RRtoolbox Documentation

Release 1

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Contents:

CHAPTER 1

RRtoolbox package

1.1 Subpackages

1.1.1 RRtoolbox.lib package

Subpackages

RRtoolbox.lib.arrayops package

Submodules

RRtoolbox.lib.arrayops.basic module This module contains simple array operation methods

RRtoolbox.lib.arrayops.basic.**angle**(*v1*, *v2*, *deg=False*)
Angle between two N dimmensional vectors.

Parameters

- **v1** – vector 1.
- **v2** – vector 2.
- **deg** – if True angle is in Degrees, else radians.

Returns angle in radians.

Example:

```
>>> angle_between((1, 0, 0), (0, 1, 0))
1.5707963267948966
>>> angle_between((1, 0, 0), (1, 0, 0))
0.0
>>> angle_between((1, 0, 0), (-1, 0, 0))
3.141592653589793
```

Note: obtained from http://stackoverflow.com/a/13849249/5288758 and tested in http://onlinemschool.com/math/assistance/vector/angl/

RRtoolbox.lib.arrayops.basic.**angle2D**(*v1*, *v2*, *deg=False*, *absolute=None*)
Angle between two 2 dimensional vectors.

Parameters

- **v1** – vector 1.
- **v2** – vector 2.
- **deg** – if True angle is in Degrees, else radians.
- **absolute** – if None returns the angle (0 yo 180(pi)) between v1 and v2. if True returns the absolute angle (0 to 360(2pi)) from v1 as axis to v2. if False returns the angle (0 to 180 or 0 to -180) from v1 as axis to v2, where v2 angle relative to v1 is positive or negative if counter-clock or clock wise.

Returns angle in radians.

Note: implemented according to http://math.stackexchange.com/a/747992 and tested in http://onlinemschool.com/math/assistance/vector/angl/

RRtoolbox.lib.arrayops.basic.**angleXY**(*coorX*, *coorY*, *angle*)

Rotate coordinate.

Parameters

- **coorX** – x coordinate.
- **coorY** – y coordinate.
- **angle** – radian angle.

Returns rotated x,y

RRtoolbox.lib.arrayops.basic.**anorm**(*a*)

norm in array.

Parameters **a** –

Returns

RRtoolbox.lib.arrayops.basic.**anorm2**(*a*)

Summation of squares (helper function for *anorm()*)

Parameters **a** –

Returns

RRtoolbox.lib.arrayops.basic.**axesIntercept**(*coorSM*, *maxS*, *maxM*)

Intercept static axis (S) and mobile axis (M) with a coordinate connecting both axes from minS to minM.

S1 S2

S0 |<————————————|————> maxS

coorSM <————| |

M1 M2

M0 <————|————————————>| maxM

Parameters

- **coorSM** – coordinate of vector from S=0 to M=0.
- **maxS** – value representing end of estatic axis.
- **maxM** – value representing end of mobile axis.

Returns S1,S2,M1,M2.

RRtoolbox.lib.arrayops.basic.**boxPads**(*bx*, *points*)
Get box pads to fit all.

Parameters

- **bx** – box coordinates or previous boxPads [left_top, right_bottom]
- **points** – array of points

Returns [(left,top),(right,bottom)] where bx and points fit.

RRtoolbox.lib.arrayops.basic.**centerM**(*coor*, *maxM*)
Center vector coor in M axis.

Parameters

- **coor** – coordinate of vector from S=0 to M center
- **maxM** – value representing end of mobile axis

Returns M centered coordinate

RRtoolbox.lib.arrayops.basic.**centerS**(*coor*, *maxS*)
Center vector coor in S axis.

Parameters

- **coor** – coordinate of vector from S center to M=0
- **maxS** – value representing end of estatic axis

Returns S centered coordinate

RRtoolbox.lib.arrayops.basic.**centerSM**(*coorSM*, *maxS*, *maxM*)
Center vector coorSM in both S and M axes.

Parameters

- **coorSM** – coordinate of vector from S to M centers.
- **maxS** – value representing end of estatic axis.
- **maxM** – value representing end of mobile axis.

Returns SM centered coordinate.

RRtoolbox.lib.arrayops.basic.**contours2mask**(*contours*, *shape=None*, *astype=<type 'bool'>*)
Creates an array with filled polygons formed by contours.

Parameters

- **contours** – list of contour or points forming objects
- **shape** – (None) shape of array. If None it creates an array fitted to contours.
- **astype** – ("bool") numpy type

Returns

RRtoolbox.lib.arrayops.basic.**contoursArea**(*contours*)
Accumulates areas from list of contours.

Parameters **contours** – list of contours or binary array.

Returns area.

RRtoolbox.lib.arrayops.basic.**convertXY**(*x*, *y*, *backshape*, *foreshape*, *flag=0*, *quartile=0*, *angle=None*)

Convert absolute XY 0,0 coordinates to new system WZ.

Parameters

- **x** – x coordinate.
- **y** – y coordinate.
- **backshape** – shape of background image.

:param foreshape:shape of foreground image. :param flag: flag for position (default=0).

•flag==0 : foreground to left up.

•flag==1 : foreground to left down.

•flag==2 : foreground to right up.

•flag==3 : foreground to right down.

•flag==4 : foreground at center of background.

•flag==5 : XY 0,0 is at center of background.

•flag==6 : XY 0,0 is at center of foreground.

•flag==7 : XY 0,0 is at right down of foreground.

Parameters

- **quartile** – place Mobile image at quartile 1,2,3,4. if left quartile=0 image won't be moved.
- **angle** – angle in radians (defalut=None). if None it does not apply.

Returns W,Z

RRtoolbox.lib.arrayops.basic.**convexityRatio**(*cnt*, *hull=None*)

Ratio to test if contours are irregular

Parameters **cnt** – contour

:param hull:(None) convex hull :return: ratio

RRtoolbox.lib.arrayops.basic.**entroyTest**(*arr*)

Entropy test of intensity arrays. (Helper function for `entropy()`)

Parameters **arr** – array MxN of dim 2.

Returns entropy.

RRtoolbox.lib.arrayops.basic.**find_near**(*m*, *thresh=None*, *side=None*)

helper function for findminima and findmaxima :param m: minima or maxima points :param thresh: guess or seed point :param side: left or right :return: value

RRtoolbox.lib.arrayops.basic.**findmaxima**(*hist*, *thresh=None*, *side=None*)

Get nearest peak value to a thresh point from a histogram.

Parameters

- **hist** – histogram
- **thresh** – initial seed
- **side** – find valley from left or right of thresh

Returns

RRtoolbox.lib.arrayops.basic.**findminima**(*hist*, *thresh=None*, *side=None*)
Get nearest valley value to a thresh point from a histogram.

Parameters

- **hist** – histogram
- **thresh** – initial seed
- **side** – find valley from left or right of thresh

Returns

RRtoolbox.lib.arrayops.basic.**getOtsuThresh**(*hist*)
From histogram calculate Otsu threshold value.

Parameters **hist** – histogram

Returns otsu threshold value

RRtoolbox.lib.arrayops.basic.**getTransformedCorners**(*shape*, *H*)
from shape gets transformed corners of array.

Parameters

- **shape** – H,W array shape
- **H** – transformation matrix

Returns upper_left, upper_right, lower_right, lower_lef transformed corners.

RRtoolbox.lib.arrayops.basic.**getTransparency**(*array*)
Convert foreground to background.

Parameters **array** – image array.

Returns alfa (int or array)

RRtoolbox.lib.arrayops.basic.**get_x_space**(*funcs*, *step=10*, *xleft=-300*, *xright=300*)
get X axis space by brute force. This can be used to find the x points where the points in the y axis of any number of functions become stable.

Parameters

- **funcs** – list of functions
- **step** –

10. step to close guess to maximum

- **xleft** – maximum left limit
- **xright** – maximum right limit

Returns linspace

RRtoolbox.lib.arrayops.basic.**getdataVH**(*array*, *ypad=0*, *xpad=0*, *bgrcolor=None*, *alfa=None*)
Get data from array according to padding (Helper function for *padVH()*).

Parameters

- **array** – list of arrays to get data
- **ypad** – how much to pad in y axis
- **xpad** – how much to pad in x axis

Returns matrix_shapes, grid_div, row_grid, row_gridpad, globalgrid

RRtoolbox.lib.arrayops.basic.**histogram**(*img*)
Get image histogram.

Parameters **img** – gray or image with any bands

Returns histogram of every band

RRtoolbox.lib.arrayops.basic.**im2imFormat**(*src*, *dst*)
Tries to convert source image to destine image format.

Parameters

- **src** – source image.
- **dst** – destine image.

Returns reshaped source image.

RRtoolbox.lib.arrayops.basic.**im2shapeFormat**(*im*, *shape*)
Tries to convert image to intuited format from shape.

Parameters

- **im** – image.
- **shape** – shape to get format.

  shapes: * (None, None): converts to gray * (None, None, 2): converts to GR555 * (None, None, 3): converts to BGR * (None, None, 4): converts to BGRA

Returns reshaped image.

RRtoolbox.lib.arrayops.basic.**instability_bf**(*funcs*, *step=10*, *maximum=300*, *guess=0*, *tolerance=0.01*)
Find the instability of function approaching value by brute force,

Parameters

- **funcs** – list of functions
- **step** –

  10. step to close guess to maximum

- **maximum** –

  300. maximum value, if guess surpass this value then calculations are stopped.

- **guess** –

  0. initial guess

- **tolerance** – (0.01) tolerance with last step to check instability.

Returns (state, updated guess). state is True if successful, else False.

RRtoolbox.lib.arrayops.basic.**invertM**(*coorSM*, *maxM*)
Invert M axis.

Parameters

- **coorSM** – coordinate of vector for M inverted axes.
- **maxS** – value representing end of estatic axis.
- **maxM** – value representing end of mobile axis.

Returns SM coordinate on S axis and inverted M axis.

RRtoolbox.lib.arrayops.basic.**invertSM**(*coorSM*, *maxS*, *maxM*)
Invert S and M axes.

Parameters

- **coorSM** – coordinate of vector for SM inverted axes.
- **maxS** – value representing end of estatic axis.
- **maxM** – value representing end of mobile axis.

Returns SM coordinate on inverted SM axes.

RRtoolbox.lib.arrayops.basic.**isnumpy**(*arr*)
Test whether an object is a numpy array. :param arr: :return: True if numpy array, else false.

RRtoolbox.lib.arrayops.basic.**makeVis**(*globalgrid*, *bgrcolor=None*)
Make visualization (Helper function for *padVH()*)

Parameters

- **globalgrid** – shape
- **bgrcolor** – color of visualization

Returns array of shape globalgrid

RRtoolbox.lib.arrayops.basic.**matrixIntercept**(*x*, *y*, *staticm*, **mobilem*)
Intercepts planes x and y of a static matrix (staticm) with N mobile matrices (mobilem) translated from the origin to x,y coordinates.

Parameters

- **x** – x coordinate.
- **y** – y coordinate.
- **staticm** – static matrix.
- **mobilem** – mobile matrices.

Returns ROI of intercepted matrices [staticm,*mobilem].

RRtoolbox.lib.arrayops.basic.**multiple_superpose**(*base*, *fore*, *H*, *foremask=None*)
Superpose multiple foreground images to a single base image.

Parameters

- **base** – backgraound, base or dipest level image (level -1)
- **fore** – foreground image list (in order of level i = 0, ... , N)
- **H** – transformation matrix of fore in level i to overlay in base
- **foremask** – foreground alfa mask in level i

Returns generator of each overlay

RRtoolbox.lib.arrayops.basic.**noisy**(*arr*, *mode*)
Add noise to arrays

Parameters

- **arr** – Input ndarray data (it will be converted to float).
- **mode** – noise method:
  - 'gauss' - Gaussian-distributed additive noise.

- 'poisson' - Poisson-distributed noise generated from the data.
- 's&p' - Replaces random pixels with 0 or 1.
- **'speckle' - Multiplicative noise using out = arr + n*arr,where** n is uniform noise with specified mean & variance.

:return noisy arr

RRtoolbox.lib.arrayops.basic.**normalize**(*arr*)
Normalize array to ensure range [0,1]

RRtoolbox.lib.arrayops.basic.**normalize2**(*arr*)
Normalize with factor of absolute maximum value.

RRtoolbox.lib.arrayops.basic.**normalizeCustom**(*arr*, *by=<function amax>*, *axis=None*)
Normalize array with custom operations.

Parameters

- **arr** – array (it does not correct negative values, use preferable NxM).
- **by** – np,max, np.sum or any function that gets an array to obtain factor.
- **axis** – if None it normalizes in all axes else in the selected axis.

Returns normalized to with factor.

RRtoolbox.lib.arrayops.basic.**overlay**(*back*, *fore*, *alpha=None*, *alfainverted=False*, *under=False*, *flag=0*)
Try to Overlay any dimension array.

Parameters

- **back** – BGRA background image.
- **fore** – BGRA foreground image.
- **alpha** – transparency channel.
- **alfainverted** – if True inverts alpha transparency.
- **under** – if True, place back as fore and fore as back.
- **flag** – (experimental)
  0. **Normally replace inverted transparency of alpha in back (N);** superpose alpha in back (V).
  1. **Bloat and replace inverted transparency of alpha in back;** superpose bgr in back (V).
  2. Superpose inverted transparent COLOR of alpha in back.
  3. Superpose inverted transparent COLOR of alpha in back.
  4. **Superpose transparent of alpha in back;** superpose transparent COLOR of alpha in back.
  5. **Superpose transparent of alpha in back;** superpose transparent COLOR of alpha in back.

Returns overlayed array

See also:

overlay2()

RRtoolbox.lib.arrayops.basic.**overlay2**(*back*, *fore*)
Overlay foreground to x,y coordinates in background image.

Parameters

- **back** – background image (numpy array dim 3).
- **fore** – foreground image (numpy array dim 4). the fourth dimension is used for transparency.

Returns back (with overlay).

#Example:

```
import cv2
import numpy as np
import time
a= time.time()
back = cv2.imread("t1.jpg")
temp = back.shape
bgr = np.zeros((temp[0],temp[1],4), np.uint8)
points = [(86, 162), (1219, 1112), (2219, 2112), (1277,3000),(86, 162)]
col_in = (0, 0, 0,255)
thickness = 10
for i in range(len(points)-1):
    pt1 = (points[i][0], points[i][1])
    pt2 = (points[i+1][0], points[i+1][1])
    cv2.line(bgr, pt1, pt2, col_in, thickness)

overlay(back,bgr)

win = "overlay"
cv2.namedWindow(win,cv2.WINDOW_NORMAL)
cv2.imshow(win, back)
print time.time()-a
cv2.waitKey()
cv2.destroyAllWindows()
```

See also:

overlay()

RRtoolbox.lib.arrayops.basic.**overlayXY**(*x*, *y*, *back*, *fore*, *alfa=None*, *alfainverted=False*, *under=False*, *flag=0*)

Overlay foreground image to x,y coordinates in background image. This function support images of different sizes with formats: BGR background and BGRA foreground of Opencv or numpy images.

Parameters

- **x** – x position in background.
- **y** – y position in background.
- **back** – background image (numpy array dim 3).
- **fore** – foreground image (numpy array dim 4). the fourth dimension is used for transparency.

Returns back (with overlay)

Example:

```
import cv2
back = cv2.imread("t1.jpg")
bgr = cv2.imread("mustache.png",-1)
x,y=convertXY(0,0,back.shape,bgr.shape,flag=1)
overlayXY(x,y,back,bgr)
```

```
    win = "overlay"
    cv2.namedWindow(win,cv2.WINDOW_NORMAL)
    cv2.imshow(win, back)
    cv2.waitKey()
    cv2.destroyAllWindows()
```

RRtoolbox.lib.arrayops.basic.**overlaypng**(*back*, *fore*, *alpha=None*, *alfainverted=False*, *under=False*, *flag=0*)

Overlay only BGRA.

Parameters

- **back** – BGRA background image.
- **fore** – BGRA foreground image.
- **alpha** – transparency channel.
- **alfainverted** – if True inverts alpha transparency.
- **under** – if True, place back as fore and fore as back.
- **flag** – (experimental)
  0. **Normally replace inverted transparency of alpha in back (N);** superpose alpha in back (V).
  1. **Bloat and replace inverted transparency of alpha in back;** superpose bgr in back (V).
  2. Superpose inverted transparent COLOR of alpha in back.
  3. Superpose inverted transparent COLOR of alpha in back.
  4. **Superpose transparent of alpha in back;** superpose transparent COLOR of alpha in back.
  5. **Superpose transparent of alpha in back;** superpose transparent COLOR of alpha in back.

Returns overlayed array

See also:

overlay(), *overlay2()*

RRtoolbox.lib.arrayops.basic.**padVH**(*imgs*, *ypad=0*, *xpad=0*, *bgrcolor=None*, *alfa=None*)

Pad Vertically and Horizontally image or group of images into an array.

Parameters

- **imgs** – image to pad or list of horizontal images (i.e. piled up horizontally as [V1,..,VN] where each can be a list of vertical piling VN = [H1,..,HM]. It can be successive like horizontals, verticals, horizontals, etc.
- **ypad** – padding in axis y
- **xpad** – padding in axis x
- **bgrcolor** – color of spaces
- **alfa** – transparency of imgs over background of bgrcolor color.

Returns visualization of paded and piled images in imgs.

RRtoolbox.lib.arrayops.basic.**pad_to_fit_H**(*shape1*, *shape2*, *H*)

get boxPads to fit transformed shape1 in shape2.

Parameters

- **shape1** – shape of array 1
- **shape2** – shape of array 2
- **H** – transformation matrix to use in shape1

Returns [(left,top),(right,bottom)]

RRtoolbox.lib.arrayops.basic.**points2mask**(*pts*, *shape=None*, *astype=<type 'bool'>*)

Creates an array with the filled polygon formed by points.

Parameters

- **pts** – points.
- **shape** – (None) shape of array. If None it creates an array fitted to points.
- **astype** – ("bool") numpy type

Returns array.

Example:

```
pts = random_points([(-100, 100), (-100, 100)])
img = points2mask(pts)
plotim("filled",img).show()
```

RRtoolbox.lib.arrayops.basic.**points_generator**(*shape=(10, 10)*, *nopoints=None*, *convex=False*, *erratic=False*, *complete=False*)

generate points.

Parameters

- **shape** – enclosed frame
- **nopoints** – number of points
- **convex** – if True make points convex, else points follow a circular pattern.

Returns

RRtoolbox.lib.arrayops.basic.**polygonArea**(*pts*)

Area of points calculating polygon Area.

Parameters **pts** – points.

Returns area value.

..note::

- If polygon is incomplete (last is not first point) it completes the array.
- If the polygon crosses over itself the algorithm will fail.
- Based on http://www.mathopenref.com/coordpolygonarea.html

RRtoolbox.lib.arrayops.basic.**polygonArea_calcule**(*pts*)

Area of points calculating polygon Area.

Parameters **pts** – points.

Returns area value.

..note::

- If polygon is incomplete (last is not first point) it completes the array.
- If the polygon crosses over itself the algorithm will fail.
- Based on http://www.mathopenref.com/coordpolygonarea.html

RRtoolbox.lib.arrayops.basic.**polygonArea_contour**(*pts*)
Area of points using contours.

Parameters **pts** – points.

Returns area value.

..note:: if polygon is incomplete (last is not first point) it completes the array.

RRtoolbox.lib.arrayops.basic.**polygonArea_fill**(*pts*)
Area of points using filled polygon and pixel count.

Parameters **pts** – points.

Returns area value.

..note:: if polygon is incomplete (last is not first point) it completes the array.

RRtoolbox.lib.arrayops.basic.**process_as_blocks**(*arr*, *func*, *block_shape=(3, 3)*, *mask=None*, *asWindows=False*)
process with function over an array using blocks (using re-striding).

Parameters

- **arr** – array to process
- **func** – function to feed blocks
- **block_shape** – (3,3) shape of blocks
- **mask** – (None) mask to process arr
- **asWindows** – (False) if True all blocks overlap each other to give a result for each position of arr, if False the results are given in blocks equivalent for each processed blocks of arr (faster).

Returns processed array.

RRtoolbox.lib.arrayops.basic.**quadrant**(*coorX*, *coorY*, *maxX*, *maxY*, *quadrant=0*)
Moves a point to a quadrant

Parameters

- **coorX** – point in x coordinate
- **coorY** – point in y coordinate
- **maxX** – max value in x axis
- **maxY** – max value in y axis
- **quadrant** – Cartesian quadrant, if 0 or False it leaves coorX and coorY unprocessed.

Returns

RRtoolbox.lib.arrayops.basic.**random_points**(*axes_range=((-50, 50),)*, *nopoints=4*, *complete=False*)
Get random points.

Parameters

- **axes_range** – [x_points_range, y_points_range] where points_range is (min,max) range in axis.
- **nopoints** – number of points.
- **complete** – last point is the first point (adds an additional point i.e. nopoints+1).

Returns numpy array.

RRtoolbox.lib.arrayops.basic.**recursiveMap**(*function*, *sequence*)
Iterate recursively over a structure using a function.

Parameters

- **function** – function to apply
- **sequence** – iterator

Returns

RRtoolbox.lib.arrayops.basic.**relativeQuadrants**(*points*)
Get quadrants of relative vectors obtained from points. :param points: array of points. :return: quadrants.

RRtoolbox.lib.arrayops.basic.**relativeVectors**(*pts*, *all=True*)
Form vectors from points.

Parameters

- **pts** – array of points [p0, ... ,(x,y)].
- **all** – (True) if True adds last vector from last and first point.

Returns array of vectors [V0, ... , (V[n] = x[n+1]-x[n],y[n+1]-y[n])].

RRtoolbox.lib.arrayops.basic.**rescale**(*arr*, *max=1*, *min=0*)
Rescales array values to range [min,max].

Parameters

- **arr** – array.
- **max** – maximum value in range.
- **min** – minimum value in range.

Returns rescaled array.

RRtoolbox.lib.arrayops.basic.**separePointsByAxis**(*pts*, *ptaxis=(1, 0)*, *origin=(0, 0)*)
Separate scattered points with respect to axis (splitting line).

Parameters

- **pts** – points to separate.
- **ptaxis** – point to form axis from origin
- **origin** – origin

Returns left, right points from axis.

RRtoolbox.lib.arrayops.basic.**splitPoints**(*pts*, *aslist=None*)
from points get x,y columns

Parameters

- **pts** – array of points
- **aslist** – True to return lists instead of arrays

Returns x, y columns

RRtoolbox.lib.arrayops.basic.**standarizePoints**(*pts*, *aslist=False*)
converts points to a standard form :param pts: list or array of points :param aslist: True to return list instead of array :return: standard points

RRtoolbox.lib.arrayops.basic.**superpose**(*back*, *fore*, *H*, *foreMask=None*, *grow=True*)
Superpose foreground image to background image.

Parameters

- **back** – background image
- **fore** – foreground image
- **H** – transformation matrix of fore to overlay in back
- **foreMask** – (None) foreground alpha mask, None or function. foreMask values are from 1 for solid to 0 for transparency. If a function is provided the new back,fore parameters are provided to produce the foreMask. If None is provided as foreMask then it is equivalent to a foreMask with all values to 1 where fore is True.
- **grow** – If True, im can be bigger than back and is calculated according to how fore is superposed in back; if False im is of the same shape as back.

Returns im, H_back, H_fore

RRtoolbox.lib.arrayops.basic.**transformPoint**(*p*, *H*)
Transform individual x,y point with Transformation Matrix.

Parameters

- **p** – x,y point
- **H** – transformation matrix

Returns transformed x,y point

RRtoolbox.lib.arrayops.basic.**transformPoints**(*p*, *H*)
Transform x,y points in array with Transformation Matrix.

Parameters

- **p** – array of points
- **H** – transformation matrix

Returns transformed array of x,y point

RRtoolbox.lib.arrayops.basic.**unit_vector**(*vector*)
Returns the unit vector of the vector.

RRtoolbox.lib.arrayops.basic.**vectorsAngles**(*pts*, *ptaxis=(1, 0)*, *origin=(0, 0)*, *dtype=None*, *deg=False*, *absolute=None*)
Angle of formed vectors in Cartesian plane with respect to formed axis vector.

i.e. angle between vector "Vn" (formed by point "Pn" and the "origin")

and vector "Vaxis" formed by "ptaxis" and the "origin".

where pts-origin = (P0-origin ... Pn-origin) = V0 ... Vn

Parameters

- **pts** – points to form vectors from origin
- **ptaxis** – point to form axis from origin

- **origin** – origin
- **dtype** – return array of type supported by numpy.
- **deg** – if True angle is in Degrees, else radians.
- **absolute** – if None returns angles (0 yo 180(pi)) between pts-origin (V0 .. Vn) and Vaxis. if True returns any Vn absolute angle (0 to 360(2pi)) from Vaxis as axis to Vn. if False returns any Vn angle (0 to 180 or 0 to -180) from Vaxis as axis to Vn, where any Vn angle is positive or negative if counter-clock or clock wise from Vaxis.

Returns

RRtoolbox.lib.arrayops.basic.**vectorsQuadrants**(*vecs*)

Get quadrants of vectors.

Parameters **vecs** – array of vectors.

Returns quadrants.

RRtoolbox.lib.arrayops.basic.**vertexesAngles**(*pts*, *dtype=None*, *deg=False*)

Relative angle of vectors formed by vertexes (where vectors cross).

i.e. angle between vectors "v01" formed by points "p0-p1" and "v12" formed by points "p1-p2" where "p1" is seen as a vertex (where vectors cross).

Parameters

- **pts** – points seen as vertexes (vectors are recreated from point to point).
- **dtype** – return array of type supported by numpy.
- **deg** – if True angle is in Degrees, else radians.

Returns angles.

RRtoolbox.lib.arrayops.basic.**view_as_blocks**(*arr_in*, *block_shape=(3, 3)*)

Provide a 2D block_shape view to 2D array. No error checking made. Therefore meaningful (as implemented) only for blocks strictly compatible with the shape of arr_in.

Parameters

- **arr_in** –
- **block_shape** –

Returns

RRtoolbox.lib.arrayops.basic.**view_as_windows**(*arr_in*, *window_shape*, *step=1*)

Provide a 2D block_shape rolling view to 2D array. No error checking made. Therefore meaningful (as implemented) only for blocks strictly compatible with the shape of arr_in.

Parameters

- **arr_in** –
- **window_shape** –
- **step** –

Returns

RRtoolbox.lib.arrayops.convert module This module unlike common and basic array operations classifies just the from-to-conversions methods

class RRtoolbox.lib.arrayops.convert.**SimKeyPoint**(**args*)
Simulates opencv keypoint (it allows manipulation, conversion and serialization of keypoints).

Note: Used for conversions and data persistence.

RRtoolbox.lib.arrayops.convert.**apply2kp_pairs**(*kp_pairs*, *kp1_rel*, *kp2_rel*, *func=None*)
Apply to kp_pairs.

Parameters

- **kp_pairs** – list of (kp1,kp2) pairs
- **kp1_rel** – x,y relation or function to apply to kp1
- **kp2_rel** – x,y relation or function to apply to kp2
- **func** – function to build new copy of keypoint

Returns transformed kp_pairs

RRtoolbox.lib.arrayops.convert.**cnt2pts**(*contours*)
Convert contours to points. (cnt2pts)

Parameters **contours** – array of contours (cnt) ([[x,y]] only for openCV)

Returns

Example:

```
contours = np.array([[[0, 0]], [[1, 0]]]) # contours
points = contour2points(contours)
print points # np.array([[0, 0], [1, 0]])
```

RRtoolbox.lib.arrayops.convert.**contour2points**(*contours*)
Convert contours to points. (cnt2pts)

Parameters **contours** – array of contours (cnt) ([[x,y]] only for openCV)

Returns

Example:

```
contours = np.array([[[0, 0]], [[1, 0]]]) # contours
points = contour2points(contours)
print points # np.array([[0, 0], [1, 0]])
```

RRtoolbox.lib.arrayops.convert.**conv3H4H**(*M*)
Convert a 3D transformation matrix (TM) to 4D TM.

Parameters **M** – Matrix

Returns 4D Matrix

RRtoolbox.lib.arrayops.convert.**dict2keyPoint**(*d*, *func=<built-in function KeyPoint>*)
KeyPoint([x, y, _size[, _angle[, _response[, _octave[, _class_id]]]]]) -> <KeyPoint object>

RRtoolbox.lib.arrayops.convert.**getSOpointRelation**(*source_shape*, *destine_shape*, *asMatrix=False*)
Return parameters to change scaled point to original point.

destine_domain = relation*source_domain

Parameters

- **source_shape** – image shape for source domain
- **destine_shape** – image shape for destine domain
- **asMatrix** – if true returns a Transformation Matrix H

Returns x, y coordinate relations or H if asMatrix is True

Note: Used to get relations to convert scaled points to original points of an Image.

RRtoolbox.lib.arrayops.convert.**invertH**(*H*)
Invert Transformation Matrix.

Parameters **H** –

Returns

RRtoolbox.lib.arrayops.convert.**keyPoint2tuple**(*keypoint*)
obj.angle, obj.class_id, obj.octave, obj.pt, obj.response, obj.size

RRtoolbox.lib.arrayops.convert.**points2contour**(*points*)
Convert points to contours. (pts2cnt)

Parameters **points** – array of points ([x,y] for openCV, [y,x] for numpy)

Returns

Example:

```
points = np.array([[0, 0], [1, 0]]) # points
contours = points2contour(points)
print contours # np.array([[[0, 0]], [[1, 0]]])
```

RRtoolbox.lib.arrayops.convert.**points2vectos**(*pts*, *origin=None*)
Convert points to vectors with respect to origin.

Parameters

- **pts** – array of points.
- **origin** – point of origin.

Returns vectors.

RRtoolbox.lib.arrayops.convert.**pts2cnt**(*points*)
Convert points to contours. (pts2cnt)

Parameters **points** – array of points ([x,y] for openCV, [y,x] for numpy)

Returns

Example:

```
points = np.array([[0, 0], [1, 0]]) # points
contours = points2contour(points)
print contours # np.array([[[0, 0]], [[1, 0]]])
```

RRtoolbox.lib.arrayops.convert.**sh2oh**(*sH*, *osrc_sh*, *sscr_sh*, *odst_sh*, *sdst_sh*)
Convert scaled transformation matrix (sH) to original (oH).

Parameters

- **sH** – scaled transformation matrix
- **osrc_sh** – original source's shape
- **sscr_sh** – scaled source's shape
- **odst_sh** – original destine's shape
- **sdst_sh** – scaled destine's shape

Returns

RRtoolbox.lib.arrayops.convert.**spairs2opairs**(*kp_pairs*, *osrc_sh*, *sscr_sh*, *odst_sh*, *sdst_sh*, *func=None*)

Convert scaled kp_pairs to original kp_pairs.

Parameters

- **kp_pairs** – list of kp_pairs
- **osrc_sh** – original source's shape
- **sscr_sh** – scaled source's shape
- **odst_sh** – original destine's shape
- **sdst_sh** – scaled destine's shape
- **func** – function to build new copy of keypoint

Returns

RRtoolbox.lib.arrayops.convert.**spoint2opointfunc**(*source_shape*, *destine_shape*)

Return function with parameters to change scaled point to original point.

Parameters

- **source_shape** –
- **destine_shape** – shape of

Returns

Example:

```
forefunc = scaled2realfunc(imgf.shape,bgr.shape)
backfunc = scaled2realfunc(imgb.shape,back.shape)
p1fore = np.array([forefunc(i) for i in p1])
p2back = np.array([backfunc(i) for i in p2])
```

RRtoolbox.lib.arrayops.convert.**toTupple**(*obj*)

Converts recursively to tuple

Parameters **obj** – numpy array, list structure, iterators, etc.

Returns tuple representation obj.

RRtoolbox.lib.arrayops.convert.**translateQuadrants**(*quadrants*, *quadrantmap={(0, 1): 'up', (-1, 1): 'left-up', (0, 0): 'origin', (-1, 0): 'left', (-1, -1): 'left-down', (0, -1): 'down', (1, 0): 'right', (1, -1): 'right-down', (1, 1): 'right-up'}*)

Convert quadrants into human readable data.

Parameters

- **quadrants** – array of quadrants.

- **quadrantmap** – dictionary map to translate quadrants. it is of the form:

```
{(0,0):"origin",(1,0):"right",(1,1):"top-right",(0,1):"top",(-1,1):"top-left",
```

(-1,0):"left",(-1,-1):"bottom-left",(0,-1):"bottom",(1,-1):"bottom-right"}

Returns list of translated quadrants.

RRtoolbox.lib.arrayops.convert.**tuple2keyPoint**(*points*, *func=<built-in function KeyPoint>*)

KeyPoint([x, y, _size[, _angle[, _response[, _octave[, _class_id]]]]]) -> <KeyPoint object>

RRtoolbox.lib.arrayops.convert.**vectos2points**(*vecs*, *origin=None*)

Convert points to vectors with respect to origin.

Parameters

- **vecs** – array of vectors.
- **origin** – point of origin.

Returns points.

RRtoolbox.lib.arrayops.filters module This module contains custom 1D adn 2D-array filters and pre-processing (as in filtering phase) methods

class RRtoolbox.lib.arrayops.filters.**BilateralParameters**(*d=None*, *sigmaColor=None*, *sigmaSpace=None*)

Bases: object

create instance to calculate bilateral parameters from image shape.

d -> inf then:

- computation is slower
- filtering is better to eliminate noise
- images look more cartoon-like

Parameters

- **d** – distance
- **sigmaColor** – sigma in color
- **sigmaSpace** – sigma in space

d = 27

d_h = <RRtoolbox.lib.arrayops.filters.bilateraP object>

filters
list of filters

sigmaColor = <RRtoolbox.lib.arrayops.filters.bilateraP object>

sigmaSpace = <RRtoolbox.lib.arrayops.filters.bilateraP object>

class RRtoolbox.lib.arrayops.filters.**FilterBase**(*alpha=None*, *beta1=None*, *beta2=None*)

Bases: object

base filter to create custom filters

alpha

beta1

beta2

class RRtoolbox.lib.arrayops.filters.**bandpass**(*alpha*, *beta1*, *beta2*)
Bases: *RRtoolbox.lib.arrayops.filters.FilterBase*

bandpass filter

class RRtoolbox.lib.arrayops.filters.**bandstop**(*alpha*, *beta1*, *beta2*)
Bases: *RRtoolbox.lib.arrayops.filters.FilterBase*

bandstop filter

class RRtoolbox.lib.arrayops.filters.**bilateraP**(*scale*, *shift=33*, *name=None*, *alpha=100*, *beta1=-400*, *beta2=200*)
Bases: *RRtoolbox.lib.arrayops.filters.bandstop*

bilateral parameter

RRtoolbox.lib.arrayops.filters.**bilateralFilter**(**args*, ***kwargs*)
Apply bilateral Filter.

Parameters

- **im** –
- **d** –
- **sigmaColor** –
- **sigmaSpace** –

Returns filtered image

RRtoolbox.lib.arrayops.filters.**filterFactory**(*alpha*, *beta1*, *beta2=None*)
Make filter.

Parameters

- **alpha** – steepness of filter
- **beta1** – first shift from origin
- **beta2** – second shift from origin:

  alpha must be != 0 if beta2 = None:

  if alpha > 0: high-pass filter, if alpha < 0: low-pass filter

  else:

  if beta2 > beta1: if alpha > 0: band-pass filter, if alpha < 0: band-stop filter

  else: if alpha > 0: inverted-band-pass filter, if alpha < 0: inverted-band-stop filter

Returns filter funtion with intup levels

Example:

```
alpha,beta1,beta2 = 10,20,100
myfilter = filter(alpha,beta1,beta2)
print myfilter,type(myfilter)
print myfilter.alpha,myfilter.beta1,myfilter.beta2
```

class RRtoolbox.lib.arrayops.filters.**highpass**(*alpha*, *beta1*)
Bases: *RRtoolbox.lib.arrayops.filters.FilterBase*

highpass filter

class RRtoolbox.lib.arrayops.filters.**invertedbandpass**(*alpha*, *beta1*, *beta2*)
Bases: *RRtoolbox.lib.arrayops.filters.bandpass*

inverted bandpass filter

class RRtoolbox.lib.arrayops.filters.**invertedbandstop**(*alpha*, *beta1*, *beta2*)
Bases: *RRtoolbox.lib.arrayops.filters.bandstop*

inverted bandstop filter

class RRtoolbox.lib.arrayops.filters.**lowpass**(*alpha*, *beta1*)
Bases: *RRtoolbox.lib.arrayops.filters.FilterBase*

lowpass filter

RRtoolbox.lib.arrayops.filters.**normsigmoid**(*x*, *alpha*, *beta*)
Apply normalized sigmoid filter.

Parameters

- **x** – data to apply filter
- **alpha** – if alpha > 0: pass high filter, if alpha < 0: pass low filter, alpha must be != 0
- **beta** – shift from origin

Returns filtered values normalized to range [-1 if x<0, 1 if x>=0]

RRtoolbox.lib.arrayops.filters.**sigmoid**(*x*, *alpha*, *beta*, *max=255*, *min=0*)
Apply sigmoid filter.

Parameters

- **x** – data to apply filter
- **alpha** – if alpha > 0: pass high filter, if alpha < 0: pass low filter, alpha must be != 0
- **beta** – shift from origin
- **max** – maximum output value
- **min** – minimum output value

Returns filtered values ranging as [min,max]

Note: Based from http://www.itk.org/Doxygen/html/classitk_1_1SigmoidImageFilter.html

---

RRtoolbox.lib.arrayops.filters.**smooth**(*x*, *window_len=11*, *window='hanning'*, *correct=False*)
Smooth the data using a window with requested size.

This method is based on the convolution of a scaled window with the signal. The signal is prepared by introducing reflected copies of the signal (with the window size) in both ends so that transient parts are minimized in the begining and end part of the output signal.

input: x: the input signal window_len: the dimension of the smoothing window; should be an odd integer window: the type of window from 'flat', 'hanning', 'hamming', 'bartlett', 'blackman'

flat window will produce a moving average smoothing.

output: the smoothed signal

Example:

```
t=linspace(-2,2,0.1)
x=sin(t)+randn(len(t))*0.1
y=smooth(x)
```

See also:

numpy.hanning, numpy.hamming, numpy.bartlett, numpy.blackman, numpy.convolve, scipy.signal.lfilter

Note: length(output) != length(input), to correct this: return y[(window_len/2-1):-(window_len/2)] instead of just y.

RRtoolbox.lib.arrayops.mask module This module contains all basic masking and pre-processing (as in segmenting phase) methods

RRtoolbox.lib.arrayops.mask.**background**(*gray*, *mask=None*, *iterations=3*)
get the background mask of a gray image. (this it the inverted of *foreground()*)

Parameters

- **gray** – gray image
- **mask** – (None) input mask to process gray
- **iterations** – (3) number of iterations to detect background with otsu threshold.

Returns output mask

RRtoolbox.lib.arrayops.mask.**biggestCnt**(*contours*)
Filters contours to get biggest contour.

Parameters **contours** –

Returns cnt

RRtoolbox.lib.arrayops.mask.**biggestCntData**(*contours*)
Gets index and area of biggest contour.

Parameters **contours** –

Returns index, area

RRtoolbox.lib.arrayops.mask.**brightness**(*img*)
get brightness from an image :param img: BGR or gray image :return:

RRtoolbox.lib.arrayops.mask.**cnt_hist**(*gray*)
Mask of a ellipse enclosing retina using histogram threshold.

Parameters

- **gray** – gray image
- **invert** – invert mask

Returns mask

RRtoolbox.lib.arrayops.mask.**foreground**(*gray*, *mask=None*, *iterations=3*)
get the foreground mask of a gray image. (this it the inverted of *background()*)

Parameters

- **gray** – gray image

- **mask** – (None) input mask to process gray
- **iterations** – (3) number of iterations to detect foreground with otsu threshold.

Returns output mask

RRtoolbox.lib.arrayops.mask.**gethull**(*contours*)
Get convex hull.

Parameters **contours** – contours or mask array

Returns cnt

RRtoolbox.lib.arrayops.mask.**hist_cdf**(*img*, *window_len=0*, *window='hanning'*)
Get image histogram and the normalized cumulative distribution function.

Parameters

- **img** – imaeg
- **window_len** –
- **window** –

Returns histogram (int), normalized cdf (float)

RRtoolbox.lib.arrayops.mask.**mask_watershed**(*BGR*, *GRAY=None*)
Get retinal mask with watershed method.

Parameters

- **BGR** –
- **GRAY** –

Returns mask

RRtoolbox.lib.arrayops.mask.**multiple_otsu**(*gray*, *mask=None*, *flag=0L*, *iterations=1*)
get the mask of a gray image applying Otsu threshold.

Parameters

- **gray** – gray image
- **mask** – (None) input mask to process gray
- **iterations** –

  1. number of iterations to detect Otsu threshold.

Returns thresh, mask

RRtoolbox.lib.arrayops.mask.**thresh_biggestCnt**(*thresh*)
From threshold obtain biggest contour.

Parameters **thresh** – binary image

Returns cnt

RRtoolbox.lib.arrayops.mask.**thresh_hist**(*gray*)
Get best possible thresh to threshold object from the gray image.

Parameters **gray** – gray image.

Returns thresh value.

RRtoolbox.lib.arrayops.mask.**threshold_opening**(*src*, *thresh*, *maxval*, *type*)
Eliminate small objects from threshold.

Parameters

- **src** –
- **thresh** –
- **maxval** –
- **type** –

Returns

Module contents

Submodules

RRtoolbox.lib.cache module

platform Unix, Windows

synopsis Serialize and Memoize.

Contains memoizing, caching, serializing and memory-mapping methods so as to let the package save its state (persistence) and to let a method "remember" what it processed in a session (with cache) or between sessions (memoization and serialization) of the same input contend once processed. It also wraps mmapping functions to let objects "live" in the disk (slower but almost unlimited) rather than in memory (faster but limited).

@cache is used as replacement of *@property* to compute a class method once. It is computed only one time after which an attribute of the same name is generated in its place.

@cachedProperty is used as replacement of *@property* to compute a class method depending on changes in its watched variables.

@memoize used as a general memoizer decorator for functions where metadata is generated to disk for persistence.

Made by Davtoh, powered by joblib. Dependent project: https://github.com/joblib/joblib

class RRtoolbox.lib.cache.**DynamicMemoizedFunc**(*func*, *cachedir=None*, *ignore=None*, *mmap_mode=None*, *compress=False*, *verbose=1*, *timestamp=None*, *banned=False*)

Bases: object

cachedir

call_and_shelve(**args*, ***kwargs*)

clear(*warn=True*)

compress

enabled

func

ignore

mmap_mode

verbose

class RRtoolbox.lib.cache.**Memoizer**(*ignore=()*, *ignoreAll=False*)

Bases: object

ignore

makememory(*cachedir=None*, *mmap_mode=None*, *compress=False*, *verbose=0*)
Make memory for *memoize()* decorator.

Parameters

- **cachedir** – path to save metadata, if left None function is not cached.
- **mmap_mode** – {None, 'r+', 'r', 'w+', 'c'}, optional. The memmapping mode used when loading from cache numpy arrays. See numpy.load for the meaning of the arguments.
- **compress** – (boolean or integer) Whether to zip the stored data on disk. If an integer is given, it should be between 1 and 9, and sets the amount of compression. Note that compressed arrays cannot be read by memmapping.
- **verbose** – (int, optional) Verbosity flag, controls the debug messages that are issued as functions are evaluated.

Returns

memoize(*memory=None*, *ignore=None*, *verbose=0*, *mmap_mode=False*)
Decorated functions are faster by trading memory for time, only hashable values can be memoized.

Parameters

- **memory** – (Memory or path to folder) if left None function is not cached.
- **ignore** – (list of strings) A list of arguments name to ignore in the hashing.
- **verbose** – (integer) Verbosity flag, controls the debug messages that are issued as functions are evaluated.
- **mmap_mode** – {None, 'r+', 'r', 'w+', 'c'}, optional. The memmapping mode used when loading from cache numpy arrays. See numpy.load for the meaning of the arguments.

Returns decorator

memoizers = {140716454851024: <weakref at 0x7ffb1a4e9208; to 'Memoizer' at 0x7ffb1a4e31d0>}

class RRtoolbox.lib.cache.**MemorizedFunc**(*func*, *cachedir*, *ignore=None*, *mmap_mode=None*, *compress=False*, *verbose=1*, *timestamp=None*)
Bases: joblib.memory.MemorizedFunc

class RRtoolbox.lib.cache.**Memory**(*cachedir*, *mmap_mode=None*, *compress=False*, *verbose=1*)
Bases: joblib.memory.Memory

A wrapper to joblib Memory to have better control.

class RRtoolbox.lib.cache.**NotMemorizedFunc**(*func*)
Bases: joblib.memory.NotMemorizedFunc

class RRtoolbox.lib.cache.**cache**(*func*)
Bases: object

Descriptor (non-data) for building an attribute on-demand at first use. @cache decorator is used for class methods without inputs (only self reference to the object) and it caches on first compute. ex:

```
class x(object):
    @cache
    def method_x(self):
        return self.data
```

Note: Cached data can be deleted in the decorated object to recalculate its value.

RRtoolbox.lib.cache.**cachedProperty**(*watch=[]*, *handle=[]*)
A memoize decorator of @property decorator specifying what to trigger caching.

Parameters

- **watch** – (list of strings) A list of arguments name to watch in the hashing.
- **handle** – (list of handles or empty list) Provided list is appended with the memo handle were data is stored for the method and where a clear() function is provided.

Returns

RRtoolbox.lib.cache.**mapper**(*path*, *obj=None*, *mode=None*, *onlynumpy=False*)
Save and load or map live objects to disk to free RAM memory.

Parameters

- **path** – path to save mapped file.
- **obj** – the object to map, if None it tries to load obj from path if exist
- **mode** – {None, 'r+', 'r', 'w+', 'c'}.
- **onlynumpy** – if True, it saves a numpy mapper from obj.

Returns mmap image, names of mmap files

class RRtoolbox.lib.cache.**memoizedDict**(*path*, *mode=None*)
Bases: _abcoll.MutableMapping

memoized dictionary with keys and values persisted to files.

Parameters

- **path** – path to save memo file
- **mode** – loading mode from memo file {None, 'r+', 'r', 'w+', 'c'}

Warning: Some data structures cannot be memoize, so this structure is not save yet. Use at your own risk.

clear()
Remove all items from D.

exception RRtoolbox.lib.cache.**notCallable**
Bases: exceptions.Exception

Defines objectGetter error: given object is not callable.

exception RRtoolbox.lib.cache.**notCreatable**
Bases: exceptions.Exception

Defines objectGetter error: objectGetter cannot create new object.

class RRtoolbox.lib.cache.**objectGetter**(*callfunc=None*, *obj=None*, *callback=None*, ***annotations*)
Bases: object

Creates or get instance object depending if it is alive.

create(*throw=False*)
Creates an object and keep reference.

Parameters **throw** – if there is not creation function throws error.

Returns created object.

Warning: previous object reference is lost even if it was alive.

Note: Recommended only to use when object from current reference is dead.

getObj(*throw=False*)

isAlive()
test if object of reference is alive

isCreatable()
test if can create object

isGettable()
test if object can be gotten either by reference or creation.

raw()
get object from reference. :return: None if object is dead, object itself if is alive.

update(***kwargs*)

class RRtoolbox.lib.cache.**resourceManager**(*maxMemory=None*, *margin=0.8*, *unit='MB'*, *all=True*)

Bases: *RRtoolbox.lib.cache.retriever*

keep track of references, create objects on demand, manage their memory and optimize for better performance.

Parameters

- **maxMemory** – (None) max memory in specified unit to keep in check optimization (it does not mean that memory never surpasses maxMemory).
- **margin** – (0.8) margin from maxMemory to trigger optimization. It is in percentage of maxMemory ranging from 0 (0%) to maximum 1 (100%). So optimal memory is inside range: maxMemory*margin < Memory < maxMemory
- **unit** – (MB) maxMemory unit, it can be GB (Gigabytes), MB (Megabytes), B (bytes)
- **all** – if True used memory is from all alive references, if False used memory is only from keptAlive references.

all

Returns all flag, if True: used memory is from all alive references, if False: used memory is only from keptAlive references.

bytes2units(*value*)
converts value from bytes to user units

getSizeOf(*item*)

keepAlive(*key*, *obj*)

margin

Returns margin used for triggering memory optimization from maxMemory.

maxMemory

optimizeObject(*key*, *getter*, *toWhiteList=False*)

register(*key*, *method=None*, *instance=None*)
Register object to retrieve.

Parameters

- **key** – hashable key to retrieve
- **method** – callable method to get object
- **instance** – object instance already created from method

Note: This method is used in __setitem__ as self.register(key, value). Overwrite this method to change key assignation behaviour.

Example:

```
def mymethod():
    class constructor: pass
    return constructor()

ret = retriever()
ret["obj"] = mymethod # register creating method in "obj"
im = ret["obj"] # get object (created obj +1, with reference)
assert im is ret["obj"] # check that it gets the same object
# it remembers that "obj" is last registered or fetched object too
assert ret() is ret()
# lets register with better control (created obj2 +1, no reference)
ret.register("obj2",mymethod(),mymethod)
# proves that obj2 is not the same as obj (created obj2 +1, no reference)
assert ret() is not ret["obj"]
print list(ret.iteritems()) # get items
```

static resetGetter(*getter*)
Helper function to reset getter parameters.

Parameters **getter** – any instance of objectGetter

unit

Returns user defined units

units2bytes(*value*)
converts value from user units two bytes

usedMemory

Returns used memory in user units

class RRtoolbox.lib.cache.**retriever**
Bases: _abcoll.MutableMapping

keep track of references and create objects on demand if needed.

register(*key*, *method=None*, *instance=None*)
Register object to retrieve.

Parameters

- **key** – hashable key to retrieve
- **method** – callable method to get object
- **instance** – object instance already created from method

Returns

Example:

```
def mymethod():
    class constructor: pass
    return constructor()

ret = retriever()
ret["obj"] = mymethod # register creating method in "obj"
im = ret["obj"] # get object (created obj +1, with reference)
assert im is ret["obj"] # check that it gets the same object
# it remembers that "obj" is last registered or fetched object too
assert ret() is ret()
# lets register with better control (created obj2 +1, no reference)
ret.register("obj2",mymethod(),mymethod)
# proves that obj2 is not the same as obj (created obj2 +1, no reference)
assert ret() is not ret["obj"]
print list(ret.iteritems()) # get items
```

RRtoolbox.lib.config module

platform Unix, Windows

synopsis Looking for a reference? look here!.

This module contains all config data to the package.

class RRtoolbox.lib.config.**ConfigTool**
Manage the configured Tools.

static getTools(*package*)
Obtains the tools of a directory for the RRtoolbox.

Parameters **package** – path to the directory or package object.

Returns a dictionary of imported modules.

class RRtoolbox.lib.config.**directoryManager**(*path=None*, *raiseError=True*, *autosave=False*)
Bases: object

Manage the configured variables, paths and files.

Parameters

- **path** – (None) path to configuration file. If None uses default path.
- **raiseError** – True to raise when not attribute in ConfigFile.
- **autosave** – (True) if True saves at each change.

Note: Any attribute that is not in ConfigFile returns None. Use raiseError to control this behaviour.

---

default
get directories from dictionary representing environment variables.

Returns dictionary of directories.

Note: Only directories in the scope of the module are detected.

---

load()
loads the configuration file and update.

Returns loaded configuration file dictionary.

> **Warning:** Unsaved instance variables will be replaced by configuration file variables.

reset()
Returns the configuration file to default variables.

Returns False, if error. Dictionary of new data, if successful.

> **Warning:** All custom data is lost in configuration file.

> **Warning:** ConfigFile is purposely not updated. Call manually method load()

save(*mode=0*)
saves configuration file.

Parameters **mode** – 0- delete and save, 1- update without replace, 2- update replacing variables.

Returns False, if error. Dictionary of new data, if successful.

RRtoolbox.lib.config.**findModules**(*package*, *exclude=None*)
Find modules from a package.

Parameters

- **package** – imported packaged or path (str).
- **exclude** – list of modules to exclude.

Returns dictionary containing importer, ispkg

RRtoolbox.lib.config.**getModules**(*package*, *exclude=None*)
Import modules from a package.

Parameters **package** – imported packaged or path (str).

Returns dictionary containing imported modules.

RRtoolbox.lib.config.**getPackagePath**(*package*)
Get the path of a package object.

Parameters **package** – package object or path (str).

Returns path to the package.

RRtoolbox.lib.descriptors module

RRtoolbox.lib.descriptors.**ASIFT**(**args*, ***kwargs*)
asift(feature_name, img, mask=None, pool=None) -> keypoints, descrs

Apply a set of affine transformations to the image, detect keypoints and reproject them into initial image coordinates. See http://www.ipol.im/pub/algo/my_affine_sift/ for the details.

ThreadPool object may be passed to speedup the computation.

Parameters

- **feature_name** – feature name to create detector.

- **img** – image to find keypoints and its descriptors
- **mask** – mask to detect keypoints (it uses default, mask[:] = 255)
- **pool** – multiprocessing pool (dummy, it uses multithreading)

Returns keypoints,descriptors

RRtoolbox.lib.descriptors.**ASIFT_iter**(*imgs*, *feature_name='sift-flann'*)

Affine-SIFT for N images.

Parameters

- **imgs** – images to apply asift
- **feature_name** – eg. SIFT SURF ORB

Returns [(kp1,desc1),...,(kpN,descN)]

RRtoolbox.lib.descriptors.**ASIFT_multiple**(*imgs*, *feature_name='sift-flann'*)

Affine-SIFT for N images.

Parameters

- **imgs** – images to apply asift
- **feature_name** – eg. SIFT SURF ORB

Returns [(kp1,desc1),...,(kpN,descN)]

class RRtoolbox.lib.descriptors.**Feature**(*pool=<multiprocessing.pool.ThreadPool object>*, *useASIFT=True*, *debug=True*)

Bases: object

Class to manage detection and computation of features

Parameters

- **pool** – multiprocessing pool (dummy, it uses multithreading)
- **useASIFT** – if True adds Affine perspectives to the detector.
- **debug** – if True prints to the stdout debug messages.

config(*name*, *separator='-'*)

This function takes parameters from a command to initialize a detector and matcher.

Parameters

- **name** – "[a-]<sift|surf|orb>[-flann]" (str) Ex: "a-sift-flann"
- **features** – it is a dictionary containing the mapping from name to the initialized detector, matcher pair. If None it is created. This feature is to reduce time by reusing created features.

Returns detector, matcher

detectAndCompute(*img*, *mask=None*)

detect keypoints and descriptors

Parameters

- **img** – image to find keypoints and its descriptors
- **mask** – mask to detect keypoints (it uses default, mask[:] = 255)

Returns keypoints,descriptors

RRtoolbox.lib.descriptors.**MATCH**(**args*, ***kwargs*)
Use matcher and asift output to obtain Transformation matrix (TM).

Parameters

- **feature_name** – feature name to create detector. It is the same used in the detector which is used in init_feature function but the detector itself is ignored. e.g. if 'detector' uses BFMatcher, if 'detector-flann' uses FlannBasedMatcher.
- **kp1** – keypoints of source image
- **desc1** – descriptors of kp1
- **kp2** – keypoints of destine image
- **desc2** – descriptors of kp2

Returns TM

http://docs.opencv.org/3.0-beta/doc/py_tutorials/py_feature2d/py_feature_homography/py_feature_homography.html

RRtoolbox.lib.descriptors.**MATCH_multiple**(*pairlist*, *feature_name='sift-flann'*)

Parameters

- **pairlist** – list of keypoint and descriptors pair e.g. [(kp1,desc1),...,(kpN,descN)]
- **feature_name** – feature name to create detector

Returns [(H1, mask1, kp_pairs1),....(HN, maskN, kp_pairsN)]

RRtoolbox.lib.descriptors.**affine_skew**(*tilt*, *phi*, *img*, *mask=None*)
Increase robustness to descriptors by calculating other invariant perspectives to image.

Parameters

- **tilt** – tilting of image
- **phi** – rotation of image (in degrees)
- **img** – image to find Affine transforms
- **mask** – mask to detect keypoints (it uses default, mask[:] = 255)

Returns skew_img, skew_mask, Ai (invert Affine Transform)

Ai - is an affine transform matrix from skew_img to img

RRtoolbox.lib.descriptors.**filter_matches**(*kp1*, *kp2*, *matches*, *ratio=0.75*)
This function applies a ratio test.

Parameters

- **kp1** – raw keypoints 1
- **kp2** – raw keypoints 2
- **matches** – raw matches
- **ratio** – filtering ratio of distance

Returns filtered keypoint 1, filtered keypoint 2, keypoint pairs

RRtoolbox.lib.descriptors.**init_feature**(*name*, *features=None*)
This function takes parameters from a command to initialize a detector and matcher.

Parameters

- **name** – "<sift|surf|orb>[-flann]" (str) Ex: "sift-flann"

- **features** – it is a dictionary containing the mapping from name to the initialized detector, matcher pair. If None it is created. This feature is to reduce time by reusing created features.

Returns detector, matcher

RRtoolbox.lib.descriptors.**inlineRatio**(*inlines*, *lines*, *thresh=30*)
Probability that a match was correct.

Parameters

- **inlines** – number of matched lines
- **lines** – number lines
- **thresh** – threshold for lines (i.e. very low probability <= thresh < good probability)

Returns

RRtoolbox.lib.directory module

This module holds all path manipulation methods and a string concept called directory (referenced paths and strings) designed to support `config` and be used with `session`.

keywords:

path: it can be to a folder or file or url if specified *filename*: the file name without its path *filepath*: the path to a file *dirname*: the path to a folder *url*: Universal Resource Locator

class RRtoolbox.lib.directory.**FileDirectory**
Bases: *RRtoolbox.lib.directory.directory*

Saves contents of a file as with directories.

Parameters

- **data** – list, directory instance, dictionary or string.
- **filename** – name of file.
- **path** – path to folder where file is (it must finish in /).
- **notes** – optional description string
- **kwargs** – additional data to add in directory.

makeFile()
Makes a file with its contents to path/filename.

Returns True if successful

RRtoolbox.lib.directory.**changedir**(*filepath*, *dirname*, *ext=True*)
Change path to file with dirname.

Parameters

- **filepath** – path to file.
- **dirname** – new path to replace in filepath.
- **ext** – True to keep extension of file if any.

Returns directory object of changed path.

RRtoolbox.lib.directory.**checkDir**(*dirname*)
checks if dirname exists.

Parameters **dirname** – path to folder

Returns True if exits, False if not

RRtoolbox.lib.directory.**checkFile**(*path*)
checks if filepath or filename exists.

Parameters **path** – filepath or filename

Returns True if exits, False if not

RRtoolbox.lib.directory.**checkPath**(*path*)
checks if path exists.

Parameters **path** – path to folder or file.

Returns True if exits, False if not

RRtoolbox.lib.directory.**checkURL**(*url*)
checks if url exists. :param url: path to url :return: True if exits, False if not

RRtoolbox.lib.directory.**correctPath**(*path*, *relative*)
Get path corrected from its relative path or level index.

Parameters

- **path** – path or file name.
- **relative** – pattern or level in directory.

Returns corrected path.

RRtoolbox.lib.directory.**correctSep**(*path='/mnt/4E443F99443F82AF/Dropbox/PYTHON/RRtools/RRtoolbox/lib/direct*
separator='/')
Replaces the path separators by custom or OS standard separator.

Parameters

- **path** – relative or absolute path (str). Default is __file__ or module's path.
- **separator** – desired separators, By default uses system separator (os.path.sep).

Returns path with corrected separator.

RRtoolbox.lib.directory.**decoratePath**(*relative*, *sep='/'*)
Decorated path is controlled to give absolute path from relative path.

Parameters

- **relative** – int or path.
- **sep** – path separator

Returns decorator

class RRtoolbox.lib.directory.**directory**
Bases: str

semi-mutable string representation of a inmutable string with support for path representations.

Parameters

- **data** – list, directory instance, dictionary or string.
- **ispath** – True to add support for paths.

- **copy** – when data is a directory if copy is True then this instance data is independent of the passed directory otherwise both directories are a reference to the same dictionary data but they are not the same object.
- **kwargs** – additional data to add in directory.

copy()
Creates copy of itself.

Returns non-referenced directory copy.

correctSTRBuiltin()
Decorate all the built-in functions of class directory.

Returns built-in decorated function.

static filterdata(*data*, *ispath=None*, *kwargs=None*)
Adequate data for dictionary creation.

Parameters

- **data** – any supported object.
- **ispath** – True to add support for paths.
- **kwargs** – additional data to add in directory.

Returns dictionary

static repr2list(*data*, *level=0*)
Converts the representation of a directory.repr to pickleable.

Parameters **data** – directory.repr of the form ["string",directory,...,directory.repr].

Returns pickleable list.

static repr2str(*data*, *ispath=True*)
Converts the representation of a directory.repr to string.

Parameters **data** – directory.repr of the form ["string",directory,...,directory.repr].

Returns converted string.

update(*data=None*)
Return an updated copy with provided data.

Parameters **data** – any supported object. If None return updated and referenced copy of itself.

Returns new directory referenced to itself.

update_left(*other*)
Updates representation a the left.

Parameters **other** – any supported object.

Returns new directory referenced to itself.

Note: Equivalent to self - other e.g. directory([other, self])

---

update_right(*other*)
Updates representation a the right.

Parameters **other** – any supported object.

Returns new directory referenced to itself.

Note: Equivalent to self + other e.g. directory([self, other])

RRtoolbox.lib.directory.**getData**(*path='/mnt/4E443F99443F82AF/Dropbox/PYTHON/RRtools/RRtoolbox/lib/directory.p*
Get standard path from path.

Parameters **path** – it can be to a folder or file. Default is __file__ or module's path.

Returns [drive,dirname,filename,ext]. 1. drive or UNC (Universal Naming Convention) 2. dirname is path to folder. 3. filename is name of file. 4. ext is extension of file.

RRtoolbox.lib.directory.**getFileHandle**(*path*)
Gets a file handle from url or disk file.

Parameters **path** – filepath or url

Returns file object

RRtoolbox.lib.directory.**getFileSize**(*path*)
Gets a size from url or disk file.

Parameters **path** – filepath or url

Returns size in bytes

RRtoolbox.lib.directory.**getPath**(*path='/mnt/4E443F99443F82AF/Dropbox/PYTHON/RRtools/RRtoolbox/lib/directory.p*
Get standard path from path.

Parameters **path** – it can be to a folder or file. Default is __file__ or module's path. If file exists it selects its folder.

Returns dirname (path to a folder)

Note: It is the same as os.path.dirname(os.path.abspath(path)).

RRtoolbox.lib.directory.**getSep**(*path*, *pattern='/\\'*)
Get path separator or indicator.

Parameters

- **path** – relative or absolute path (str).
- **pattern** – guess characters to compare path (str).

Returns sep (str).

Note: It is equivalent to os.path.sep but obtained from the given path and patterns.

RRtoolbox.lib.directory.**getShortenedPath**(*path*, *comp*)
Path is controlled to give absolute path from relative path or integer.

Parameters

- **path** – absolute path (str).
- **comp** – pattern or relative path (str) or integer representing level of folder determined by the separator Ex. "/level 1/level 2/.../level N or -1".

Returns path before matched to comp Ex: "C://level 1//comp –> C://level 1"

Example:

```
>>> path = 'LEVEL1/LEVEL2/LEVEL3/LEVEL4/LEVEL5'
>>> print getShortenedPath(path,-2) # minus two levels
LEVEL1/LEVEL2/LEVEL3
>>> print getShortenedPath(path,2) # until three levels
LEVEL1/LEVEL2
>>> print getShortenedPath(path,'LEVEL1/LEVEL2/LEVEL3/')
LEVEL1/LEVEL2/LEVEL3/
>>> print getShortenedPath(path,'LEVEL4/REPLACE5/NEWLEVEL')
LEVEL1/LEVEL2/LEVEL3/LEVEL4/REPLACE5/NEWLEVEL
>>> print getShortenedPath(path,'../../SHOULD_BE_LEVEL4')
LEVEL1/LEVEL2/LEVEL3/SHOULD_BE_LEVEL4
```

RRtoolbox.lib.directory.**getSplitted**(*path='/mnt/4E443F99443F82AF/Dropbox/PYTHON/RRtools/RRtoolbox/lib/direc*

Splits a file path by its separators.

Parameters **path** – it can be to a folder or file. Default is __file__ or module's path.

Returns splitted path.

RRtoolbox.lib.directory.**increment_if_exits**(*fn*, *add='_{num}'*)

Generates new name if it exits.

Parameters

- **fn** – absolute path or filename
- **add** – if fn exists add pattern

Returns un-existent fn

RRtoolbox.lib.directory.**joinPath**(*absolute*, *relative*)

Joins an absolute path to a relative path.

Parameters

- **absolute** – directory or path.
- **relative** – directory or path.

Returns joined path.

Note: It is equivalent to os.path.join but works with directories.

RRtoolbox.lib.directory.**mkPath**(*path*)

Make path (i.e. creating folder) for filepath.

Parameters **path** – path to nonexistent folder or file.

Returns created path.

RRtoolbox.lib.directory.**quickOps**(*path*, *comp*)

(IN DEVELOPMENT) make quick matching operations in path.

Parameters

- **path** – path to folder
- **comp** – pattern

Returns

Requirements:

```
    path = 'LEVEL1/LEVEL2/LEVEL3/LEVEL4/LEVEL5'
    print quickOps(path,'../ROOT/../LEVEL1/../LEVEL2/LEVEL3/../../LEVEL4')
    'LEVEL4'
    print quickOps(path,'ROOT/../LEVEL1/LEVEL2/../../LEVEL4')
    'LEVEL3/LEVEL4'
    print quickOps(path,'../LEVEL2/../')
    'LEVEL1/LEVEL3/LEVEL4/LEVEL5'
    print quickOps(path,'../LEVEL2/..')
    'LEVEL1/LEVEL3/LEVEL4/LEVEL5/'
    print quickOps(path,'LEVEL2/../../LEVEL4/')
    'LEVEL2/LEVEL3/LEVEL4/'
    print quickOps(path,'ROOT/../LEVEL2/../../LEVEL4')
    'ROOT/LEVEL3/LEVEL4'
    print quickOps(path,'LEVEL-1/../NEW7/LEVEL8')
    'LEVEL-1/LEVEL1/LEVEL2/LEVEL3/LEVEL4/LEVEL5/NEW7/LEVEL8'
    print
```

RRtoolbox.lib.directory.**rmFile**(*filepath*)

Remove file.

Parameters **filepath** – path to file.

Returns None

RRtoolbox.lib.directory.**rmPath**(*path*, *ignore_errors=False*, *onerror=None*)

Remove path from path.

Parameters **path** – path to nonexistent folder or file.

Returns None

See also:

shutil.rmtree

RRtoolbox.lib.directory.**strdifference**(*s1*, *s2*)

Get string differences.

Parameters

- **s1** – string 1
- **s2** – string 2

Returns (splitted string 1, splitted string 2, index). A splitted string is a list with the string parts. Index is a list containing the indexes of different parts of the two splitted strings.

RRtoolbox.lib.image module

RRtoolbox.lib.inspector module

This module is an all purpose intended for debugging, tracking, auto-documenting and self-introspecting the package

Made by Davtoh. Powered partially by pycallgraph. Dependent project: https://github.com/gak/pycallgraph/#python-call-graph

class RRtoolbox.lib.inspector.**Asyncronous**(*outputs*, *config*)

Bases: *RRtoolbox.lib.inspector.Syncronous*

done()

start()

tracer(*frame*, *event*, *arg*)

class RRtoolbox.lib.inspector.**Logger**(***kwargs*)
Bases: object

Logger for decorated functions. Holds important information of an instanced object and can be used with @trace decorator for traceback purposes.

Parameters

- **func** – object reference.
- **funcname** – object name.
- **inputs** – inputs pass to the object.
- **outputs** – outputs given by the object execution.
- **time** – initial time of execution.
- **exectime** – time of execution in seconds.
- **writer** – writer function where messages are passed.
- **eventHandle** – event function where object is passed when Logger.broadcast() is called.
- **msg_report** – message format to use in reports.
- **msg_no_executed** – massage format to pass to writer when object has not been executed and Logger.report() is called.
- **msg_executed** – massage format to use when object is executed and Logger.broadcast() is called.

Time_
returns formated time (str)

Type_
returns type name (str)

broadcast()
pass a notification message on object execution to the writer

eventHandle = None

file = <open file '<stdout>', mode 'w'>

renew()
renew Instance

report()
pass a report of the last executed object to the writer

throwError()
throw caught error :return:

tracer

writer(*sender*, **arg*)

class RRtoolbox.lib.inspector.**Syncronous**(*outputs*, *config*)
Bases: pycallgraph.tracer.SyncronousTracer

start()

stop()

RRtoolbox.lib.inspector.**funcData**(*func*)

class RRtoolbox.lib.inspector.**graphTrace**(*output=None*, *config=None*)
Bases: pycallgraph.pycallgraph.PyCallGraph

get_tracer_class()

saveSource(*file*)

source

class RRtoolbox.lib.inspector.**graphTraceOutput**(*source=None*, *saveflag=True*, *label=''*, ***kwargs*)
Bases: pycallgraph.output.graphviz.GraphvizOutput

done()

save(*file=None*, *source=None*)

saveSource(*file*, *source=None*)

RRtoolbox.lib.inspector.**load**(*mod_name*, *obj_name*)
Convert a string version of a class name to the object.

For example, get_class('sympy.core.Basic') will return class Basic located in module sympy.core

RRtoolbox.lib.inspector.**reloadFunc**(*func*)

RRtoolbox.lib.inspector.**tracer**(*instance*, *broadcast=True*, *report=True*)
Tracer for decorated functions.

Parameters

- **instance** – Logger instance
- **broadcast** –
- **report** –

Returns

RRtoolbox.lib.plotter module

This module holds the plotting and data-visualization tools. Motto: don't know how it is interpreted? i'll show you!

#plotim example filename = "t2.jpg" win = "test" img = cv2.resize(cv2.imread(filename), (400, 400)) # (height, width) plot = plotim(win,img) plot.show()

RRtoolbox.lib.plotter.**background**(*color*, *x=1*, *y=1*, *flag=0*)
Creates background rectangle.

Parameters

- **color** – main color.
- **x** – x pixels in axis x.
- **y** – y pixels in axis y.
- **flag** – Not implemented.

Returns image of shape y,x and ndim == color.ndim.

RRtoolbox.lib.plotter.**convert2bgr**(*src*, *bgrcolor=None*)
Tries to convert any image format to BGR.

Parameters

- **src** – source image.

- **bgrcolor** – background or transparent color.

Returns BGR array image.

RRtoolbox.lib.plotter.**convert2bgra**(*src*, *bgracolor=None*, *transparency=None*)
Tries to convert any image format to BGRA.

Parameters

- **src** – source image.
- **bgracolor** – background or transparent color.
- **transparency** – mask or A channel. (typically source image has not A channel, so user can provide it)

Returns BGRA array image.

RRtoolbox.lib.plotter.**echo**(*obj*)
Printer (used when user wants to print an object from plotim) :param obj: object

class RRtoolbox.lib.plotter.**edger**(*img*, *isSIZE=True*, *isEQUA=False*, *isCLAHE=False*, *isBFILTER=False*)
Bases: *RRtoolbox.lib.plotter.plotim*

Test visualization for edges

self.edge -> the edges in processed image self.img -> the processed image self.sample -> the rendered precessed image

computeAll()

computeEdge()

getParameters(*params=('d', 'sigmaColor', 'sigmaSpace', 'clipLimit', 'tileGridSize', 'isSIZE', 'isEQUA', 'isCLAHE', 'isBFILTER', 'th1', 'th2', 'size', 'apertureSize', 'L2gradient')*)

isActiveWindow()

isBFILTER

isCLAHE

isEQUA

isSIZE

load(*img*, *compute=True*)

maxth

onTrackbar1(**args*)

onTrackbar2(**args*)

save(*strname=None*, *ext='.png'*, *name='img'*)

showgray

size

th1

th2

windowfunc()

RRtoolbox.lib.plotter.**fastplt**(*image*, *cmap=None*, *title='visualazor'*, *win=None*, *block=False*, *daemon=False*)
Fast plot.

Parameters

- **image** – image to show
- **cmap** – "gray" or None
- **title** – title of subplot
- **win** – title of window
- **block** – if True it wait for window close, else it detaches (Experimental)
- **daemon** – if True window closes if main thread ends, else windows must be closed to main thread to end (Experimental)

Returns plt

RRtoolbox.lib.plotter.**graph_filter**(*filters*, *levels=None*, *titles=None*, *win=None*, *single=True*, *legend=True*, *annotate=True*, *cols=3*, *scale=0.07*, *show=True*, *lxp=None*, *lyp=None*)

Graph filter with standard data to watch response.

Parameters

- **filters** – list of filters
- **levels** – numpy array with values. if None tries to fit data or assumes from 0 to 255
- **titles** – list of titles for each filter in filters. if None creates the titles
- **win** – window name
- **single** – True to plot all filters in one plot. else separate each filter in a plot.
- **legend** – True to add legends.
- **annotate** – True to add annotations.
- **cols** – number of columns to create plots
- **scale** – factor from maximum to draw annotations
- **show** – to show the figure

Returns figure

class RRtoolbox.lib.plotter.**imtester**(*img*, *win='imtester plot'*)

Bases: *RRtoolbox.lib.plotter.plotim*

Used to test some concepts as thresholds and filters

static applythresh(*img*, *type*, *adaptativetoggle*, *threshtoggle*, *th*, *blocksz*, *c*, *i=''*, *ti=''*, *info=''*, *title=''*)

builtcmd()

computefunc(*image=None*)

detectType(*type*, *i=''*, *info=''*)

static formatinfo(*info*, *words=9*)

updatevisualization(*image*, *channel*, *th=None*, *items=None*, *thresh1=None*, *thresh2=None*)

visualize()

windowfunc()

RRtoolbox.lib.plotter.**limitaxis**(*c*, *maxc*, *minc=0*)

Limit value in axis.

Parameters

- **c** – value
- **maxc** – max c value.
- **minc** – min c value.

Returns limited c value c E [minc,maxc]

class RRtoolbox.lib.plotter.**matchExplorer**(*win*, *img1*, *img2*, *kp_pairs=()*, *status=None*, *H=None*, *show=True*, *block=True*, *daemon=True*)

Bases: *RRtoolbox.lib.plotter.plotim*

Draws a set of keypoint pairs obtained on a match method of a descriptor on two images imgf and imgb. (backend: plotim).

Parameters

- **win** – window's name (str)
- **img1** – image1 (numpy array)
- **img2** – image2 (numpy array)
- **kp_pairs** – zip(keypoint1, keypoint2)
- **status** – obtained from cv2.findHomography
- **H** – obtained from cv2.findHomography (default=None)
- **show** – if True shows plotim using block and daemon, else do not show
- **block** – if True it wait for window close, else it detaches
- **daemon** – if True window closes if main thread ends, else windows must be closed to main thread to end

Returns plotim object with visualization as self.rimg (image with matching result) (default=None)

Note: It supports BGR and gray images.

---

drawline()
Draws background visualization without interaction

drawrelation()
Draw keypoints where pointer is placed and pressed

keyfunc()

mousefunc()

static randomColor()

updaterenderer(*img=None*, *zoom=True*)
update renderer when called.

Parameters

- **img** – image to update in renderer, if None use self.img
- **zoom** – True to enable zoom, else updates with original img.

Returns None

RRtoolbox.lib.plotter.**plotPointsContour**(*pts*, *ax=None*, *lcor='k'*, *pcor=None*, *deg=None*, *annotate=True*, *width=0.004*, *label='pt{pt}({x}, {y}, {a})'*, *arrowprops=None*)

Plots points and joining lines in axes.

Parameters

- **pts** – points. [(x0,y0)...(xN,yN)]
- **ax** – axes handle to draw points.
- **lcor** – color of joining lines.
- **pcor** – color of points. If specified uses lines, else vectors.
- **deg** – angle of vertex, if True in degrees, if False in radians, if None do not add.

Returns ax.

class RRtoolbox.lib.plotter.**plotim**(*win*, *im=array([[1]])*, *bgrcolor=(250*, *243*, *238)*)

Bases: object

Show and image with events, animations, controls, internal commands and highly customizable by code.

Parameters

- **win** – window name
- **im** – image of numpy array
- **bgrcolor** – default color to use for transparent or background color.

Warning: plotim is deprecated and will be replaced in the future (it was made to test concepts). Originally it was made for windows but some functions were removed to let it be multi-platform.

builtincmd()

Internal cmd control

builtincontrol(*control=False*)

Internal control. use self.usecontrol = True to activate.

Parameters **control** – if True, use control key.

Returns

builtinplot(*pixel=None*, *useritems=None*, *flag=1*, *xpad=0*, *ypad=0*, *bgrcolor=None*, *alpha=None*)

Internal plot.

Parameters

- **pixel** – pixel color where mouse is placed (placed for better control). Color can be from real image, showed image, original image or rendered image, or any color.
- **useritems** – items to show.
- **flag** – flag for position (default=0).
  - flag==0 : foreground to left up.
  - flag==1 : foreground to left down.
  - flag==2 : foreground to right up.
  - flag==3 : foreground to right down.
  - flag==4 : foreground at center of background.

  - flag==5 : XY 0,0 is at center of background.
  - flag==6 : XY 0,0 is at center of foreground.
  - flag==7 : XY 0,0 is at right down of foreground.
- **xpad** – padding in x
- **ypad** – padding in y
- **bgrcolor** – background color
- **alpha** – alpha mask or value for transparency

Returns

builtinwindow()
loads windowfunc, showfunc, starts window thread and mousecallback.

clean()
Attempt to clean the plotter dictionary for an error in garbage collection. :return:

closefunc()
Decoupled close function for plotim (replace self.closefunc).

Parameters **self** – plotim instance

cmdfunc(*execute=False*)
command function and decoupled cmd solver for plotim. (repalce self.cmdfunc)

Parameters

- **self** –
- **execute** – True, enable execution of commands, False, disable execution.

errorbackground

formatcmd(*cmd*, *references=('+', '-', '*', '=')*, *lmissing='self.'*)
Decoupled cmd formatter for cmdfunc and plotim.

Parameters

- **self** – plotim instance
- **cmd** – command
- **references** –
- **lmissing** – assumed missing part in command

Returns

help(*showAll=False*)
function to print the quick help for the user with all the commands

init()
Pseudo __init__. it is used to restart default values without destroying configurations.

keyfunc()
Decoupled key function for plotim (replace self.keyfunc).

Parameters **self** – plotim instance

makeoverlay(*items*, *xpad=0*, *ypad=0*, *bgrcolor=None*, *alpha=None*)
overlay items over image.

Parameters

- **self** – instance
- **items** – list of object to overlay
- **xpad** – pad in x
- **ypad** – pad in y
- **bgrcolor** – background color
- **alpha** – transparency color

Returns overlayed

mousefunc()
Decoupled mouse function for plotim (replace self.mousefunc).

Parameters **self** – plotim instance

static onmouse(*event*, *x*, *y*, *flags*, *self*)
Mouse event function for plotim. (replace self.mousefunc)

Parameters

- **event** – mouse event
- **x** – x position
- **y** – y postion
- **flags** – mouse flag to use in control (it represents clicks)
- **self** – plotim object

Returns

plotatpointer(*items*, *img=None*, *x=0*, *y=0*, *flag=6*, *xpad=0*, *ypad=0*, *bgrcolor=None*, *alpha=None*, *pixel=None*)
Plot message where mouse pointer is.

Parameters

- **items** – list of items supported by `self.makeoverlay()`
- **img** – image to place in items. If None it uses self.remg
- **x** – x position
- **y** – y position
- **flag** – flag for position (default=0).
  - flag==0 : foreground to left up.
  - flag==1 : foreground to left down.
  - flag==2 : foreground to right up.
  - flag==3 : foreground to right down.
  - flag==4 : foreground at center of background.
  - flag==5 : XY 0,0 is at center of background.
  - flag==6 : XY 0,0 is at center of foreground.
  - flag==7 : XY 0,0 is at right down of foreground.
- **xpad** – padding in x
- **ypad** – padding in y

- **bgrcolor** – background color
- **alpha** – alpha mask or value for transparency
- **pixel** – color to add as item im items,

Returns

plotatxy(*items*, *img=None*, *x=0*, *y=0*, *flag=0*, *xpad=0*, *ypad=0*, *bgrcolor=None*, *alpha=None*)
Plot message in xy position.

Parameters

- **items** – list of items supported by *makeoverlay()*
- **img** – image to place in items. If None it uses self.remg
- **x** – x position
- **y** – y position
- **flag** – flag for position (default=0).
  - flag==0 : foreground to left up.
  - flag==1 : foreground to left down.
  - flag==2 : foreground to right up.
  - flag==3 : foreground to right down.
  - flag==4 : foreground at center of background.
  - flag==5 : XY 0,0 is at center of background.
  - flag==6 : XY 0,0 is at center of foreground.
  - flag==7 : XY 0,0 is at right down of foreground.
- **xpad** – padding in x
- **ypad** – padding in y
- **bgrcolor** – background color
- **alpha** – alpha mask or value for transparency

Returns

plotintime(*items=None*, *wait=2*, *img=None*, *bgrcolor=None*)
plots messages and events.

Parameters

- **items** – list of items supported by *makeoverlay()*
- **wait** – time of message.
- **img** – image to place in items. If None it uses self.remg
- **bgrcolor** – color of message.

Returns

real2render(*x*, *y*, *astype=None*)
from real coordinates get rendered coordinates.

Parameters

- **x** – real x

- **y** – real y
- **astype** – (np.int32) return as the specified type

Returns rendered x, rendered y

render2real(*rx*, *ry*, *astype=<type 'numpy.int32'>*)
from rendered coordinates get real coordinates.

Parameters

- **rx** – rendered x
- **ry** – rendered y
- **astype** – (np.int32) return as the specified type

Returns real x, real y

rx1

rx2

ry1

ry2

save(*strname=None*, *ext='.png'*, *name='img'*)
Save image (save image if not Qt backend is installed) :param strname: name to save, a label with {win} can be used to be replaced with the plot win name :param ext: (".png") extension. :param name: ("img") name of image object from self. default is "img" that is self.img

(it allows better control to get custom image)

Returns True if saved, False if not saved (possibly because folder does not exists)

show(*frames=None*, *block=True*, *daemon=False*, *clean=True*)
Show function. calls buildinwindow, handles key presses and close events.

Parameters

- **frames** – show number of frames and close.
- **block** – if True it wait for window close, else it detaches (Experimental)
- **daemon** – if True window closes if main thread ends, else windows must be closed to main thread to end (Experimental)

Returns

showfunc(*img=None*)
Decoupled show function for plotim (replace self.showfunc).

Parameters

- **self** – plotim instance
- **img** – image to show

textbackground

updaterenderer(*img=None*, *zoom=True*)
update renderer when called.

Parameters

- **img** – image to update in renderer, if None use self.img

- **zoom** – True to enable zoom, else updates with original img.

Returns None

windowfunc()
Decoupled window function for plotim (replace self.windowfunc).

Parameters **self** – plotim instance

RRtoolbox.lib.root module

This module holds core-like methods for library modules but not for the hole package

RRtoolbox.lib.root.**Controlstdout**(**args*, ***kwds*)
Context manager to control output to stdout

Parameters **disable** – if True suppress output.

class RRtoolbox.lib.root.**FactorConvert**(*factor=None*, *factorIndex=1*)
Bases: object

Keep track of factor and converts to any available factor.

convert(*factor*, *to=None*)
Convert from actual factor to another factor.

Parameters

- **factor** – number
- **to** – factor to convert

Returns converted value, units

convert2sample(*factor*, *to=None*)
Convert to resemble sample.

Parameters

- **factor** – number
- **to** – sample factor.

Returns converted value, units

exactFactorIndex(*key*)
Find the index of a factor that contains a key.

Parameters **key** – anything to look in factors (i.e. factor name, factor value, abbreviation).

Returns factor structure, else None.

factor

factors

getFactor(*key*)
Tries to find factor value in factors.

Parameters **key** – anything to look in factors (i.e. factor name, factor value, abbreviation). If key is a factor value it will look for the nearest factor value.

Returns factor structure, else raises error.

nearFactorIndex(*factor*)
Find the index of nearest factor value.

Parameters **factor** – factor value.

Returns factor structure near factor value.

static parts(*value*, *precision=4*)
Get number parts.

Parameters

- **value** – number
- **precision** – decimal precision

Returns ([... ,Hundreds, Tens, Ones],[Tenths, ...])

static split(*value*)
Get number fraction.

Parameters **value** – number

Returns integer, fraction

RRtoolbox.lib.root.**TimeCode**(**args*, ***kwds*)
Context to profile code by printing a prelude and prologue with time.

Parameters

- **msg** – prelude or description message
- **unit** – unit supported by FactorConvert class
- **precision** – number of digits after a float point
- **abv** – if True prints "s", if False "seconds" for time
- **endmsg** – prologue message
- **enableMsg** – (True) A flag specifying if context should be printed or not.
- **printfunc** – function to print messages. By default it is sys.stdout.write

Returns

RRtoolbox.lib.root.**addto**(*instance*, *funcname=None*)
Decorator: Add function as method to instance.

Parameters

- **instance** – class instance.
- **funcname** – name to register in instance.

Returns

RRtoolbox.lib.root.**decorateInstanceMethods**(*self*, *decorator*, *excludeMth='__init__'*, *includeMth=None*)
Decorate methods in an instance. It should be used in the __init__ method of a class.

Parameters

- **self** – class instance.
- **decorator** – decorator function to apply to self.
- **excludeMth** – list of methods to exclude.
- **includeMth** – list of methods to include if not in exclude. if excludeMth is None then decorateInstanceMethods checks for includeMth list. if includeMth and excludeMth is None then all methods of self are decorated.

Returns self

Note: It must be used at instance initialization (i.e. inside __init__ method)

RRtoolbox.lib.root.**glob**(*path*)
Return a list of paths matching a pathname pattern with valid files.

Parameters **path** – path to process ing glob filter

Returns return list of files

RRtoolbox.lib.root.**lookinglob**(*pattern*, *path*, *ext=None*, *returnAll=False*, *raiseErr=False*)

Parameters

- **pattern** – look pattern in path
- **path** – path to look pattern
- **ext** – extension
- **raiseErr** – If true raise Exception if patter not found in path

Returns fn or None

class RRtoolbox.lib.root.**stdoutLOG**(*path*, *mode='w+'*, *chain=False*)
simple logger to save stdout output so anything printed in the console is logged to a file.

Parameters

- **path** – path to logging file
- **mode** – mode for opening the file.
- **chain** – if True closes previous logs and continues with new log

close()

flush()

printline(*text*, ***kwargs*)

printlines(*lines*, ***kwargs*)

write(*text*, ***kwargs*)

class RRtoolbox.lib.root.**stdoutSIM**(*disable=False*)
simple logger to simulate stdout output

close()

flush()

printline(*text*, ***kwargs*)

printlines(*lines*, ***kwargs*)

write(*text*, ***kwargs*)

RRtoolbox.lib.serverServices module

class RRtoolbox.lib.serverServices.**Conection**(*conn*)
represent a connection to interchange objects between servers and clients.

getLen(*timeout=None*)

rcv()

recvall()

send(*obj*)

sendLen(*length*, *timeout=None*)

exception RRtoolbox.lib.serverServices.**TimeOutException**
Bases: exceptions.Exception

exception RRtoolbox.lib.serverServices.**TransferExeption**
Bases: exceptions.Exception

RRtoolbox.lib.serverServices.**generateServer**(*host='localhost'*, *to=63342*)
generates a simple Server in available address.

Parameters **to** – until port.

Returns socket, address

RRtoolbox.lib.serverServices.**initClient**(*addr*, *timeout=None*)
Inits a simple client from address. :param addr: (host, port) :return: socket

RRtoolbox.lib.serverServices.**initServer**(*addr*)
Inits a simple server from address.

Parameters **addr** – (host, port)

Returns socket

RRtoolbox.lib.serverServices.**parseString**(*string*, *timeout=3*)

RRtoolbox.lib.serverServices.**ping**(*host*, *port*)
Ping to.

Parameters

- **host** – IP address
- **port** – port address

Returns

RRtoolbox.lib.serverServices.**rcvPickle**(*addr=('localhost'*, *50007)*, *timeout=None*)
Receive potentially any data using sockets.

Parameters

- **addr** – socket or address.
- **timeout** – NotImplemented

Returns data, else throws error.

RRtoolbox.lib.serverServices.**recv_into**(*viewable*, *socket*)
Receive from socket into viewable object.

Parameters

- **viewable** – viewable object
- **socket** – source socket

Returns None

RRtoolbox.lib.serverServices.**scan_ports**(*host*)
Scan opened ports in address.

Parameters **host** – host IP to filter opened ports.

Returns generator

RRtoolbox.lib.serverServices.**sendPickle**(*obj*, *addr=('localhost', 50007)*, *timeout=None*, *threaded=False*)

Send potentially any data using sockets.

Parameters

- **obj** – packable object.
- **addr** – socket or address.
- **timeout** – NotImplemented

Returns True if sent successfully, else Throw error.

RRtoolbox.lib.serverServices.**send_from**(*viewable*, *socket*)

Send from viewable object.

Parameters

- **viewable** – viewable object
- **socket** – destine socket

Returns None

RRtoolbox.lib.session module

This module have serializing methods for data persistence so to let the package "save" custom objects

session module made by Davtoh and powered by dill Dependency project: https://github.com/uqfoundation/dill

RRtoolbox.lib.session.**checkFromSession**(*filepath*, *varlist*)

Check that variables exits in session file.

Parameters

- **filepath** – path to session file.
- **varlist** – list of variables to checkLoaded.

Returns list checkLoaded results

RRtoolbox.lib.session.**deleteFromSession**(*filepath*, *varlist*)

Delete variables from session file.

Parameters

- **filepath** – path to session file.
- **varlist** – list of variables to delete.

Returns None

RRtoolbox.lib.session.**flushSession**(*filepath*)

Empty session in file.

Parameters **filepath** – path to session file.

Returns

RRtoolbox.lib.session.**getEnviromentSession**(*enviroment=None*)

Gets the filtered session from the global variables.

Returns dictionary containing filtered session.

RRtoolbox.lib.session.**readSession**(*filepath*, *helper=None*)
Loads a dictionary session from file.

Parameters

- **filepath** – path to load session file.
- **helper** – function to pos-process session file

Returns session

RRtoolbox.lib.session.**saveSession**(*filepath*, *session*, *helper=None*)
Saves dictionary session to file.

Parameters

- **filepath** – path to save session file.
- **session** – dictionary
- **helper** – function to pre-process session

Returns

RRtoolbox.lib.session.**updateSession**(*filepath*, *session*, *replace=True*, *rdhelper=None*, *svhelper=None*)
Updates a dictionary session in file.

Parameters

- **filepath** – path to session file.
- **session** – dictionary.
- **replace** – if True key values are replaced else old key values ar kept.
- **rdhelper** – read helper.
- **svhelper** – save helper.

Returns None

Module contents

This module contains core-like, too-much-used and too-much-referenced modules

1.1.2 RRtoolbox.tools package

Submodules

RRtoolbox.tools.lens module

RRtoolbox.tools.lens.**drawCircle**(*array*, *cnt*, *color=0*)
project circle over array.

Parameters

- **array** – array to draw circle
- **cnt** – contours of segmentation to fit circle
- **color** – color of lens

Returns array

RRtoolbox.tools.lens.**drawEllipse**(*array*, *cnt*, *color=0*)
project ellipse over array.

Parameters

- **array** – array to draw ellipse
- **cnt** – contours of segmentation to fit ellipse
- **color** – color of lens

Returns array

RRtoolbox.tools.lens.**fitLens**(*img*, *mask*, *color=0*, *asEllipse=False*, *addmask=False*)
Place lens-like object in image.

Parameters

- **img** – image to place lens
- **mask** – mask to fit lens
- **color** – color of the lens
- **asEllipse** – True to fit lens as a ellipse, False to fit circle.
- **addmask** – return additional mask parameter

Returns image with simulated lens

RRtoolbox.tools.lens.**simulateLens**(*img*, *threshfunc=None*, *pshape=(300*, *300)*, *color=0*, *asEllipse=True*)
Place lens-like object in image.

Parameters

- **img** – image to place lens.
- **threshfunc** – function to segment retinal area and get its mask.
- **pshape** – shape to resize processing image to increase performance.
- **color** – color of the lens.
- **asEllipse** – True to fit lens as a ellipse, False to fit circle.

Returns image with simulated lens.

RRtoolbox.tools.restoration module

RRtoolbox.tools.segmentation module

RRtoolbox.tools.segmentation.**find_optic_disc**(*img*, *P*)
find optic disk in image

Parameters

- **img** – BGR image
- **P** – gray image

Returns optic_disc, Crs, markers, watershed

RRtoolbox.tools.segmentation.**getBrightAlpha**(*backgray*, *foregray*, *window=None*)
Get alpha transparency for merging foreground to background gray image according to brightness.

Parameters

- **backgray** – background image. (as float)
- **foregray** – foreground image. (as float)
- **window** – window used to customizing alfa. It can be a binary or alfa mask, values go from 0 for transparency to any value where the maximum is visible i.e a window with all the same values does nothing. A binary mask can be used, where 0 is transparent and 1 is visible. If not window is given alfa is not altered and the intended alfa is returned.

Returns alfa mask

RRtoolbox.tools.segmentation.**get_beta_params**(*P*)
automatically find parameters for bright alpha masks.

Parameters **P** – gray image

Returns beta1,beta2

RRtoolbox.tools.segmentation.**layeredfloods**(*img*, *gray=None*, *backmask=None*, *step=1*, *connectivity=4*, *weight=False*)

Parameters

- **img** –
- **gray** –
- **backmask** –
- **step** –
- **connectivity** –
- **weight** –

Returns

RRtoolbox.tools.segmentation.**retina_markers_thresh**(*P*)
Retinal markers thresholds to find background, retinal area and optic disc with flares based in the histogram

Parameters **P** – gray image

Returns min,b1,b2,max

RRtoolbox.tools.segmentation.**retinal_mask**(*img*, *biggest=False*, *addalpha=False*)

Parameters

- **img** –
- **biggest** –
- **addalpha** –

Returns

RRtoolbox.tools.segmentation.**retinal_mask_simple**(*img*, *parameters=(10, 30, None)*)

RRtoolbox.tools.selectors module

RRtoolbox.tools.selectors.**entropy**(*imlist*, *loadfunc=None*, *invert=False*)
Entropy function modified from:

Yan Liu, Feihong Yu, An automatic image fusion algorithm for unregistered multiply multi-focus images, Optics Communications, Volume 341, 15 April 2015,

Pages 101-113, ISSN 0030-4018, http://dx.doi.org/10.1016/j.optcom.2014.12.015. (http://www.sciencedirect.com/science/article/pii/S0030401814011559)

Parameters **imlist** – list of path to images or arrays

Returns sortedD,sortedImlist,D,fns

where sortedD is the ranking of the Entropy test, D = [D0,...,DN] D0>DN sortedImlist is fns sorted to match sortedD, D is the list of the absolute difference between entropy and the root mean square, D = **|E-RMS|**

class RRtoolbox.tools.selectors.**entropyPlot**(*images*, *win='Entropy tests'*, *func=None*)
Bases: *RRtoolbox.lib.plotter.plotim*

Plot entropy test

getData(*im*)

getImage(*im*)

keyfunc()

nextim()

previousim()

selectlist(*imlist*)

RRtoolbox.tools.selectors.**hist_comp**(*imlist*, *loadfunc=None*, *method='correlation'*)
Histogram comparison

Parameters **imlist** – list of path to images or arrays

Returns comparison

RRtoolbox.tools.sticher module

RRtoolbox.tools.sticher.**stich**(***opts*)

Module contents

1.2 Submodules

1.3 RRtoolbox.core module

RRtoolbox.core.**f**(**args*, ***kwargs*)

class RRtoolbox.core.**rrbox**(**args*)
Bases: object

asift(*fn*)

RRtoolbox.core.**tools**(*instance*, *modules*)

RRtoolbox.core.**tools2**(*instance*, *modules*)

1.4 RRtoolbox.run module

1.5 RRtoolbox.shell module

exception RRtoolbox.shell.**NoParserFound**
Bases: exceptions.Exception

RRtoolbox.shell.**getDocParamLines**(*doc*)
gets each parameter line from reStructured doc.

Parameters **doc** – documentation

Returns lines

RRtoolbox.shell.**getDocParameters**(*doc*)
gets param and comment from reStructured doc.

Parameters **doc** – documentation

Returns list of (param,comment) items.

class RRtoolbox.shell.**shell**

generateParser(*func*)

getParser(*func*)

parse(*func*, *args=None*, *namespace=None*)

parser_fastplt()

parser_loadFunc()

RRtoolbox.shell.**shell_processor**(*commands*)

RRtoolbox.shell.**shell_processor_parser**(*syslist*, *flags=''*, *longopts=('feature=', 'nnn=')*)

1.6 Module contents

CHAPTER 2

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