID = 4618) 14299\_QFNNTDIVLLEDFQK/3 across two SWATH runs:

run1 : hroest\_K120809\_Strep0%PlasmaBiolRepl2\_R04\_SW\_filt.chrom.mzML

run2 : hroest\_K120809\_Strep10%PlasmaBiolRepl2\_R04\_SW\_filt.chrom.mzML

### Usage

```
alignObj_DIAAlignR
```

### Format

**A** S4 object of 16 slots:

**s** similarity score matrix.

**M** Match or Mismatch matrix, residues of A and B are aligned without a gap.  $M(i,j)$  = Best score upto (i,j) given  $A_i$  is aligned to  $B_j$ .

**A** Insert in sequence A, residue in A is aligned to gap in B.  $A(i,j)$  is the best score given that  $A_i$  is aligned to a gap in B.

**B** Insert in sequence B, residue in B is aligned to gap in A.  $B(i,j)$  is the best score given that  $B_j$  is aligned to a gap in A.

**Traceback** Traceback matrices store source matrix name and direction as matrices are filled with dynamic programming.

**path** Path matrix would represent alignment path through similarity matrix as binary-hot encoding.

**signalA\_len** Number of data-points in signal A.

**signalB\_len** Number of data-points in signal B.

**GapOpen** Penalty for Gap opening. For n consecutive gaps:  $\text{Penalty} = \text{GapOpen} + (n-1)*\text{GapExten}$ .

**GapExten** Penalty for Gap extension. For n consecutive gaps:  $\text{Penalty} = \text{GapOpen} + (n-1)*\text{GapExten}$ .

**FreeEndGaps** True for Overlap alignment.

**indexA\_aligned** Aligned signalA indices after affine alignment.

**indexB\_aligned** Aligned signalB indices after affine alignment.

**score** Cumulative score along the aligned path.

**simScore\_forw** Not needed, will be removed.

**nGaps** Total number of gaps in the alignment path.

### Source

C++ code is explained at [DIAAlign namespace](#). File test\_GenerateData.R has [source code](#) to generate the example data.



---

alignTargetedRuns      *Outputs intensities for each analyte from aligned Targeted-MS runs*

---

### Description

This function expects osw and xics directories at dataPath. It first reads osw files and fetches chromatogram indices for each analyte. It then align XICs of its reference XICs. Best peak, which has lowest m-score, about the aligned retention time is picked for quantification.

### Usage

```
alignTargetedRuns(  
  dataPath,  
  outFile = "DIAAlignR",  
  params = paramsDIAAlignR(),  
  oswMerged = TRUE,  
  runs = NULL,  
  refRun = NULL,  
  applyFun = lapply  
)
```

### Arguments

dataPath	(string) path to xics and osw directory.
outFile	(string) name of the output file.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
runs	(a vector of string) names of xics file without extension.
refRun	(string) reference for alignment. If no run is provided, m-score is used to select reference run.
applyFun	(function) value must be either lapply or BiocParallel::bplapply.

### Value

An output table with following columns: precursor, run, intensity, RT, leftWidth, rightWidth, peak\_group\_rank, m\_score, alignment\_rank, peptide\_id, sequence, charge, group\_label.

### Author(s)

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**References**

Gupta S, Ahadi S, Zhou W, Röst H. "DIAAlignR Provides Precise Retention Time Alignment Across Distant Runs in DIA and Targeted Proteomics." *Mol Cell Proteomics*. 2019 Apr;18(4):806-817. doi: <https://doi.org/10.1074/mcp.TIR118.001132> Epub 2019 Jan 31.

**See Also**

[getRunNames](#), [getFeatures](#), [setAlignmentRank](#), [getMultipeptide](#)

**Examples**

```
params <- paramsDIAAlignR()
params[["context"]] <- "experiment-wide"
dataPath <- system.file("extdata", package = "DIAAlignR")
BiocParallel::register(BiocParallel::MulticoreParam(workers = 4, progressBar = TRUE))
alignTargetedRuns(dataPath, outFile = "testDIAAlignR", params = params, applyFun = BiocParallel::bplapply)
```

---

areaIntegrator	<i>Calculates area between signal-boundaries.</i>
----------------	---

---

**Description**

This function sums all the intensities between left-index and right-index.

**Usage**

```
areaIntegrator(
  l1,
  l2,
  left,
  right,
  integrationType,
  baselineType,
  fitEMG,
  baseSubtraction
)
```

**Arguments**

l1	(list) A list of time vectors.
l2	(list) A list of intensity vectors.
left	(numeric) left boundary of the peak.
right	(numeric) right boundary of the peak.
integrationType	(string) method to compute the area of a peak contained in XICs. Must be from "intensity_sum", "trapezoid", "simpson".

baselineType (string) method to estimate the background of a peak contained in XICs. Must be from "base\_to\_base", "vertical\_division\_min", "vertical\_division\_max".

fitEMG (logical) enable/disable exponentially modified gaussian peak model fitting.

baseSubtraction (logical) TRUE: remove background from peak signal using estimated noise levels.

**Value**

area (numeric).

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**Examples**

```
data("XIC_QFNNTDIVLLEDFQK_3_DIAAlignR", package = "DIAAlignR")
XICs <- XIC_QFNNTDIVLLEDFQK_3_DIAAlignR[["hroest_K120809_Strep0%PlasmaBiolRep12_R04_SW_filt"]][["4618"]]
l1 <- lapply(XICs, `[[`, 1)
l2 <- lapply(XICs, `[[`, 2)
areaIntegrator(l1, l2, left = 5203.7, right = 5268.5, "intensity_sum", "base_to_base", FALSE, TRUE)
# 66.10481 69.39996 46.53095 16.34266 13.13564 13.42331
```

---

as.list,AffineAlignObj-method

*Converts instances of class AffineAlignObj into list*

---

**Description**

Converts instances of class AffineAlignObj into list

**Usage**

```
## S4 method for signature 'AffineAlignObj'
as.list(x)
```

**Arguments**

x An object of class AffineAlignObj.

**Value**

list

**Author(s)**

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---

as.list,AffineAlignObjLight-method

*Converts instances of class AffineAlignObjLight into list*

---

**Description**

Converts instances of class AffineAlignObjLight into list

**Usage**

```
## S4 method for signature 'AffineAlignObjLight'  
as.list(x)
```

**Arguments**

x                    An object of class AffineAlignObjLight

**Value**

list

**Author(s)**

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---

as.list,AffineAlignObjMedium-method

*Converts instances of class AffineAlignObjMedium into list*

---

**Description**

Converts instances of class AffineAlignObjMedium into list

**Usage**

```
## S4 method for signature 'AffineAlignObjMedium'  
as.list(x)
```

**Arguments**

x                    An object of class AffineAlignObjMedium

**Value**

list

**Author(s)**

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---

*as.list, AlignObj-method*

*Converts instances of class AlignObj into list*

---

**Description**

Converts instances of class AlignObj into list

**Usage**

```
## S4 method for signature 'AlignObj'  
as.list(x)
```

**Arguments**

x                    An object of class AlignObj

**Value**

list

**Author(s)**

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---

`childXICs`*Get child chromatograms from parents*

---

**Description**

Get child chromatograms from parents

**Usage**

```
childXICs(  
  XICs.ref,  
  XICs.eXp,  
  alignedIndices,  
  method = "spline",  
  polyOrd = 4,  
  kernelLen = 9,  
  splineMethod = "fmm",  
  wRef = 0.5,  
  mergeStrategy = "avg",  
  keepFlanks = TRUE  
)
```

**Arguments**

<code>XICs.ref</code>	(list of data-frames) extracted ion chromatograms from reference run.
<code>XICs.eXp</code>	(list of data-frames) extracted ion chromatograms from experiment run.
<code>alignedIndices</code>	(data-frame) must have two columns "indexAligned.ref" and "indexAligned.eXp".
<code>method</code>	(string) must be either "spline", "sgolay" or "linear".
<code>polyOrd</code>	(integer) must be less than kernelLen.
<code>kernelLen</code>	(integer) must be an odd integer.
<code>splineMethod</code>	(string) must be either "fmm" or "natural".
<code>wRef</code>	(numeric) Weight of the reference XIC. Must be between 0 and 1.
<code>mergeStrategy</code>	(string) must be either ref, avg, refStart or refEnd.
<code>keepFlanks</code>	(logical) TRUE: Flanking chromatogram is not removed.

**Value**

(list) the first element is a list of chromatograms. The second element is aligned parent time-vectors.

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**See Also**[childXIC](#), [mergeXIC](#)**Examples**

```
data(XIC_QFNNTDIVLLEDFQK_3_DIAalignR, package="DIAalignR")
data(alignObj_DIAalignR, package="DIAalignR")
XICs.ref <- XIC_QFNNTDIVLLEDFQK_3_DIAalignR[["hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt"]][["4618"]]
XICs.exp <- XIC_QFNNTDIVLLEDFQK_3_DIAalignR[["hroest_K120809_Strep10%PlasmaBiolRepl2_R04_SW_filt"]][["4618"]]
alignedIndices <- cbind(alignObj_DIAalignR@indexA_aligned, alignObj_DIAalignR@indexB_aligned)
colnames(alignedIndices) <- c("indexAligned.ref", "indexAligned.exp")
alignedIndices[, 1:2][alignedIndices[, 1:2] == 0] <- NA_integer_
newXICs <- childXICs(XICs.ref, XICs.exp, alignedIndices)[[1]]
plotXICgroup(XICs.ref)
plotXICgroup(newXICs)
```

---

`constrainSimCpp`*Constrain similarity matrix with a mask*

---

**Description**

Constrain similarity matrix with a mask

**Usage**

```
constrainSimCpp(sim, MASK, samples4gradient = 100)
```

**Arguments**

`sim` (matrix) A numeric matrix. Input similarity matrix.

`MASK` (matrix) A numeric matrix. Masked indices have non-zero values.

`samples4gradient` (numeric) This parameter modulates penalization of masked indices.

**Value**

`s_new` (matrix) A constrained similarity matrix.

**Author(s)**

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## Examples

```
sim <- matrix(c(-2, 10, -2, -2, -2, -2, 10, -2, 10, -2, -2, -2, -2, -2, 10, 10, -2, -2, -2),
  4, 5, byrow = FALSE)
MASK <- matrix(c(0.000, 0.000, 0.707, 1.414, 0.000, 0.000, 0.000, 0.707, 0.707, 0.000,
  0.000, 0.000, 1.414, 0.707, 0, 0, 2.121, 1.414, 0, 0), 4, 5, byrow = FALSE)
constrainSimCpp(sim, MASK, 10)
matrix(c(-2, 10, -3.414, -4.828, -2, -2, 10, -3.414, 8.586, -2, -2, -2, -4.828,
  -3.414, -2, 10, 5.758, -4.828, -2, -2), 4, 5, byrow = FALSE)
```

---

createMZML

*Create an mzML file*

---

## Description

Writes an mzML file having chromatograms and their native IDs.

## Usage

```
createMZML(ropenms, filename, XICs, transitionIDs)
```

## Arguments

ropenms (pyopenms module) get this python module through `get_ropenms()`.  
filename (string) name of the mzML file to be written. Extension should be `.chrom.mzML`.  
XICs (list of list of data-frames) list of extracted ion chromatograms of all precursors.  
transitionIDs (list of integer) length must be the same as of XICs.

## Value

(None)

## Author(s)

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License: (c) Author (2020) + GPL-3 Date: 2020-06-06

## See Also

[get\\_ropenms](#), [addXIC](#)



## Examples

```
dataPath <- system.file("extdata", package = "DIAAlignR")
filename <- paste0(dataPath, "/xics/hroest_K120809_Strep10%PlasmaBiolRepl2_R04_SW_filt.chrom.mzML")
data(XIC_QFNNTDIVLLEDFQK_3_DIAAlignR)
XICs <- XIC_QFNNTDIVLLEDFQK_3_DIAAlignR[["hroest_K120808_Strep10%PlasmaBiolRepl1_R03_SW_filt"]]
nativeIds <- list(27706:27711)
## Not run:
ropenms <- get_ropenms(condaEnv = "envName")
createMZML(ropenms, "testfile.chrom.mzML", XICs, nativeIds)
mzR::chromatogramHeader(mzR::openMSfile("testfile.chrom.mzML", backend = "pwiz"))
file.remove("testfile.chrom.mzML")

## End(Not run)
```

---

createSqMass	<i>Create an sqMass file</i>
--------------	------------------------------

---

## Description

Writes a sqMass file having chromatograms and their native IDs.

## Usage

```
createSqMass(filename, XICs, transitionIDs, lossy)
```

## Arguments

filename	(string) name of the mzML file to be written. Extension should be .chrom.sqMass.
XICs	(list of list of data-frames) list of extracted ion chromatograms of all precursors.
transitionIDs	(list of integer) length must be the same as of XICs.
lossy	(logical) if TRUE, time and intensity are lossy-compressed.

## Details

- compression is one of 0 = no, 1 = zlib, 2 = np-linear, 3 = np-slof, 4 = np-pic, 5 = np-linear + zlib, 6 = np-slof + zlib, 7 = np-pic + zlib
- data\_type is one of 0 = mz, 1 = int, 2 = rt
- data contains the raw (blob) data for a single data array

## Value

(None)

## Author(s)

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2021) + GPL-3 Date: 2021-01-16

**See Also**

[createMZML](#), [blobXICs](#)

**Examples**

```
data(XIC_QFNNTDIVLLEDFQK_3_DIAalignR)
XICs <- XIC_QFNNTDIVLLEDFQK_3_DIAalignR[["hroest_K120808_Strep10%PlasmaBiolRep11_R03_SW_filt"]]
XICs <- list(XICs[[1]], XICs[[1]])
nativeIds <- list(27706:27711, 1:6)
sqName <- "testfile.chrom.sqlMass"
## Not run:
createSqMass(sqName, XICs, nativeIds, TRUE)
con <- DBI::dbConnect(RSQLite::SQLite(), dbname = sqName)
XIC_group <- extractXIC_group2(con, 0:5)
DBI::dbDisconnect(con)
file.remove(sqName)

## End(Not run)
```

---

DIAalignR

*DIAalignR*

---

**Description**

This package implements dynamic programming with affine gap penalty to find a highest-scoring scoring path. A hybrid approach of global alignment through MS2 features and local alignment with MS2 chromatograms is implemented in this tool.

**Author(s)**

Shubham Gupta, Hannes Rost

---

doAffineAlignmentCpp *Perform affine global and overlap alignment on a similarity matrix*

---

**Description**

Perform affine global and overlap alignment on a similarity matrix

**Usage**

```
doAffineAlignmentCpp(sim, go, ge, OverlapAlignment)
```

**Arguments**

sim (NumericMatrix) A numeric matrix with similarity values of two sequences or signals.

go (numeric) Penalty for introducing first gap in alignment.

ge (numeric) Penalty for introducing subsequent gaps in alignment.

OverlapAlignment (logical) An input for alignment with free end-gaps. False: Global alignment, True: overlap alignment.

**Value**

affineAlignObj (S4class) An object from C++ class of AffineAlignObj.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca> ORCID: 0000-0003-3500-8152 License: (c) Author (2019) + MIT Date: 2019-03-08

**Examples**

```
# Get sequence similarity of two DNA strings
Match=10; MisMatch=-2
seq1 = "GCAT"; seq2 = "CAGTG"
s <- getSeqSimMatCpp(seq1, seq2, Match, MisMatch)
objAffine_Global <- doAffineAlignmentCpp(s, 22, 7, FALSE)
slot(objAffine_Global, "score") # -2 -4 -6 4 -18
objAffine_Olap <- doAffineAlignmentCpp(s, 22, 7, TRUE)
slot(objAffine_Olap, "score") # 0 10 20 18 18 18

Match=10; MisMatch=-2
seq1 = "CAT"; seq2 = "CAGTG"
s <- getSeqSimMatCpp(seq1, seq2, Match, MisMatch)
objAffine_Global <- doAffineAlignmentCpp(s, 22, 7, FALSE)
slot(objAffine_Global, "score") # 10 20 -2 -9 -11
objAffine_Olap <- doAffineAlignmentCpp(s, 22, 7, TRUE)
slot(objAffine_Olap, "score") # 10 20 18 18 18

Match=10; MisMatch=-2
seq1 = "CA"; seq2 = "AG"
s <- getSeqSimMatCpp(seq1, seq2, Match, MisMatch)
objAffine_Global <- doAffineAlignmentCpp(s, 22, 7, FALSE)
slot(objAffine_Global, "simScore_forw") # -4
```

---

doAlignmentCpp	<i>Perform non-affine global and overlap alignment on a similarity matrix</i>
----------------	---

---

**Description**

Perform non-affine global and overlap alignment on a similarity matrix

**Usage**

```
doAlignmentCpp(sim, gap, OverlapAlignment)
```

**Arguments**

sim	(NumericMatrix) A numeric matrix with similarity values of two sequences or signals.
gap	(double) Penalty for introducing gaps in alignment.
OverlapAlignment	(logical) An input for alignment with free end-gaps. False: Global alignment, True: overlap alignment.

**Value**

AlignObj (S4class) An object from C++ class of AlignObj.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca> ORCID: 0000-0003-3500-8152 License: (c) Author (2019) + MIT Date: 2019-03-08

**Examples**

```
# Get sequence similarity of two DNA strings
Match=10; MisMatch=-2
seq1 = "GCAT"; seq2 = "CAGTG"
s <- getSeqSimMatCpp(seq1, seq2, Match, MisMatch)
obj_Global <- doAlignmentCpp(s, 22, FALSE)
slot(obj_Global, "score") # -2 -4 -6 4 -18
obj_Olap <- doAlignmentCpp(s, 22, TRUE)
slot(obj_Olap, "score") # 0 10 20 18 18 18

Match=1; MisMatch=-1
seq1 = "TTTC"; seq2 = "TGC"
s <- getSeqSimMatCpp(seq1, seq2, Match, MisMatch)
obj_Global <- doAlignmentCpp(s, 2, FALSE)
slot(obj_Global, "optionalPaths")
matrix(data = c(1,1,1,1,1,1,1,1,1,2,1,2,1,3,3,1,1,3,6,3), nrow = 5, ncol =4, byrow = TRUE)
slot(obj_Global, "M_forw")
matrix(data = c(0,-2,-4,-6,-2,-7,-22,-45,-4,-20,-72,-184,-6,-41,-178,-547,-8,-72,-366,-1274),
  nrow = 5, ncol =4, byrow = TRUE)
```

---

getAlignedTimes	<i>Get aligned Retention times.</i>
-----------------	-------------------------------------

---

### Description

This function aligns XICs of reference and experiment runs. It produces aligned retention times between reference run and experiment run.

### Usage

```
getAlignedTimes(
  XICs.ref,
  XICs.exp,
  globalFit,
  alignType,
  adaptiveRT,
  normalization,
  simMeasure,
  goFactor,
  geFactor,
  cosAngleThresh,
  OverlapAlignment,
  dotProdThresh,
  gapQuantile,
  kerLen,
  hardConstrain,
  samples4gradient,
  objType = "light"
)
```

### Arguments

XICs.ref	List of extracted ion chromatograms from reference run.
XICs.exp	List of extracted ion chromatograms from experiment run.
globalFit	Linear or loess fit object between reference and experiment run.
alignType	Available alignment methods are "global", "local" and "hybrid".
adaptiveRT	(numeric) Similarity matrix is not penalized within adaptive RT.
normalization	(character) Must be selected from "mean", "l2".
simMeasure	(string) Must be selected from dotProduct, cosineAngle, crossCorrelation, cosine2Angle, dotProductMasked, euclideanDist, covariance and correlation.
goFactor	(numeric) Penalty for introducing first gap in alignment. This value is multiplied by base gap-penalty.
geFactor	(numeric) Penalty for introducing subsequent gaps in alignment. This value is multiplied by base gap-penalty.

<code>cosAngleThresh</code>	(numeric) In <code>simType = dotProductMasked</code> mode, angular similarity should be higher than <code>cosAngleThresh</code> otherwise similarity is forced to zero.
<code>OverlapAlignment</code>	(logical) An input for alignment with free end-gaps. <code>False</code> : Global alignment, <code>True</code> : overlap alignment.
<code>dotProdThresh</code>	(numeric) In <code>simType = dotProductMasked</code> mode, values in similarity matrix higher than <code>dotProdThresh</code> quantile are checked for angular similarity.
<code>gapQuantile</code>	(numeric) Must be between 0 and 1. This is used to calculate base gap-penalty from similarity distribution.
<code>kerLen</code>	(integer) In <code>simType = crossCorrelation</code> , length of the kernel used to sum similarity score. Must be an odd number.
<code>hardConstrain</code>	(logical) If <code>FALSE</code> ; indices farther from <code>noBeef</code> distance are filled with distance from linear fit line.
<code>samples4gradient</code>	(numeric) This parameter modulates penalization of masked indices.
<code>objType</code>	(char) Must be selected from <code>light</code> , <code>medium</code> and <code>heavy</code> .

**Value**

(list) the first element corresponds to the aligned reference time, the second element is the aligned experiment time.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>  
 ORCID: 0000-0003-3500-8152  
 License: (c) Author (2019) + GPL-3 Date: 2019-12-13

**See Also**

[alignChromatogramsCpp](#), [getAlignObj](#)

**Examples**

```
data(XIC_QFNNTDIVLLEDFQK_3_DIAalignR, package="DIAalignR")
data(oswFiles_DIAalignR, package="DIAalignR")
run1 <- "hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt"
run2 <- "hroest_K120809_Strep10%PlasmaBiolRepl2_R04_SW_filt"
XICs.ref <- XIC_QFNNTDIVLLEDFQK_3_DIAalignR[[run1]][["4618"]]
XICs.eXp <- XIC_QFNNTDIVLLEDFQK_3_DIAalignR[[run2]][["4618"]]
RUNS_RT <- getRTdf(oswFiles_DIAalignR, ref = "run1", eXp = "run2", maxFdrGlobal = 0.05)
globalFit <- loess(RT.eXp ~ RT.ref, data = RUNS_RT, span = 0.1, control=loess.control(surface="direct"))
adaptiveRT <- 77.82315 #3.5*globalFit$s
getAlignedTimes(XICs.ref, XICs.eXp, globalFit, alignType = "hybrid",
  adaptiveRT = adaptiveRT, normalization = "mean",
  simMeasure = "dotProductMasked", goFactor = 0.125, geFactor = 40, cosAngleThresh = 0.3,
  OverlapAlignment = TRUE, dotProdThresh = 0.96, gapQuantile = 0.5, kerLen = 9L, hardConstrain = FALSE,
  samples4gradient = 100)
```

---

getAlignedTimesCpp      *Get aligned indices from MS2 extracted-ion chromatograms(XICs) pair.*

---

### Description

Get aligned indices from MS2 extracted-ion chromatograms(XICs) pair.

### Usage

```
getAlignedTimesCpp(  
  l1,  
  l2,  
  kernellLen,  
  polyOrd,  
  alignType,  
  adaptiveRT,  
  normalization,  
  simType,  
  B1p = 0,  
  B2p = 0,  
  goFactor = 0.125,  
  geFactor = 40,  
  cosAngleThresh = 0.3,  
  OverlapAlignment = TRUE,  
  dotProdThresh = 0.96,  
  gapQuantile = 0.5,  
  kerLen = 9L,  
  hardConstrain = FALSE,  
  samples4gradient = 100  
)
```

### Arguments

l1	(list) A list of numeric matrix of two columns. l1 and l2 should have same length.
l2	(list) A list of numeric matrix of two columns. l1 and l2 should have same length.
kernellLen	(integer) length of filter. Must be an odd number.
polyOrd	(integer) TRUE: remove background from peak signal using estimated noise levels.
alignType	(char) A character string. Available alignment methods are "global", "local" and "hybrid".
adaptiveRT	(numeric) Similarity matrix is not penalized within adaptive RT.
normalization	(char) A character string. Normalization must be selected from (L2, mean or none).

simType	(char) A character string. Similarity type must be selected from (dotProductMasked, dotProduct, cosineAngle, cosine2Angle, euclideanDist, covariance, correlation, crossCorrelation). Mask = $s > \text{quantile}(s, \text{dotProdThresh})$ AllowDotProd = $[\text{Mask} \times \text{cosine2Angle} + (1 - \text{Mask})] > \text{cosAngleThresh}$ $s_{\text{new}} = s \times \text{AllowDotProd}$
B1p	(numeric) Timepoint mapped by global fit for tA[1].
B2p	(numeric) Timepoint mapped by global fit for tA[length(tA)].
goFactor	(numeric) Penalty for introducing first gap in alignment. This value is multiplied by base gap-penalty.
geFactor	(numeric) Penalty for introducing subsequent gaps in alignment. This value is multiplied by base gap-penalty.
cosAngleThresh	(numeric) In simType = dotProductMasked mode, angular similarity should be higher than cosAngleThresh otherwise similarity is forced to zero.
OverlapAlignment	(logical) An input for alignment with free end-gaps. False: Global alignment, True: overlap alignment.
dotProdThresh	(numeric) In simType = dotProductMasked mode, values in similarity matrix higher than dotProdThresh quantile are checked for angular similarity.
gapQuantile	(numeric) Must be between 0 and 1. This is used to calculate base gap-penalty from similarity distribution.
kerLen	(integer) In simType = crossCorrelation, length of the kernel used to sum similarity score. Must be an odd number.
hardConstrain	(logical) if false; indices farther from noBeef distance are filled with distance from linear fit line.
samples4gradient	(numeric) This parameter modulates penalization of masked indices.

**Value**

NumericMatrix Aligned indices of I1 and I2.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca> ORCID: 0000-0003-3500-8152 License: (c) Author (2019) + MIT Date: 2019-03-08

**Examples**

```
data(XIC_QFNNTDIVLLEDFQK_3_DIAAlignR, package="DIAAlignR")
XICs <- XIC_QFNNTDIVLLEDFQK_3_DIAAlignR
XICs.ref <- lapply(XICs[["hroest_K120809_Strep0%PlasmaBio1Rep12_R04_SW_filt"]][["4618"]], as.matrix)
XICs.exp <- lapply(XICs[["hroest_K120809_Strep10%PlasmaBio1Rep12_R04_SW_filt"]][["4618"]], as.matrix)
B1p <- 4964.752
B2p <- 5565.462
time <- getAlignedTimesCpp(XICs.ref, XICs.exp, 11, 4, alignType = "hybrid", adaptiveRT = 77.82315,
  normalization = "mean", simType = "dotProductMasked", B1p = B1p, B2p = B2p,
```



```
goFactor = 0.125, geFactor = 40, cosAngleThresh = 0.3, OverlapAlignment = TRUE,  
dotProdThresh = 0.96, gapQuantile = 0.5, hardConstrain = FALSE, samples4gradient = 100)
```

---

getAlignedTimesFast    *Get aligned Retention times.*

---

### Description

This function aligns XICs of reference and experiment runs. It produces aligned retention times between reference run and experiment run.

### Usage

```
getAlignedTimesFast(XICs.ref, XICs.exp, globalFit, adaptiveRT, params)
```

### Arguments

XICs.ref	List of extracted ion chromatograms from reference run.
XICs.exp	List of extracted ion chromatograms from experiment run.
globalFit	Linear or loess fit object between reference and experiment run.
adaptiveRT	(numeric) Similarity matrix is not penalized within adaptive RT.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.

### Value

(matrix) the first column corresponds to the aligned reference time, the second column is the aligned experiment time.

### Author(s)

Shubham Gupta, <[shubh.gupta@mail.utoronto.ca](mailto:shubh.gupta@mail.utoronto.ca)>

ORCID: 0000-0003-3500-8152

License: (c) Author (2021) + GPL-3 Date: 2021-01-02

### See Also

[alignChromatogramsCpp](#), [getAlignObj](#)

**Examples**

```

data(XIC_QFNNTDIVLLEDFQK_3_DIAAlignR, package="DIAAlignR")
data(oswFiles_DIAAlignR, package="DIAAlignR")
run1 <- "hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt"
run2 <- "hroest_K120809_Strep10%PlasmaBiolRepl2_R04_SW_filt"
XICs.ref <- lapply(XIC_QFNNTDIVLLEDFQK_3_DIAAlignR[[run1]][["4618"]], as.matrix)
XICs.eXp <- lapply(XIC_QFNNTDIVLLEDFQK_3_DIAAlignR[[run2]][["4618"]], as.matrix)
params <- paramsDIAAlignR()
params[["globalAlignment"]] <- "linear"
globalFit <- getGlobalAlignment(oswFiles_DIAAlignR, ref = "run2", eXp = "run0",
  fitType = params[["globalAlignment"]], maxFdrGlobal = 0.05, spanvalue = 0.1)
adaptiveRT <- 77.82315 #3.5*getRSE(globalFit, params[["globalAlignment"]])
globalFit <- coef(globalFit)
getAlignedTimesFast(XICs.ref, XICs.eXp, globalFit, adaptiveRT, params)

```

---

getAlignObj

*Outputs AlignObj from an alignment of two XIC-groups*


---

**Description**

Outputs AlignObj from an alignment of two XIC-groups

**Usage**

```

getAlignObj(
  XICs.ref,
  XICs.eXp,
  globalFit,
  alignType,
  adaptiveRT,
  normalization,
  simType,
  goFactor,
  geFactor,
  cosAngleThresh,
  OverlapAlignment,
  dotProdThresh,
  gapQuantile,
  kerLen,
  hardConstrain,
  samples4gradient,
  objType = "light"
)

```

**Arguments**

XICs.ref            List of extracted ion chromatograms from reference run.

XICs.eXp	List of extracted ion chromatograms from experiment run.
globalFit	Linear or loess fit object between reference and experiment run.
alignType	Available alignment methods are "global", "local" and "hybrid".
adaptiveRT	(numeric) Similarity matrix is not penalized within adaptive RT.
normalization	(character) Must be selected from "mean", "l2".
simType	(string) Must be selected from dotProduct, cosineAngle, crossCorrelation, cosine2Angle, dotProductMasked, euclideanDist, covariance and correlation.
goFactor	(numeric) Penalty for introducing first gap in alignment. This value is multiplied by base gap-penalty.
geFactor	(numeric) Penalty for introducing subsequent gaps in alignment. This value is multiplied by base gap-penalty.
cosAngleThresh	(numeric) In simType = dotProductMasked mode, angular similarity should be higher than cosAngleThresh otherwise similarity is forced to zero.
OverlapAlignment	(logical) An input for alignment with free end-gaps. False: Global alignment, True: overlap alignment.
dotProdThresh	(numeric) In simType = dotProductMasked mode, values in similarity matrix higher than dotProdThresh quantile are checked for angular similarity.
gapQuantile	(numeric) Must be between 0 and 1. This is used to calculate base gap-penalty from similarity distribution.
kerLen	(integer) In simType = crossCorrelation, length of the kernel used to sum similarity score. Must be an odd number.
hardConstrain	(logical) If FALSE; indices farther from noBeef distance are filled with distance from linear fit line.
samples4gradient	(numeric) This parameter modulates penalization of masked indices.
objType	(char) Must be selected from light, medium and heavy.

**Value**

A S4 object. Three most-important slots are:

indexA_aligned	(integer) aligned indices of reference run.
indexB_aligned	(integer) aligned indices of experiment run.
score	(numeric) cumulative score of alignment.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2019) + GPL-3 Date: 2019-12-13

**See Also**

[alignChromatogramsCpp](#)

## Examples

```
data(XIC_QFNNTDIVLLEDFQK_3_DIAAlignR, package="DIAAlignR")
data(oswFiles_DIAAlignR, package="DIAAlignR")
run1 <- "hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt"
run2 <- "hroest_K120809_Strep10%PlasmaBiolRepl2_R04_SW_filt"
XICs.ref <- XIC_QFNNTDIVLLEDFQK_3_DIAAlignR[[run1]][["4618"]]
XICs.eXp <- XIC_QFNNTDIVLLEDFQK_3_DIAAlignR[[run2]][["4618"]]
RUNS_RT <- getRTdf(oswFiles_DIAAlignR, ref = "run1", eXp = "run2", maxFdrGlobal = 0.05)
globalFit <- loess(RT.eXp ~ RT.ref, data = RUNS_RT, span = 0.1, control=loess.control(surface="direct"))
AlignObj <- getAlignObj(XICs.ref, XICs.eXp, globalFit, alignType = "hybrid", adaptiveRT = 77.82315,
  normalization = "mean", simType = "dotProductMasked", goFactor = 0.125,
  geFactor = 40, cosAngleThresh = 0.3, OverlapAlignment = TRUE, dotProdThresh = 0.96,
  gapQuantile = 0.5, kerLen = 9L, hardConstrain = FALSE, samples4gradient = 100, objType = "light")
```

---

getAlignObjs

*AlignObj for analytes between a pair of runs*

---

## Description

This function expects osw and xics directories at dataPath. It first reads osw files and fetches chromatogram indices for each requested analyte. It then align XICs of each analyte to its reference XICs. AlignObj is returned which contains aligned indices and cumulative score along the alignment path.

## Usage

```
getAlignObjs(
  analytes,
  runs,
  dataPath = ".",
  refRun = NULL,
  oswMerged = TRUE,
  params = paramsDIAAlignR(),
  objType = "light"
)
```

## Arguments

analytes	(vector of integers) transition_group_ids for which features are to be extracted.
runs	(a vector of string) names of xics file without extension.
dataPath	(string) path to xics and osw directory.
refRun	(string) reference for alignment. If no run is provided, m-score is used to select reference run.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.
objType	(char) Must be selected from light, medium and heavy.

**Value**

A list of fileInfo and AlignObjs. Each AlignObj is an S4 object. Three most-important slots are:

indexA\_aligned (integer) aligned indices of reference run.  
indexB\_aligned (integer) aligned indices of experiment run.  
score (numeric) cumulative score of alignment.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2019) + GPL-3 Date: 2019-12-14

**References**

Gupta S, Ahadi S, Zhou W, Röst H. "DIAAlignR Provides Precise Retention Time Alignment Across Distant Runs in DIA and Targeted Proteomics." Mol Cell Proteomics. 2019 Apr;18(4):806-817. doi: <https://doi.org/10.1074/mcp.TIR118.001132> Epub 2019 Jan 31.

**See Also**

[plotAlignedAnalytes](#), [getRunNames](#), [getFeatures](#), [getXICs4AlignObj](#), [getAlignObj](#)

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
params <- paramsDIAAlignR()
params[["context"]] <- "experiment-wide"
runs <- c("hroest_K120808_Strep10%PlasmaBiolRepl1_R03_SW_filt",
         "hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt",
         "hroest_K120809_Strep10%PlasmaBiolRepl2_R04_SW_filt")
analytes <- c(32L, 898L, 2474L)
AlignObjOutput <- getAlignObjs(analytes, runs, dataPath = dataPath)
plotAlignedAnalytes(AlignObjOutput)
```

---

getBaseGapPenaltyCpp *Calculates gap penalty for dynamic programming based alignment.*

---

**Description**

This function outputs base gap-penalty depending on SimType used. In case of getting base gap-penalty from similarity matrix distribution, gapQuantile will be used to pick the value.

**Usage**

```
getBaseGapPenaltyCpp(sim, SimType, gapQuantile = 0.5)
```

**Arguments**

sim	(matrix) A numeric matrix. Input similarity matrix.
SimType	(char) A character string. Similarity type must be selected from (dotProductMasked, dotProduct, cosineAngle, cosine2Angle, euclideanDist, covariance, correlation, crossCorrelation).
gapQuantile	(numeric) Must be between 0 and 1.

**Value**

baseGapPenalty (numeric).

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca> ORCID: 0000-0003-3500-8152 License: (c) Author (2019) + MIT Date: 2019-03-08

**Examples**

```
sim <- matrix(c(-12, 1.0, 12, -2.3, -2, -2, 1.07, -2, 1.80, 2, 22, 42, -2, -1.5, -2, 10), 4, 4,
  byrow = FALSE)
getBaseGapPenaltyCpp(sim, "dotProductMasked", 0.5) # -0.25
```

---

getChildXICpp

*Get child chromatogram from two parent chromatogram*

---

**Description**

Get child chromatogram from two parent chromatogram

**Usage**

```
getChildXICpp(
  l1,
  l2,
  kernelLen,
  polyOrd,
  alignType,
  adaptiveRT,
  normalization,
  simType,
  B1p = 0,
  B2p = 0,
  goFactor = 0.125,
  geFactor = 40,
  cosAngleThresh = 0.3,
  OverlapAlignment = TRUE,
  dotProdThresh = 0.96,
```

```

    gapQuantile = 0.5,
    kerLen = 9L,
    hardConstrain = FALSE,
    samples4gradient = 100,
    wRef = 0.5,
    splineMethod = "natural",
    mergeStrategy = "avg",
    keepFlanks = TRUE
)

```

### Arguments

l1	(list) A list of numeric matrix of two columns. l1 and l2 should have same length.
l2	(list) A list of numeric matrix of two columns. l1 and l2 should have same length.
kernellLen	(integer) length of filter. Must be an odd number.
polyOrd	(integer) TRUE: remove background from peak signal using estimated noise levels.
alignType	(char) A character string. Available alignment methods are "global", "local" and "hybrid".
adaptiveRT	(numeric) Similarity matrix is not penalized within adaptive RT.
normalization	(char) A character string. Normalization must be selected from (L2, mean or none).
simType	(char) A character string. Similarity type must be selected from (dotProductMasked, dotProduct, cosineAngle, cosine2Angle, euclideanDist, covariance, correlation, crossCorrelation). Mask = $s > \text{quantile}(s, \text{dotProdThresh})$ AllowDotProd = $[\text{Mask} \times \text{cosine2Angle} + (1 - \text{Mask})] > \text{cosAngleThresh}$ $s_{\text{new}} = s \times \text{AllowDotProd}$
B1p	(numeric) Timepoint mapped by global fit for tA[1].
B2p	(numeric) Timepoint mapped by global fit for tA[length(tA)].
goFactor	(numeric) Penalty for introducing first gap in alignment. This value is multiplied by base gap-penalty.
geFactor	(numeric) Penalty for introducing subsequent gaps in alignment. This value is multiplied by base gap-penalty.
cosAngleThresh	(numeric) In simType = dotProductMasked mode, angular similarity should be higher than cosAngleThresh otherwise similarity is forced to zero.
OverlapAlignment	(logical) An input for alignment with free end-gaps. False: Global alignment, True: overlap alignment.
dotProdThresh	(numeric) In simType = dotProductMasked mode, values in similarity matrix higher than dotProdThresh quantile are checked for angular similarity.
gapQuantile	(numeric) Must be between 0 and 1. This is used to calculate base gap-penalty from similarity distribution.

kerLen	(integer) In simType = crossCorrelation, length of the kernel used to sum similarity score. Must be an odd number.
hardConstrain	(logical) if false; indices farther from noBeef distance are filled with distance from linear fit line.
samples4gradient	(numeric) This parameter modulates penalization of masked indices.
wRef	(numeric) Weight of the reference XIC. Must be between 0 and 1.
splineMethod	(string) must be either "fmm" or "natural".
mergeStrategy	(string) must be either ref, avg, refStart or refEnd.
keepFlanks	(logical) TRUE: Flanking chromatogram is not removed.

**Value**

(List) of chromatograms and their aligned time vectors.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca> ORCID: 0000-0003-3500-8152 License: (c) Author (2021) + MIT Date: 2021-01-08

**Examples**

```
data(XIC_QFNNTDIVLLEDFQK_3_DIAAlignR, package="DIAAlignR")
XICs <- XIC_QFNNTDIVLLEDFQK_3_DIAAlignR
XICs.ref <- lapply(XICs[["hroest_K120809_Strep0%PlasmaBiolRep12_R04_SW_filt"]][["4618"]], as.matrix)
XICs.exp <- lapply(XICs[["hroest_K120809_Strep10%PlasmaBiolRep12_R04_SW_filt"]][["4618"]], as.matrix)
B1p <- 4964.752
B2p <- 5565.462
chrom <- getChildXICpp(XICs.ref, XICs.exp, 11L, 4L, alignType = "hybrid", adaptiveRT = 77.82315,
  normalization = "mean", simType = "dotProductMasked", B1p = B1p, B2p = B2p,
  goFactor = 0.125, geFactor = 40, cosAngleThresh = 0.3, OverlapAlignment = TRUE,
  dotProdThresh = 0.96, gapQuantile = 0.5, hardConstrain = FALSE, samples4gradient = 100,
  wRef = 0.5, keepFlanks= TRUE)
```

---

getChildXICs

*Develop child XICs for precursors*

---

**Description**

This function performs the chromatogram alignment of all precursors across runA and runB. Aligned chromatograms are merged into a child chromatogram. Aligned time vector and resulting child time vector for each precursor is also returned.



**Usage**

```

getChildXICs(
  runA,
  runB,
  fileInfo,
  features,
  mzPtrs,
  precursors,
  prec2chromIndex,
  refRun,
  peptideScores,
  params,
  applyFun = lapply
)

```

**Arguments**

runA	(string) name of a run to be merged with runB. Must be in the rownames of fileInfo.
runB	(string) name of a run to be merged with runA. Must be in the rownames of fileInfo.
fileInfo	(data-frame) output of <a href="#">getRunNames</a> .
features	(list of data-frames) contains features and their properties identified in each run.
mzPtrs	(list) a list of mzRpviz.
precursors	(data-frame) atleast two columns transition_group_id and transition_ids are required.
prec2chromIndex	(list) a list of dataframes having following columns: transition_group_id: it is PRECURSOR.ID from osw file. chromatogramIndex: index of chromatogram in mzML file.
refRun	(integer) must be of the same length as of precursors. 1: reference is runA, 2: reference is runB.
peptideScores	(list of data-frames) each dataframe has scores of a peptide across all runs.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAalignR</a> function.
applyFun	(function) value must be either lapply or BiocParallel::bplapply.

**Value**

(list) has three elements. The first element has child XICs for all the precursors. The second element has corresponding aligned time vectors. Third element contains Residual Standard Errors (RSE) of global fits amongst runA and runB.

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License: (c) Author (2020) + GPL-3 Date: 2020-06-06

**See Also**

[childXICs](#), [getNodeRun](#)

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
params <- paramsDIAAlignR()
fileInfo <- DIAAlignR::getRunNames(dataPath = dataPath)
mzPntrs <- getMZMLpointers(fileInfo)
features <- getFeatures(fileInfo, maxFdrQuery = 1.00, runType = "DIA_Proteomics")
precursors <- getPrecursors(fileInfo, oswMerged = TRUE, runType = "DIA_Proteomics",
  context = "experiment-wide", maxPeptideFdr = 0.05)
precursors <- dplyr::arrange(precursors, .data$peptide_id, .data$transition_group_id)
peptideIDs <- unique(precursors$peptide_id)
peptideScores <- getPeptideScores(fileInfo, peptideIDs, oswMerged = TRUE, params[["runType"]], params[["context"])
peptideScores <- lapply(peptideIDs, function(pep) dplyr::filter(peptideScores, .data$peptide_id == pep))
names(peptideScores) <- as.character(peptideIDs)
prec2chromIndex <- getChromatogramIndices(fileInfo, precursors, mzPntrs)
var2 <- as.character(sapply(peptideIDs, function(p) precursors$transition_group_id[which(precursors$peptide_id == p)]))
refRun <- data.frame(rep(1L, length(peptideIDs)), var2)
mergedXICs <- getChildXICs(runA = "run1", runB = "run2", fileInfo, features, mzPntrs,
  precursors, prec2chromIndex, refRun, peptideScores, params)
for(con in mzPntrs) DBI::dbDisconnect(con)
```

---

getChromatogramIndices

*Get chromatogram indices of precursors.*

---

**Description**

This function reads the header of chromatogram files. It then fetches chromatogram indices by matching transition\_id(osw) with chromatogramID(xics).

**Usage**

```
getChromatogramIndices(fileInfo, precursors, mzPntrs, applyFun = lapply)
```

**Arguments**

fileInfo	(data-frame) Output of getRunNames function.
precursors	(data-frame) Atleast two columns transition_group_id and transition_ids are required.
mzPntrs	A list of mzRpwis.
applyFun	(function) value must be either lapply or BiocParallel::bplapply.

**Value**

(list) A list of dataframes having following columns:

transition\_group\_id

(string) it is PRECURSOR.ID from osw file.

chromatogramIndex

(integer) index of chromatogram in mzML file.

**Author(s)**

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License: (c) Author (2019) + GPL-3 Date: 2019-04-07

**See Also**

[chromatogramIdAsInteger](#), [mapPrecursorToChromIndices](#)

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
fileInfo <- getRunNames(dataPath = dataPath)
precursors <- getPrecursors(fileInfo, oswMerged = TRUE, context = "experiment-wide")
mzPtrs <- getMZMLpointers(fileInfo)
prec2chromIndex <- getChromatogramIndices(fileInfo, precursors, mzPtrs)
for(mz in mzPtrs) DBI::dbDisconnect(mz)
```

---

getChromSimMatCpp	<i>Calculates similarity matrix of two fragment-ion chromatogram groups or extracted-ion chromatograms(XICs)</i>
-------------------	--

---

**Description**

Calculates similarity matrix of two fragment-ion chromatogram groups or extracted-ion chromatograms(XICs)

**Usage**

```
getChromSimMatCpp(
  l1,
  l2,
  normalization,
  simType,
  cosAngleThresh = 0.3,
  dotProdThresh = 0.96,
  kerLen = 9L
)
```

**Arguments**

l1	(list) A list of vectors. Length should be same as of l2.
l2	(list) A list of vectors. Length should be same as of l1.
normalization	(char) A character string. Normalization must be selected from (L2, mean or none).
simType	(char) A character string. Similarity type must be selected from (dotProductMasked, dotProduct, cosineAngle, cosine2Angle, euclideanDist, covariance, correlation, crossCorrelation). Mask = s > quantile(s, dotProdThresh) AllowDotProd= [Mask × cosine2Angle + (1 - Mask)] > cosAngleThresh s_new= s × AllowDotProd
cosAngleThresh	(numeric) In simType = dotProductMasked mode, angular similarity should be higher than cosAngleThresh otherwise similarity is forced to zero.
dotProdThresh	(numeric) In simType = dotProductMasked mode, values in similarity matrix higher than dotProdThresh quantile are checked for angular similarity.
kerLen	(integer) In simType = crossCorrelation, length of the kernel used to sum similarity score. Must be an odd number.

**Value**

s (matrix) Numeric similarity matrix. Rows and columns expresses seq1 and seq2, respectively.

**Author(s)**

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**Examples**

```
# Get similarity matrix of dummy chromatograms
r1 <- list(c(1.0,3.0,2.0,4.0), c(0.0,0.0,0.0,1.0), c(4.0,4.0,4.0,5.0))
r2 <- list(c(1.4,2.0,1.5,4.0), c(0.0,0.5,0.0,0.0), c(2.0,3.0,4.0,0.9))
round(getChromSimMatCpp(r1, r2, "L2", "dotProductMasked"), 3)
matrix(c(0.125, 0.162, 0.144, 0.208, 0.186, 0.240,
0.213, 0.313, 0.233, 0.273, 0.253, 0.346, 0.101, 0.208, 0.154, 0.273), 4, 4, byrow = FALSE)

round(getChromSimMatCpp(r1, r2, "L2", "dotProduct"), 3)
matrix(c(0.125, 0.162, 0.144, 0.208, 0.186,0.240, 0.213, 0.313, 0.233,
0.273, 0.253, 0.346, 0.101, 0.208, 0.154, 0.273), 4, 4, byrow = FALSE)

round(getChromSimMatCpp(r1, r2, "L2", "cosineAngle"), 3)
matrix(c(0.934, 0.999, 0.989, 0.986, 0.933, 0.989,
0.983, 0.996, 0.994, 0.960, 0.995, 0.939, 0.450,
0.761, 0.633, 0.772), 4, 4, byrow = FALSE)

round(getChromSimMatCpp(r1, r2, "L2", "cosine2Angle"), 3)
matrix(c(0.744, 0.998, 0.957, 0.944, 0.740, 0.956, 0.932,
0.985, 0.974, 0.842, 0.978, 0.764, -0.596, 0.158,
```

```

-0.200, 0.190), 4, 4, byrow = FALSE)

round(getChromSimMatCpp(r1, r2, "mean", "euclideanDist"), 3)
matrix(c(0.608, 0.614, 0.680, 0.434, 0.530, 0.742,
0.659, 0.641, 0.520, 0.541, 0.563, 0.511, 0.298,
0.375, 0.334, 0.355), 4, 4, byrow = FALSE)

round(getChromSimMatCpp(r1, r2, "L2", "covariance"), 3)
matrix(c(0.025, 0.028, 0.027, 0.028, 0.032, 0.034,
0.033, 0.034, 0.055, 0.051, 0.053, 0.051,
-0.004, 0.028, 0.012, 0.028), 4, 4, byrow = FALSE)

round(getChromSimMatCpp(r1, r2, "L2", "correlation"), 3)
matrix(c(0.874, 0.999, 0.974, 0.999, 0.923, 0.986, 0.993,
0.986, 0.991, 0.911, 0.990, 0.911, -0.065, 0.477,
0.214, 0.477), 4, 4, byrow = FALSE)

```

---

getFeatures

*Get features from all feature files*


---

## Description

Get a list of data-frame of OpenSwath features that contains retention time, intensities, boundaries etc.

## Usage

```

getFeatures(
  fileInfo,
  maxFdrQuery = 0.05,
  runType = "DIA_Proteomics",
  applyFun = lapply
)

```

## Arguments

fileInfo	(data-frame) output of <a href="#">getRunNames</a> function.
maxFdrQuery	(numeric) a numeric value between 0 and 1. It is used to filter features from osw file which have SCORE_MS2.QVALUE less than itself.
runType	(char) this must be one of the strings "DIA_Proteomics", "DIA_Metabolomics".
applyFun	(function) value must be either lapply or BiocParallel::bplapply.

## Value

(list of dataframes) each dataframe has following columns:

transition_group_id	(integer) a unique id for each precursor.
---------------------	---

RT	(numeric) retention time as in FEATURE.EXP_RT of osw files.
Intensity	(numeric) peak intensity as in FEATURE_MS2.AREA_INTENSITY of osw files.
leftWidth	(numeric) as in FEATURE.LEFT_WIDTH of osw files.
rightWidth	(numeric) as in FEATURE.RIGHT_WIDTH of osw files.
peak_group_rank	(integer) rank of each feature associated with transition_group_id.
m_score	(numeric) q-value of each feature associated with transition_group_id.

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License: (c) Author (2019) + GPL-3 Date: 2019-04-06

**See Also**

[getRunNames](#), [fetchPrecursorsInfo](#)

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
fileInfo <- getRunNames(dataPath = dataPath)
## Not run:
features <- getFeatures(fileInfo, maxFdrQuery = 1.00, runType = "DIA_Proteomics")
dim(features[[2]]) # 938 8

## End(Not run)
```

---

getGlobalAlignMaskCpp *Outputs a mask for constraining similarity matrix*

---

**Description**

This function takes in timeVectors from both runs, global-fit mapped values of end-points of first time vector and sample-length of window of no constraining. Outside of window, all elements of matrix are either equally weighted or weighted proportional to distance from window-boundry.

**Usage**

```
getGlobalAlignMaskCpp(tA, tB, B1p, B2p, noBeef = 50L, hardConstrain = FALSE)
```

**Arguments**

tA	(numeric) A numeric vector. This vector has equally spaced timepoints of XIC A.
tB	(numeric) A numeric vector. This vector has equally spaced timepoints of XIC B.
B1p	(numeric) Timepoint mapped by global fit for tA[1].
B2p	(numeric) Timepoint mapped by global fit for tA[length(tA)].
noBeef	(integer) It defines the distance from the global fit, upto which no penalization is performed. The window length = 2*noBeef.
hardConstrain	(logical) if false; indices farther from noBeef distance are filled with distance from linear fit line.

**Value**

mask (matrix) A numeric matrix.

**Author(s)**

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**Examples**

```
tA <- c(3353.2, 3356.6, 3360.0, 3363.5)
tB <- c(3325.9, 3329.3, 3332.7, 3336.1)
B1p <- 3325.751; B2p <- 3336.119
noBeef <- 1
mask <- getGlobalAlignMaskCpp(tA, tB, B1p, B2p, noBeef, FALSE)
round(mask, 3)
matrix(c(0.000, 0.000, 0.707, 1.414, 0.000, 0.000, 0.000, 0.707, 0.707, 0.000,
0.000, 0.000, 1.414, 0.707, 0.000, 0.000), 4, 4, byrow = FALSE)
```

---

getGlobalAlignment      *Calculates global alignment between RT of two runs*

---

**Description**

This function selects features from oswFiles which has m-score < maxFdrLoess. It fits linear/loess regression on these feature. Retention-time mapping is established from reference to experiment run.

**Usage**

```
getGlobalAlignment(  
  oswFiles,  
  ref,  
  eXp,  
  fitType = "linear",  
  maxFdrGlobal = 0.01,  
  spanvalue = 0.1  
)
```

**Arguments**

oswFiles	(list of data-frames) it is output from getFeatures function.
ref	(string) Must be a combination of "run" and an iteger e.g. "run2".
eXp	(string) Must be a combination of "run" and an iteger e.g. "run2".
fitType	(string) Must be from "loess" or "linear".
maxFdrGlobal	(numeric) A numeric value between 0 and 1. Features should have m-score lower than this value for participation in global fit.
spanvalue	(numeric) Spanvalue for LOESS fit. For targeted proteomics 0.1 could be used.

**Value**

An object of class "loess".

**Author(s)**

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License: (c) Author (2019) + GPL-3 Date: 2019-12-14

**See Also**

[getFeatures](#)

**Examples**

```
data(oswFiles_DIAalignR, package="DIAalignR")  
fit <- getGlobalAlignment(oswFiles = oswFiles_DIAalignR, ref = "run1", eXp = "run2",  
  fitType = "linear", maxFdrGlobal = 0.05, spanvalue = 0.1)
```



---

getMultipeptide	<i>Get multipeptides</i>
-----------------	--------------------------

---

**Description**

Each element of the multipeptide is a collection of features associated with a peptide.

**Usage**

```
getMultipeptide(precursors, features, applyFun = lapply, masters = NULL)
```

**Arguments**

precursors	(data-frames) Contains precursors and associated transition IDs.
features	(list of data-frames) Contains features and their properties identified in each run.
applyFun	(function) value must be either lapply or BiocParallel::bplapply.
masters	(characters) names of extra runs.

**Value**

(list) of dataframes having following columns:

transition_group_id	(integer) a unique id for each precursor.
run	(string) run identifier.
RT	(numeric) retention time as in FEATURE.EXP_RT of osw files.
Intensity	(numeric) peak intensity as in FEATURE_MS2.AREA_INTENSITY of osw files.
leftWidth	(numeric) as in FEATURE.LEFT_WIDTH of osw files.
rightWidth	(numeric) as in FEATURE.RIGHT_WIDTH of osw files.
peak_group_rank	(integer) rank of each feature associated with transition_group_id.
m_score	(numeric) q-value of each feature associated with transition_group_id.
alignment_rank	(integer) rank of each feature post-alignment.

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License: (c) Author (2020) + GPL-3 Date: 2020-04-08

**See Also**

[getPrecursors](#), [getFeatures](#)

### Examples

```
dataPath <- system.file("extdata", package = "DIAAlignR")
fileInfo <- getRunNames(dataPath, oswMerged = TRUE)
precursors <- getPrecursors(fileInfo, oswMerged = TRUE, context = "experiment-wide")
features <- getFeatures(fileInfo, maxFdrQuery = 0.05)
multipeptide <- getMultipeptide(precursors, features)
multipeptide[["9861"]]
```

---

getMZMLpointers	<i>Get pointers to each mzML file.</i>
-----------------	--

---

### Description

Returns instantiated mzRpviz object associated to mzML file.

### Usage

```
getMZMLpointers(fileInfo)
```

### Arguments

fileInfo (data-frame) Output of DIAAlignR::getRunNames function

### Value

(A list of mzRpviz)

### Author(s)

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ORCID: 0000-0003-3500-8152

License: (c) Author (2019) + GPL-3 Date: 2019-12-13

### Examples

```
dataPath <- system.file("extdata", package = "DIAAlignR")
fileInfo <- getRunNames(dataPath = dataPath)
mzPntrs <- getMZMLpointers(fileInfo)
```

---

getPeptideScores      *Get scores of peptide*

---

### Description

Get a list of dataframes that contains peptide scores, pvalues, and qvalues across all runs.

### Usage

```
getPeptideScores(  
  fileInfo,  
  peptides,  
  oswMerged = TRUE,  
  runType = "DIA_Proteomics",  
  context = "global"  
)
```

### Arguments

fileInfo	(data-frame) Output of <a href="#">getRunNames</a> function.
peptides	(integer) Ids of peptides for which scores are required.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
runType	(char) This must be one of the strings "DIA_Proteomics", "DIA_Metabolomics".
context	(string) Context used in pyprophet peptide. Must be either "run-specific", "experiment-wide", or "global".

### Value

(list of dataframes) dataframe has following columns:

peptide_id	(integer) a unique id for each precursor.
run	(character) as in SCORE_PEPTIDE.RUN_ID of osw files.
score	(numeric) as in SCORE_PEPTIDE.SCORE of osw files.
pvalue	(numeric) as in SCORE_PEPTIDE.PVALUE of osw files.
qvalue	(numeric) as in SCORE_PEPTIDE.QVALUE of osw files.

### Author(s)

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### See Also

[getRunNames](#), [fetchPeptidesInfo](#)

**Examples**

```

dataPath <- system.file("extdata", package = "DIAAlignR")
fileInfo <- getRunNames(dataPath = dataPath)
precursorsInfo <- getPrecursors(fileInfo, oswMerged = TRUE, runType = "DIA_Proteomics",
context = "experiment-wide", maxPeptideFdr = 0.05)
peptidesInfo <- getPeptideScores(fileInfo, unique(precursorsInfo$peptide_id))
dim(peptidesInfo) # 684 5

```

---

getPrecursorByID      *Find precursors given their IDs*

---

**Description**

Get a data-frame of analytes' transition\_group\_id, transition\_ids, peptide\_id and amino-acid sequences.

**Usage**

```

getPrecursorByID(
  analytes,
  fileInfo,
  oswMerged = TRUE,
  runType = "DIA_Proteomics"
)

```

**Arguments**

analytes	(integer) a vector of integers.
fileInfo	(data-frame) Output of <code>getRunNames</code> function.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
runType	(char) This must be one of the strings "DIA_Proteomics", "DIA_Metabolomics".

**Value**

(data-frames) A data-frame having following columns:

transition_group_id	(integer) a unique id for each precursor.
transition_id	(list) fragment-ion ID associated with transition_group_id. This is matched with chromatogram ID in mzML file.
peptide_id	(integer) a unique id for each peptide. A peptide can have multiple precursors.
sequence	(string) amino-acid sequence of the precursor with possible modifications.
charge	(integer) charge on the precursor.
group_label	(string) TODO Figure it out.

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License: (c) Author (2020) + GPL-3 Date: 2019-04-06

**See Also**

[getRunNames](#), [fetchPrecursorsInfo](#)

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
fileInfo <- getRunNames(dataPath = dataPath, oswMerged = TRUE)
precursors <- getPrecursorByID(c(32L, 2474L), fileInfo, oswMerged = TRUE)
```

---

getPrecursors

*Get precursors from all feature files*

---

**Description**

Get a data-frame of analytes' transition\_group\_id, transition\_ids, peptide\_id and amino-acid sequences.

**Usage**

```
getPrecursors(
  fileInfo,
  oswMerged = TRUE,
  runType = "DIA_Proteomics",
  context = "global",
  maxPeptideFdr = 0.05,
  level = "Peptide"
)
```

**Arguments**

fileInfo	(data-frame) Output of <a href="#">getRunNames</a> function.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
runType	(char) This must be one of the strings "DIA_Proteomics", "DIA_Metabolomics".
context	(string) Context used in pyprophet peptide. Must be either "run-specific", "experiment-wide", or "global".
maxPeptideFdr	(numeric) A numeric value between 0 and 1. It is used to filter peptides from osw file which have SCORE_PEPTIDE.QVALUE less than itself.
level	(string) Apply maxPeptideFDR on Protein as well if specified as "Protein". Default: "Peptide".

**Value**

(data-frames) A data-frame having following columns:

transition_group_id	(integer) a unique id for each precursor.
peptide_id	(integer) a unique id for each peptide. A peptide can have multiple precursors.
sequence	(string) amino-acid sequence of the precursor with possible modifications.
charge	(integer) charge on the precursor.
group_label	(string) TODO Figure it out.
transition_ids	(list) fragment-ion ID associated with transition_group_id. This is matched with chromatogram ID in mzML file.

**Author(s)**

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ORCID: 0000-0003-3500-8152

License: (c) Author (2019) + GPL-3 Date: 2019-04-06

**See Also**

[getRunNames](#), [fetchPrecursorsInfo](#)

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
fileInfo <- getRunNames(dataPath = dataPath)
precursorsInfo <- getPrecursors(fileInfo, oswMerged = TRUE, runType = "DIA-Proteomics",
context = "experiment-wide", maxPeptideFdr = 0.05)
dim(precursorsInfo) # 234 6
```

---

getRefRun

*Fetch the reference run for each peptide*

---

**Description**

Provides the reference run based on lowest p-value.

**Usage**

```
getRefRun(peptideScores, applyFun = lapply)
```

**Arguments**

peptideScores	(list of data-frames) each dataframe has scores of a peptide across all runs.
applyFun	(function) value must be either lapply or BiocParallel::bplapply.

**Value**

(dataframe) has two columns:

peptide\_id      (integer) a unique id for each peptide.  
run              (string) run identifier.

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License: (c) Author (2020) + GPL-3 Date: 2020-04-08

**See Also**

[getPeptideScores](#)

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
fileInfo <- getRunNames(dataPath = dataPath)
precursorsInfo <- getPrecursors(fileInfo, oswMerged = TRUE, runType = "DIA-Proteomics",
                               context = "experiment-wide", maxPeptideFdr = 0.05)
peptideIDs <- unique(precursorsInfo$peptide_id)
peptidesInfo <- getPeptideScores(fileInfo, peptideIDs)
peptidesInfo <- lapply(peptideIDs, function(pep) peptidesInfo [.(pep),])
names(peptidesInfo) <- as.character(peptideIDs)
getRefRun(peptidesInfo)
```

---

getRTdf

*Calculates global alignment between RT of two runs*

---

**Description**

This function selects features from oswFiles which has m-score < maxFdrLoess. It fits linear/loess regression on these feature. Retention-time mapping is established from reference to experiment run.

**Usage**

```
getRTdf(features, ref, eXp, maxFdrGlobal)
```

**Arguments**

features      (list of data-frames) it is output from getFeatures function.  
ref            (string) Must be a combination of "run" and an iteger e.g. "run2".  
eXp            (string) Must be a combination of "run" and an iteger e.g. "run2".  
maxFdrGlobal (numeric) A numeric value between 0 and 1. Features should have m-score lower than this value for participation in global fit.

**Value**

A data-frame

**Author(s)**

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License: (c) Author (2021) + GPL-3 Date: 2019-03-01

**See Also**

[getGlobalAlignment](#)

**Examples**

```
data(oswFiles_DIAalignR, package="DIAalignR")
df <- getRTdf(features = oswFiles_DIAalignR, ref = "run1", exp = "run2", maxFdrGlobal = 0.05)
```

---

getRunNames	<i>Get names of all runs</i>
-------------	------------------------------

---

**Description**

Fetches all osw files, then, keeps only those runs which has corresponding mzML files. mzML file names must match with RUN.FILENAME columns of osw files.

**Usage**

```
getRunNames(dataPath, oswMerged = TRUE, params = paramsDIAalignR())
```

**Arguments**

dataPath	(char) Path to xics and osw directory.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAalignR</a> function.

**Value**

(dataframe) it has five columns:

spectraFile	(string) as mentioned in RUN table of osw files.
runName	(string) contain respective mzML names without extension.
spectraFileID	(string) ID in RUN table of osw files.
featureFile	(string) Path to the feature file.
chromatogramFile	(string) Path to the chromatogram file.



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License: (c) Author (2019) + GPL-3 Date: 2019-12-14

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
getRunNames(dataPath = dataPath, oswMerged = TRUE)
```

---

getSeqSimMatCpp	<i>Calculates similarity matrix for two sequences</i>
-----------------	---

---

**Description**

Calculates similarity matrix for two sequences

**Usage**

```
getSeqSimMatCpp(seq1, seq2, match, misMatch)
```

**Arguments**

seq1	(char) A single string.
seq2	(char) A single string.
match	(double) Score for character match.
misMatch	(double) score for character mismatch.

**Value**

s (matrix) Numeric similarity matrix. Rows and columns expresses seq1 and seq2, respectively.

**Author(s)**

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**Examples**

```
# Get sequence similarity of two DNA strings
Match=10; MisMatch=-2
seq1 = "GCAT"; seq2 = "CAGTG"
getSeqSimMatCpp(seq1, seq2, Match, MisMatch)
matrix(c(-2, 10, -2, -2, -2, -2, 10, -2, 10, -2, -2, -2, -2, -2, 10, 10, -2, -2, -2),
      4, 5, byrow = FALSE)
```

---

getTransitions            *Get transitions from all feature files*

---

### Description

Get a list of data-frame of OpenSwath features that contains retention time, intensities, boundaries etc.

### Usage

```
getTransitions(  
  fileInfo,  
  maxFdrQuery = 0.05,  
  runType = "DIA_Proteomics",  
  applyFun = lapply  
)
```

### Arguments

`fileInfo`            (data-frame) output of `getRunNames` function.  
`maxFdrQuery`        (numeric) a numeric value between 0 and 1. It is used to filter features from osw file which have SCORE\_MS2.QVALUE less than itself.  
`runType`            (char) yhis must be one of the strings "DIA\_Proteomics", "DIA\_Metabolomics".  
`applyFun`           (function) value must be either `lapply` or `BiocParallel::bplapply`.

### Value

(list of dataframes) each dataframe has following columns:

`transition_group_id`        (integer) a unique id for each precursor.  
`RT`                    (numeric) retention time as in FEATURE.EXP\_RT of osw files.  
`intensity`            (list) of peak intensities as in FEATURE\_TRANSITION.AREA\_INTENSITY of osw files.  
`leftWidth`            (numeric) as in FEATURE.LEFT\_WIDTH of osw files.  
`rightWidth`           (numeric) as in FEATURE.RIGHT\_WIDTH of osw files.  
`peak_group_rank`        (integer) rank of each feature associated with `transition_group_id`.  
`m_score`              (numeric) q-value of each feature associated with `transition_group_id`.

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License: (c) Author (2020) + GPL-3 Date: 2020-11-15

**See Also**

[getRunNames](#), [fetchTransitionsFromRun](#)

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
fileInfo <- getRunNames(dataPath = dataPath)
transitions <- getTransitions(fileInfo, maxFdrQuery = 1.00, runType = "DIA_Proteomics")
dim(transitions[[2]]) # 938 8
```

---

getXICs

*Get XICs of all analytes*

---

**Description**

For all the analytes requested in runs, it first creates oswFiles, then, fetches chromatogram indices from oswFiles and extract chromatograms from mzML files.

**Usage**

```
getXICs(
  analytes,
  runs,
  dataPath = ".",
  maxFdrQuery = 1,
  runType = "DIA_Proteomics",
  oswMerged = TRUE,
  params = paramsDIAAlignR()
)
```

**Arguments**

analytes	(integer) a vector of precursor IDs.
runs	(vector of string) names of mzML files without extension.
dataPath	(string) Path to xics and osw directory.
maxFdrQuery	(numeric) A numeric value between 0 and 1. It is used to filter features from osw file which have SCORE_MS2.QVALUE less than itself.
runType	(char) This must be one of the strings "DIA_Proteomics", "DIA_Metabolomics".
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.

**Value**

A list of list. Each list contains XIC-group for that run. XIC-group is a list of dataframe that has elution time and intensity of fragment-ion XIC.

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License: (c) Author (2019) + GPL-3 Date: 2019-12-13

**See Also**

[getXICs4AlignObj](#), [getRunNames](#), [analytesFromFeatures](#)

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
runs <- c("hroest_K120808_Strep10%PlasmaBiolRep11_R03_SW_filt",
         "hroest_K120809_Strep10%PlasmaBiolRep12_R04_SW_filt")
analytes <- c(32L, 898L, 2474L)
XICs <- getXICs(analytes, runs = runs, dataPath = dataPath)
```

---

<code>getXICs4AlignObj</code>	<i>Extract XICs of analytes</i>
-------------------------------	---------------------------------

---

**Description**

For all the analytes requested, it fetches chromatogram indices from `prec2chromIndex` and extracts chromatograms using `mzPntrs`.

**Usage**

```
getXICs4AlignObj(mzPntrs, fileInfo, runs, prec2chromIndex, analytes)
```

**Arguments**

<code>mzPntrs</code>	a list of <code>mzRpwiz</code> .
<code>fileInfo</code>	(data-frame) output of <code>getRunNames()</code> .
<code>runs</code>	(vector of string) names of <code>mzML</code> files without extension.
<code>prec2chromIndex</code>	(list of data-frames) output of <code>getChromatogramIndices()</code> . Each dataframe has two columns: <code>transition_group_id</code> and <code>chromatogramIndex</code> .
<code>analytes</code>	(integer) a vector of precursor IDs.

**Value**

A list of list of data-frames. Each data frame has elution time and intensity of fragment-ion XIC.

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**See Also**

[getChromatogramIndices](#), [getRunNames](#)

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
runs <- c("hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt",
         "hroest_K120808_Strep10%PlasmaBiolRepl1_R03_SW_filt")
analytes <- c(32L, 898L, 2474L)
params <- paramsDIAAlignR()
params[["chromFile"]] <- "mzML"
fileInfo <- getRunNames(dataPath = dataPath)
fileInfo <- updateFileInfo(fileInfo, runs)
precursors <- getPrecursorByID(analytes, fileInfo)
mzPntrs <- getMZMLpointers(fileInfo)
prec2chromIndex <- getChromatogramIndices(fileInfo, precursors, mzPntrs)
XICs <- getXICs4AlignObj(mzPntrs, fileInfo, runs, prec2chromIndex, analytes)
rm(mzPntrs)
```

---

get\_ropenms

*Get ropenms handle*

---

**Description**

Python path can also be set using `Sys.setenv(RETICULATE_PYTHON = pythonPath)`. Also, remove `.Rhistory` file to avoid conflict with previously used python version.

**Usage**

```
get_ropenms(pythonPath = NULL, condaEnv = NULL, useConda = TRUE)
```

**Arguments**

`pythonPath` (string) path of the python program that has `pyopenms` module.

`condaEnv` (string) name of the conda environment that has `pyopenms` module.

`useConda` (logical) TRUE: Use conda environment. FALSE: Use python through `pythonPath`.

**Value**

(`pyopenms` module)

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License: (c) Author (2020) + GPL-3 Date: 2020-06-06

**Examples**

```
## Not run:  
  ropenms <- get_ropenms(condaEnv = "envName", useConda=TRUE)  
  
## End(Not run)
```

---

imputeChromatogram      *Fill missing intensities in a chromatogram*

---

**Description**

Fill missing intensities in a chromatogram

**Usage**

```
imputeChromatogram(  
  chromatogram,  
  method = "spline",  
  polyOrd = 4,  
  kernelLen = 9,  
  splineMethod = "fmm"  
)
```

**Arguments**

chromatogram      (data-frames) first column is time, second column is intensity.  
method            (string) must be either "spline", "sgolay" or "linear".  
polyOrd           (integer) must be less than kernelLen.  
kernelLen         (integer) must be an odd integer.  
splineMethod      (string) must be either "fmm" or "natural".

**Value**

(dataframe) has two columns:

time              (numeric)  
intensity         (numeric)

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ORCID: 0000-0003-3500-8152

License: (c) Author (2020) + GPL-3 Date: 2020-05-21

**See Also**

[na.approx](#), [na.spline](#)

**Examples**

```
time <- seq(from = 3003.4, to = 3048, by = 3.4)
y <- c(0.2050595, 0.8850070, 2.2068768, 3.7212677, 5.1652605, 5.8288915, 5.5446804,
      4.5671360, 3.3213154, 1.9485889, 0.9520709, 0.3294218, 0.2009581, 0.1420923)
chrom <- data.frame(time, y)
chrom$y[c(1,8, 14)] <- NA
imputeChromatogram(chrom, "sgolay")
imputeChromatogram(chrom, "spline")
imputeChromatogram(chrom, "linear")
```

---

mapIdxToTime

*Establishes mapping from index to time*

---

**Description**

Takes a time vector and index vector of same length. This function create a new time vector given indices specified in `idx`.

**Usage**

```
mapIdxToTime(timeVec, idx)
```

**Arguments**

`timeVec`            A numeric vector

`idx`                An integer vector

**Value**

A mutated time vector

**Author(s)**

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License: (c) Author (2019) + GPL-3 Date: 2019-12-13

## Examples

```
timeVec <- c(1.3,5.6,7.8)
idx <- c(NA, NA, 1L, 2L, NA, NA, 3L, NA)
mapIdxToTime(timeVec, idx) # c(NA, NA, 1.3, 5.6, 6.333, 7.067, 7.8, NA)
```

---

masterXICs\_DIAAlignR    *Master fragment-ion chromatograms from two parents*

---

## Description

Created merged XICs of peptide (ID = 4618) 14299\_QFNNTDIVLLEDFQK/3 from two SWATH runs:

run1 : hroest\_K120809\_Strep0%PlasmaBiolRepl2\_R04\_SW\_filt.chrom.mzML

run2 : hroest\_K120809\_Strep10%PlasmaBiolRepl2\_R04\_SW\_filt.chrom.mzML

## Usage

```
masterXICs_DIAAlignR
```

## Format

The format is similar to the output of childXICs. A list of two elements: First element contains six fragmentation chromatograms. The second element has aligned parent time-vectors and corresponding child time-vector. It has five columns:

**indexAligned.ref** (integer) aligned indices of reference run.

**indexAligned.eXp** (integer) aligned indices of experiment run.

**tAligned.ref** (numeric) aligned time-vector of reference run.

**tAligned.eXp** (numeric) aligned time-vector of experiment run.

**alignedChildTime** (numeric) aligned time-vector of master run.

## Source

File test\_GenerateData.R has [source code](#) to generate the example data.



multipeptide\_DIAalignR *Analytes information from multipeptide.*

### Description

analytes info from three SWATH runs:

run0 : hroest\_K120808\_Strep10%PlasmaBiolRepl1\_R03\_SW\_filt.chrom.mzML

run1 : hroest\_K120809\_Strep0%PlasmaBiolRepl2\_R04\_SW\_filt.chrom.mzML

run2 : hroest\_K120809\_Strep10%PlasmaBiolRepl2\_R04\_SW\_filt.chrom.mzML

### Usage

multipeptide\_DIAalignR

### Format

A list of 199 elements where each element represents a precursor and consists of a dataframe:

**transition\_group\_id** ID of each precursor. Same as the name of the list

**RT** Retention time, in sec

**intensity** Intensity of associated feature

**leftWidth** Left width of the peak, in sec

**rightWidth** Right width of the peak, in sec

**peak\_group\_rank** Ranking of associated feature

**m\_score** qvalue of associated feature

**run** Name of the run, feature is from

**alignment\_rank** Rank of the feature after alignment

### Source

Raw files are downloaded from [Peptide Atlas](#). File test\_GenerateData.R has [source code](#) to generate the example data.

oswFiles\_DIAalignR *Analytes information from osw files*

### Description

analytes info from three SWATH runs:

run0 : hroest\_K120808\_Strep10%PlasmaBiolRepl1\_R03\_SW\_filt.chrom.mzML

run1 : hroest\_K120809\_Strep0%PlasmaBiolRepl2\_R04\_SW\_filt.chrom.mzML

run2 : hroest\_K120809\_Strep10%PlasmaBiolRepl2\_R04\_SW\_filt.chrom.mzML

**Usage**

```
oswFiles_DIAAlignR
```

**Format**

A list of three elements where each element consists of a dataframe:

**transition\_group\_id** ID of each peptide

**RT** Retention time, in sec

**intensity** Intensity of associated feature

**leftWidth** Left width of the peak, in sec

**rightWidth** Right width of the peak, in sec

**peak\_group\_rank** Ranking of associated feature

**m\_score** qvalue of associated feature

**Source**

Raw files are downloaded from [Peptide Atlas](#). File test\_GenerateData.R has [source code](#) to generate the example data.

---

otherChildXICpp	<i>Get child chromatogram for other precursors using main precursor alignment</i>
-----------------	---

---

**Description**

Get child chromatogram for other precursors using main precursor alignment

**Usage**

```
otherChildXICpp(  
  l1,  
  l2,  
  kernelLen,  
  polyOrd,  
  mat,  
  childTime,  
  wRef = 0.5,  
  splineMethod = "natural"  
)
```

**Arguments**

l1	(list) A list of numeric matrix of two columns. l1 and l2 should have same length.
l2	(list) A list of numeric matrix of two columns. l1 and l2 should have same length.
kernelLen	(integer) length of filter. Must be an odd number.
polyOrd	(integer) TRUE: remove background from peak signal using estimated noise levels.
mat	(matrix) aligned time and child time from the main precursor.
childTime	(numeric) iime vector from the child chromatogram.
wRef	(numeric) Weight of the reference XIC. Must be between 0 and 1.
splineMethod	(string) must be either "fmm" or "natural".

**Value**

(List) of chromatograms.

**Author(s)**

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**Examples**

```
data(XIC_QFNNTDIVLLEDFQK_3_DIAalignR, package="DIAalignR")
XICs <- XIC_QFNNTDIVLLEDFQK_3_DIAalignR
XICs.ref <- lapply(XICs[["hroest_K120809_Strep0%PlasmaBiolRep12_R04_SW_filt"]][["4618"]], as.matrix)
XICs.exp <- lapply(XICs[["hroest_K120809_Strep10%PlasmaBiolRep12_R04_SW_filt"]][["4618"]], as.matrix)
B1p <- 4964.752
B2p <- 5565.462
chrom <- getChildXICpp(XICs.ref, XICs.exp, 11L, 4L, alignType = "hybrid", adaptiveRT = 77.82315,
  normalization = "mean", simType = "dotProductMasked", B1p = B1p, B2p = B2p,
  goFactor = 0.125, geFactor = 40, cosAngleThresh = 0.3, OverlapAlignment = TRUE,
  dotProdThresh = 0.96, gapQuantile = 0.5, hardConstrain = FALSE, samples4gradient = 100,
  wRef = 0.5, keepFlanks= TRUE)
chrom2 <- otherChildXICpp(XICs.ref, XICs.exp, 11L, 4L, chrom[[2]], chrom[[1]][[1]][,1],
  0.5, "natural")
```

**Description**

Retention alignment requires OpenSWATH/pyProphet extracted features and chromatograms. This function provides a suite of parameters used for selecting features and manipulating chromatograms. Chromatogram alignment can be performed via reference based or progressively via rooted or unrooted tree. This function provides sensible parameters for these tasks.

**Usage**

```
paramsDIAAlignR()
```

**Value**

A list of parameters:

runType	(string) must be one of the strings "DIA_Proteomics", "DIA_Metabolomics".
chromFile	(string) must either be "mzML" or "sqMass".
maxFdrQuery	(numeric) a numeric value between 0 and 1. It is used to filter peptides from osw file which have SCORE_MS2.QVALUE less than itself.
maxPeptideFdr	(numeric) a numeric value between 0 and 1. It is used to filter peptides from osw file which have SCORE_PEPTIDE.QVALUE less than itself.
analyteFDR	(numeric) defines the upper limit of FDR on a precursor to be considered for multipeptide.
context	(string) used in pyprophet peptide. Must be either "run-specific", "experiment-wide", or "global".
unalignedFDR	(numeric) must be between 0 and maxFdrQuery. Features below unalignedFDR are considered for quantification even without the RT alignment.
alignedFDR	(numeric) must be between unalignedFDR and 1. Features below alignedFDR are considered for quantification after the alignment.
level	(string) apply maxPeptideFDR on Protein as well if specified as "Protein". Default: "Peptide".
integrationType	(string) method to compute the area of a peak contained in XICs. Must be from "intensity_sum", "trapezoid", "simpson".
baseSubtraction	logical TRUE: remove background from peak signal using estimated noise levels.
baselineType	(string) method to estimate the background of a peak contained in XICs. Must be from "none", "base_to_base", "vertical_division_min", "vertical_division_max".
fitEMG	(logical) enable/disable exponentially modified gaussian peak model fitting.
recalIntensity	(logical) recalculate intensity for all analytes.
fillMissing	(logical) calculate intensity for analytes for which features are not found.
XICfilter	(string) must be either sgolay, boxcar, gaussian, loess or none.
polyOrd	(integer) order of the polynomial to be fit in the kernel.
kernellen	(integer) number of data-points to consider in the kernel.
globalAlignment	(string) must be either "loess" or "linear".
globalAlignmentFdr	(numeric) a numeric value between 0 and 1. Features should have m-score lower than this value for participation in LOESS fit.

globalAlignmentSpan	(numeric) spanvalue for LOESS fit. For targeted proteomics 0.1 could be used.
RSEdistFactor	(numeric) defines how much distance in the unit of rse remains a noBeef zone.
normalization	(string) must be selected from "mean", "l2".
simMeasure	(string) must be selected from dotProduct, cosineAngle, crossCorrelation, cosine2Angle, dotProductMasked, euclideanDist, covariance and correlation.
alignType	(numeric) available alignment methods are "global", "local" and "hybrid".
goFactor	(numeric) penalty for introducing first gap in alignment. This value is multiplied by base gap-penalty.
geFactor	(numeric) penalty for introducing subsequent gaps in alignment. This value is multiplied by base gap-penalty.
cosAngleThresh	(numeric) in simType = dotProductMasked mode, angular similarity should be higher than cosAngleThresh otherwise similarity is forced to zero.
OverlapAlignment	(logical) an input for alignment with free end-gaps. False: Global alignment, True: overlap alignment.
dotProdThresh	(numeric) in simType = dotProductMasked mode, values in similarity matrix higher than dotProdThresh quantile are checked for angular similarity.
gapQuantile	(numeric) must be between 0 and 1. This is used to calculate base gap-penalty from similarity distribution.
kerLen	(integer) In simType = crossCorrelation, length of the kernel used to sum similarity score. Must be an odd number.
hardConstrain	(logical) if FALSE; indices farther from noBeef distance are filled with distance from linear fit line.
samples4gradient	(numeric) modulates penalization of masked indices.
fillMethod	(string) must be either "spline", "sgolay" or "linear".
splineMethod	(string) must be either "fmm" or "natural".
mergeTime	(string) must be either "ref", "avg", "refStart" or "refEnd".
keepFlanks	(logical) TRUE: Flanking chromatogram is not removed.
fraction	(integer) indicates which fraction to align.
fractionNum	(integer) Number of fractions to divide the alignment.
lossy	(logical) if TRUE, time and intensity are lossy-compressed in generated sqMass file.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2020) + GPL-3 Date: 2020-07-11

**See Also**

[checkParams](#), [alignTargetedRuns](#)

**Examples**

```
params <- paramsDIAAlignR()
```

---

plotAlignedAnalytes *Plot aligned XICs group for a specific peptide. AlignObjOutput is the output from getAlignObjs fucntion.*

---

**Description**

Plot aligned XICs group for a specific peptide. AlignObjOutput is the output from getAlignObjs fucntion.

**Usage**

```
plotAlignedAnalytes(
  AlignObjOutput,
  plotType = "All",
  outFile = "AlignedAnalytes.pdf",
  annotatePeak = FALSE,
  saveFigs = FALSE
)
```

**Arguments**

AlignObjOutput (list) list contains fileInfo, AlignObj, raw XICs for reference and experiment, and reference-peak label.

plotType (string) must be one of the strings "All", "onlyUnaligned" and "onlyAligned".

outFile (string) name of the output pdf file.

annotatePeak (logical) TRUE: Peak boundaries and apex will be highlighted.

saveFigs (logical) TRUE: Figures will be saved in AlignedAnalytes.pdf .

**Value**

A plot to the current device.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2019) + GPL-3 Date: 2019-12-13

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
runs <- c("hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt",
  "hroest_K120809_Strep10%PlasmaBiolRepl2_R04_SW_filt")
AlignObjOutput <- getAlignObjs(analytes = 4618L, runs, dataPath = dataPath)
plotAlignedAnalytes(AlignObjOutput)
```

---

plotAlignmentPath      *Visualize alignment path through similarity matrix*

---

### Description

Plot aligned path through the similarity matrix. Reference run has indices on X-axis, eXp run has them on Y-axis. In getAlignObjs function, objType must be set to medium.

### Usage

```
plotAlignmentPath(AlignObjOutput)
```

### Arguments

AlignObjOutput (list) The list contains AlignObj, raw XICs for reference and experiment, and reference-peak label.

### Value

A plot to the current device.

### Author(s)

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2019) + GPL-3 Date: 2019-12-13

### Examples

```
library(lattice)
dataPath <- system.file("extdata", package = "DIAAlignR")
runs <- c("hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt",
         "hroest_K120809_Strep10%PlasmaBiolRepl2_R04_SW_filt")
AlignObjOutput <- getAlignObjs(analytes = 4618L, runs, dataPath = dataPath, objType = "medium")
plotAlignmentPath(AlignObjOutput)
```

---

plotAnalyteXICs      *Plot extracted-ion chromatogram.*

---

### Description

Plot extracted-ion chromatogram.

**Usage**

```
plotAnalyteXICs(  
  analyte,  
  run,  
  dataPath = ".",  
  maxFdrQuery = 1,  
  XICfilter = "sgolay",  
  polyOrd = 4,  
  kernellLen = 9,  
  runType = "DIA_Proteomics",  
  oswMerged = TRUE,  
  peakAnnot = NULL,  
  Title = NULL  
)
```

**Arguments**

analyte	(integer) an analyte is a PRECURSOR.ID from the osw file.
run	(string) Name of a xics file without extension.
dataPath	(string) path to xics and osw directory.
maxFdrQuery	(numeric) A numeric value between 0 and 1. It is used to filter features from osw file which have SCORE_MS2.QVALUE less than itself.
XICfilter	(string) must be either sgolay, boxcar, gaussian, loess or none.
polyOrd	(integer) order of the polynomial to be fit in the kernel.
kernellLen	(integer) number of data-points to consider in the kernel.
runType	(char) This must be one of the strings "DIA_Proteomics", "DIA_Metabolomics".
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
peakAnnot	(numeric) Peak-apex time.
Title	(logical) TRUE: name of the list will be displayed as title.

**Value**

A plot to the current device.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2019) + GPL-3 Date: 2019-12-13

**See Also**

[plotXICgroup](#)



## Examples

```
dataPath <- system.file("extdata", package = "DIAAlignR")
run <- "hroest_K120809_Strep10%PlasmaBiolRepl2_R04_SW_filt"
plotAnalyteXICs(analyte = 2474L, run, dataPath = dataPath, oswMerged = TRUE, XICfilter = "none")
plotAnalyteXICs(analyte = 2474L, run, dataPath = dataPath, oswMerged = TRUE, XICfilter = "sgolay")
```

---

plotXICgroup	<i>Plot Extracted-ion chromatogram group.</i>
--------------	---

---

## Description

Plot Extracted-ion chromatogram group.

## Usage

```
plotXICgroup(XIC_group, peakAnnot = NULL, Title = NULL)
```

## Arguments

XIC_group	(list) It is a list of dataframe which has two columns. First column is for time and second column indicates intensity.
peakAnnot	(numeric) Peak-apex time.
Title	(logical) TRUE: name of the list will be displayed as title.

## Value

A plot to the current device.

## Author(s)

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>  
ORCID: 0000-0003-3500-8152  
License: (c) Author (2019) + GPL-3 Date: 2019-12-13

## See Also

[plotAnalyteXICs](#)

## Examples

```
dataPath <- system.file("extdata", package = "DIAAlignR")
runs <- c("hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt",
         "hroest_K120809_Strep10%PlasmaBiolRepl2_R04_SW_filt")
XICs <- getXICs(analytes = 4618L, runs = runs, dataPath = dataPath, oswMerged = TRUE)
plotXICgroup(XICs[["hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt"]][["4618"]])
XICs <- smoothXICs(XICs[["hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt"]][["4618"]],
                  type = "sgolay", kernelLen = 13, polyOrd = 4)
plotXICgroup(XICs, Title = "Precursor 4618 \n
run hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt")
```

---

`progAlignRuns`*Peptide quantification through progressive alignment*

---

## Description

This function expects `osw` and `xics` directories at `dataPath`. It first reads `osw` files and fetches chromatogram indices for each analyte. To perform alignment, first a crude guide-tree is built which can also be provided with `newickTree` parameter. As we traverse from the leaf-nodes to the root node, runs are aligned pairwise. The root node is named `master1` that has average of all fragment ion chromatograms and identified peak-groups. These features are propagated back to leaf nodes and finally aligned features are written in the output file.

## Usage

```
progAlignRuns(  
  dataPath,  
  params,  
  outFile = "DIAAlignR",  
  ropenms = NULL,  
  oswMerged = TRUE,  
  runs = NULL,  
  newickTree = NULL,  
  applyFun = lapply  
)
```

## Arguments

<code>dataPath</code>	(string) path to <code>xics</code> and <code>osw</code> directory.
<code>params</code>	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.
<code>outFile</code>	(string) name of the output file.
<code>ropenms</code>	(pyopenms module) get this python module through <a href="#">get_ropenms</a> . Required only for <code>chrom.mzML</code> files.
<code>oswMerged</code>	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by <code>pyprophet</code> .
<code>runs</code>	(string) names of <code>xics</code> file without extension.
<code>newickTree</code>	(string) guidance tree in newick format. Look up <a href="#">getTree</a> .
<code>applyFun</code>	(function) value must be either <code>lapply</code> or <code>BiocParallel::bplapply</code> .

## Value

(None)

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2020) + GPL-3 Date: 2020-07-10

**See Also**

[alignTargetedRuns](#)

**Examples**

```
dataPath <- system.file("extdata", package = "DIAAlignR")
params <- paramsDIAAlignR()
params[["context"]] <- "experiment-wide"
## Not run:
ropenms <- get_ropenms(condaEnv = "envName")
progAlignRuns(dataPath, params = params, outFile = "test3", ropenms = ropenms)
# Removing aligned vectors
file.remove(list.files(dataPath, pattern = "*_av.rds", full.names = TRUE))
# Removing temporarily created master chromatograms
file.remove(list.files(file.path(dataPath, "xics"), pattern = "^master[0-9]+\\.chrom\\.mzML$", full.names = TRUE))
file.remove(file.path(dataPath, "test3.temp.RData"))
file.remove(file.path(dataPath, "master.merged.osw"))

## End(Not run)
```

---

progComb3

*Step 3 for progressive alignment*

---

**Description**

Step 3 for progressive alignment

**Usage**

```
progComb3(
  dataPath,
  params,
  outFile = "DIAAlignR",
  oswMerged = TRUE,
  applyFun = lapply
)
```

**Arguments**

dataPath	(string) path to xics and osw directory.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.
outFile	(string) name of the output file.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
applyFun	(function) value must be either lapply or BiocParallel::bplapply.

**Author(s)**

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ORCID: 0000-0003-3500-8152

License: (c) Author (2021) + GPL-3 Date: 2021-03-03

**See Also**

[progAlignRuns](#)

---

progSplit2

*Step 2 for progressive alignment*

---

**Description**

Step 2 for progressive alignment

**Usage**

```
progSplit2(  
  dataPath,  
  params,  
  outFile = "DIAAlignR",  
  oswMerged = TRUE,  
  applyFun = lapply  
)
```

**Arguments**

dataPath	(string) path to xics and osw directory.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.
outFile	(string) name of the output file.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
applyFun	(function) value must be either lapply or BiocParallel::bplapply.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2021) + GPL-3 Date: 2021-03-03

**See Also**

[progAlignRuns](#)

---

progSplit4

*Step 4 for progressive alignment*

---

**Description**

Step 4 for progressive alignment

**Usage**

```
progSplit4(  
  dataPath,  
  params,  
  outFile = "DIAAlignR",  
  oswMerged = TRUE,  
  applyFun = lapply  
)
```

**Arguments**

dataPath	(string) path to xics and osw directory.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.
outFile	(string) name of the output file.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
applyFun	(function) value must be either lapply or BiocParallel::bplapply.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2021) + GPL-3 Date: 2021-03-03

**See Also**

[progAlignRuns](#)

---

progTree1

*Step 1 for progressive alignment*

---

## Description

Step 1 for progressive alignment

## Usage

```
progTree1(  
  dataPath,  
  params,  
  outFile = "DIAAlignR",  
  oswMerged = TRUE,  
  runs = NULL,  
  newickTree = NULL,  
  applyFun = lapply  
)
```

## Arguments

dataPath	(string) path to xics and osw directory.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.
outFile	(string) name of the output file.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
runs	(string) names of xics file without extension.
newickTree	(string) guidance tree in newick format. Look up <a href="#">getTree</a> .
applyFun	(function) value must be either lapply or BiocParallel::bplapply.

## Author(s)

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2021) + GPL-3 Date: 2021-03-03

## See Also

[progAlignRuns](#)

---

recalculateIntensity *Calculates area of peaks in peakTable*

---

### Description

For the give peak boundary in peakTable, the function extracts raw chromatograms and recalculate intensities.

### Usage

```
recalculateIntensity(  
  peakTable,  
  dataPath = ".",  
  oswMerged = TRUE,  
  params = paramsDIAAlignR()  
)
```

### Arguments

peakTable	(data-frame) usually an output of alignTargetedRuns. Must have these columns: run, precursor, leftWidth, rightWidth.
dataPath	(string) path to xics and osw directory.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.

### Value

(data-frame)

### Author(s)

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2020) + GPL-3 Date: 2020-05-28

### See Also

[alignTargetedRuns](#), [calculateIntensity](#)

## Examples

```
peakTable <- data.frame(precursor = c(1967L, 1967L, 2474L, 2474L),
  run = rep(c("hroest_K120808_Strep10%PlasmaBiolRepl1_R03_SW_filt",
    "hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt"), 2),
  intensity = c(186.166, 579.832, 47.9525, 3.7413),
  leftWidth = c(5001.76, 5025.66, 6441.51, 6516.6),
  rightWidth = c(5076.86, 5121.25, 6475.65, 6554.2), stringsAsFactors = FALSE)
dataPath <- system.file("extdata", package = "DIAAlignR")
newTable <- recalculateIntensity(peakTable, dataPath)
```

---

script1

*Extract features and generate pairwise alignments.*

---

## Description

Extract features and generate pairwise alignments.

## Usage

```
script1(
  dataPath,
  outFile = "DIAAlignR",
  params = paramsDIAAlignR(),
  oswMerged = TRUE,
  runs = NULL,
  applyFun = lapply
)
```

## Arguments

dataPath	(string) path to xics and osw directory.
outFile	(string) name of the output file.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
runs	(a vector of string) names of xics file without extension.
applyFun	(function) value must be either lapply or BiocParallel::bplapply.

## Author(s)

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2021) + GPL-3 Date: 2021-02-20



**See Also**[alignTargetedRuns](#)**Examples**

```

params <- paramsDIAAlignR()
params[["context"]] <- "experiment-wide"
dataPath <- system.file("extdata", package = "DIAAlignR")
BiocParallel::register(BiocParallel::MulticoreParam(workers = 4, progressbar = TRUE))
script1(dataPath, outFile = "testDIAAlignR", params = params, applyFun = BiocParallel::bplapply)
file.remove(file.path(dataPath, "testDIAAlignR_script1.RData"))

```

script2

*Performs alignment using script1 output***Description**

Performs alignment using script1 output

**Usage**

```

script2(
  dataPath,
  outFile = "DIAAlignR",
  params = paramsDIAAlignR(),
  oswMerged = TRUE,
  runs = NULL,
  refRun = NULL,
  applyFun = lapply
)

```

**Arguments**

dataPath	(string) path to xics and osw directory.
outFile	(string) name of the output file.
params	(list) parameters are entered as list. Output of the <a href="#">paramsDIAAlignR</a> function.
oswMerged	(logical) TRUE for experiment-wide FDR and FALSE for run-specific FDR by pyprophet.
runs	(a vector of string) names of xics file without extension.
refRun	(string) reference for alignment. If no run is provided, m-score is used to select reference run.
applyFun	(function) value must be either lapply or BiocParallel::bplapply.

**Author(s)**

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ORCID: 0000-0003-3500-8152

License: (c) Author (2021) + GPL-3 Date: 2021-02-20

**See Also**

[alignTargetedRuns](#)

**Examples**

```
params <- paramsDIAAlignR()
params[["context"]] <- "experiment-wide"
dataPath <- system.file("extdata", package = "DIAAlignR")
BiocParallel::register(BiocParallel::MulticoreParam(workers = 4, progressbar = TRUE))
script1(dataPath, outFile = "testDIAAlignR", params = params, applyFun = BiocParallel::bplapply)
script2(dataPath, outFile = "testDIAAlignR", params = params, applyFun = lapply)
file.remove(file.path(dataPath, "testDIAAlignR_script1.RData"))
```

---

sgolayCpp

*Smooth chromatogram with savitzky-golay filter.*

---

**Description**

Smooth chromatogram with savitzky-golay filter.

**Usage**

```
sgolayCpp(chrom, kernellLen, polyOrd)
```

**Arguments**

chrom	(matrix) chromatogram containing time and intensity vectors.
kernellLen	(integer) length of filter. Must be an odd number.
polyOrd	(integer) TRUE: remove background from peak signal using estimated noise levels.

**Value**

(matrix).

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca> ORCID: 0000-0003-3500-8152 License: (c) Author (2020) + MIT Date: 2019-12-31

**Examples**

```
data("XIC_QFNNTDIVLLEDFQK_3_DIAalignR", package = "DIAalignR")
XICs <- XIC_QFNNTDIVLLEDFQK_3_DIAalignR[["hroest_K120809_Strep0%PlasmaBiolRepl2_R04_SW_filt"]][["4618"]]
xic <- sgolayCpp(as.matrix(XICs[[1]]), kernelLen = 11L, polyOrd = 4L)
```

---

smoothSingleXIC	<i>Smooth chromatogram signal</i>
-----------------	-----------------------------------

---

**Description**

Smoothing methods are Savitzky-Golay, Boxcar, Gaussian kernel and LOESS. Savitzky-Golay smoothing is good at preserving peak-shape compared to gaussian and boxcar smoothing. However, it assumes equidistant points that fortunately is the case for DIA data. This requires a quadratic memory to store the fit and slower than other smoothing methods.

**Usage**

```
smoothSingleXIC(
  chromatogram,
  type,
  samplingTime = NULL,
  kernelLen = NULL,
  polyOrd = NULL
)
```

**Arguments**

chromatogram	(dataframe) A dataframe of two columns. First column must always be monotonically increasing.
type	(char) must be either sgolay, boxcar, gaussian, loess or none.
samplingTime	(numeric) Time difference between neighboring points.
kernelLen	(integer) Number of data-points to consider in the kernel.
polyOrd	(integer) Order of the polynomial to be fit in the kernel.

**Details**

Gaussian smoothing uses a gaussian function whose bandwidth is scaled by 0.3706505 to have quartiles at  $\pm 0.25 \cdot \text{bandwidth}$ . The point selection cut-off is also hard at  $0.3706505 \cdot 4 \cdot \text{bandwidth}$ . `qnorm(0.75, sd = 0.3706505)`

The definition of `C_ksmooth` can be found using `getAnywhere('C_ksmooth')` `stats:::C_ksmooth`

**Value**

A dataframe with two columns.

**Author(s)**

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ORCID: 0000-0003-3500-8152

License: (c) Author (2020) + GPL3 Date: 2020-02-21

**See Also**

<https://terpconnect.umd.edu/~toh/spectrum/Smoothing.html>, <https://rafalab.github.io/dsbook/smoothing.html>, <https://github.com/SurajGupta/r-source/blob/master/src/library/stats/src/ksmooth.c>

**Examples**

```
data("XIC_QFNNTDIVLLEDFQK_3_DIAalignR")
chrom <- XIC_QFNNTDIVLLEDFQK_3_DIAalignR[["hroest_K120808_Strep10%PlasmaBio1Rep11_R03_SW_filt"]][["4618"]][[1]]
## Not run:
newChrom <- smoothSingleXIC(chrom, type = "sgolay", samplingTime = 3.42, kernelLen = 9,
  polyOrd = 3)

## End(Not run)
```

---

smoothXICs

*Smooth chromatogram signals from a list*

---

**Description**

Smoothing methods are Savitzky-Golay, Boxcar, Gaussian kernel and LOESS. Savitzky-Golay smoothing is good at preserving peak-shape compared to gaussian and boxcar smoothing. However, it assumes equidistant points that fortunately is the case for DIA data. This requires a quadratic memory to store the fit and slower than other smoothing methods.

**Usage**

```
smoothXICs(
  XICs,
  type = "none",
  samplingTime = NULL,
  kernelLen = 9L,
  polyOrd = NULL
)
```

**Arguments**

XICs (A list) A list of dataframe that consists of two columns. First column must be monotonically increasing.

type (char) must be either sgolay, boxcar, gaussian, loess or none.

samplingTime (numeric) Time difference between neighboring points.  
 kernelLen (integer) Number of data-points to consider in the kernel.  
 polyOrd (integer) Order of the polynomial to be fit in the kernel.

**Value**

A list.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>

ORCID: 0000-0003-3500-8152

License: (c) Author (2020) + GPL3 Date: 2020-02-21

**See Also**

<https://terpconnect.umd.edu/~toh/spectrum/Smoothing.html>, <https://rafalab.github.io/dsbook/smoothing.html>

**Examples**

```
data("XIC_QFNNTDIVLLEDFQK_3_DIAalignR")
XICs <- XIC_QFNNTDIVLLEDFQK_3_DIAalignR[["hroest_K120808_Strep10%PlasmaBiolRep11_R03_SW_filt"]][["4618"]]
newXICs <- smoothXICs(XICs, type = "sgolay", samplingTime = 3.42, kernelLen = 9,
  polyOrd = 3)
```

---

splineFillCpp

*Interpolate using spline*

---

**Description**

Interpolate using spline

**Usage**

```
splineFillCpp(x, y, xout)
```

**Arguments**

x (numeric) A numeric matrix with similarity values of two sequences or signals.  
 y (numeric) Penalty for introducing first gap in alignment.  
 xout (numeric) Penalty for introducing subsequent gaps in alignment.

**Value**

(numeric)

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca> ORCID: 0000-0003-3500-8152 License: (c) Author (2021) + MIT Date: 2021-01-06

**Examples**

```
time <- seq(from = 3003.4, to = 3048, by = 3.4)
y <- c(0.2050595, 0.8850070, 2.2068768, 3.7212677, 5.1652605, 5.8288915, 5.5446804,
      4.5671360, 3.3213154, 1.9485889, 0.9520709, 0.3294218, 0.2009581, 0.1420923)
y[c(1,6)] <- NA_real_
idx <- !is.na(y)
splineFillCpp(time[idx], y[idx], time[!idx])
zoo::na.spline(zoo::zoo(y[idx], time[idx]), xout = time[!idx], method = "natural")
```

---

trimXICs

*Selects a part of chromatograms*


---

**Description**

This function trims chromatograms from the end-points.

**Usage**

```
trimXICs(XICs, len = 1)
```

**Arguments**

XICs	(A list) A list of dataframe that consists of two columns. First column must be monotonically increasing.
len	(numeric) must be between 0.1 and 1.

**Value**

A list.

**Author(s)**

Shubham Gupta, <shubh.gupta@mail.utoronto.ca>  
ORCID: 0000-0003-3500-8152  
License: (c) Author (2020) + GPL3 Date: 2020-04-01

**Examples**

```
data("XIC_QFNNTDIVLLEDFQK_3_DIAalignR")
XICs <- XIC_QFNNTDIVLLEDFQK_3_DIAalignR[["hroest_K120808_Strep10%PlasmaBiolRepl1_R03_SW_filt"]][["4618"]]
## Not run:
newXICs <- smoothXICs(XICs, len = 0.5)

## End(Not run)
```

---

updateFileInfo	<i>Get intersection of runs and fileInfo</i>
----------------	--

---

## Description

Get intersection of runs and fileInfo

## Usage

```
updateFileInfo(fileInfo, runs = NULL)
```

## Arguments

fileInfo (data-frame) output of getRunNames function.  
runs (vector of string) names of mzML files without extension.

## Value

(dataframe) it has five columns:

spectraFile (string) as mentioned in RUN table of osw files.  
runName (string) contain respective mzML names without extension.  
spectraFileID (string) ID in RUN table of osw files.  
featureFile (string) path to the feature file.  
chromatogramFile (string) path to the chromatogram file.

## Author(s)

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## Examples

```
dataPath <- system.file("extdata", package = "DIAAlignR")  
fileInfo <- getRunNames(dataPath = dataPath, oswMerged = TRUE)  
runs <- c("hroest_K120809_Strep0%PlasmaBiolRep12_R04_SW_filt",  
         "hroest_K120808_Strep10%PlasmaBiolRep11_R03_SW_filt")  
updateFileInfo(fileInfo, runs)
```

---

XIC\_QFNNTDIVLLEDFQK\_3\_DIAalignR

*Extracted-ion chromatograms (XICs) of a peptide*

---

### Description

XICs of peptide QFNNTDIVLLEDFQK/3 (precursor ID: 4618) from three SWATH runs:

run0 : hroest\_K120808\_Strep10%PlasmaBiolRepl1\_R03\_SW\_filt.chrom.mzML

run1 : hroest\_K120809\_Strep0%PlasmaBiolRepl2\_R04\_SW\_filt.chrom.mzML

run2 : hroest\_K120809\_Strep10%PlasmaBiolRepl2\_R04\_SW\_filt.chrom.mzML

### Usage

XIC\_QFNNTDIVLLEDFQK\_3\_DIAalignR

### Format

A list of three elements where each element consists of a list of six data frames. Each data frame has two columns:

**time** Retention time of ananlyte in the run, in sec

**intensity** Intensity of signal for the transition

### Source

Raw files are downloaded from [Peptide Atlas](#). File test\_GenerateData.R has [source code](#) to generate the example data.



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