**Introduction:** The acpcdetect program is a module of the Automatic Registration Toolbox (ART). The program takes a 3D T1-weighted structural MRI of the human brain as input. It automatically detects the mid-sagittal plane (MSP) using the method described in [1]. It then detects the AC and PC intersection points on the MSP using the method described in [2]. Finally, it detects 8 additional landmarks[[1]](#footnote-1) (the so-called Orion landmarks) on the MSP using the method described in [3]. This information is used to tilt-correct the input volume into a standard orientation. In this orientation: (1) the MSP is precisely aligned with the central plane of the FOV; (2) the anterior-posterior (AP) axis is on the MSP and aligned with the AC-PC line; (3) the inferior-superior (IS) axis is on the MSP and perpendicular to the AC-PC line; (4) the left-right (LR) axis is perpendicular to the MSP; and (5) the FOV center is approximately the mid-point between the AC and the PC on the MSP. The FOV center can alternatively be placed on the AC point using the -center-AC option.

**Orientation code:** In ART, the anatomical orientation of 3D volumes is specified by a 3-letter orientation code consisting of a combination of letters A, P, L, R, S and I, denoting anterior, posterior, left, right, superior and inferior directions, respectively. For example, the orientation code PIL indicates the volume’s (i, j, k) voxel coordinates point towards posterior, inferior and left directions. Similarly, the orientation code RAS indicates (i, j, k) point to right, anterior and superior directions. There are 48 possible orientation codes.

**Usage:**

acpcdetect –i <input-image>.nii [–v –h –center-AC –output-orient –nx <interger> –ny <integer> –nz <integer> –dx <float> –dy <float> –dz <float> –noppm –nopng –notxt –lm <landmarks-file> –standard –nn –rac <float> –rpc <float> –rvsps <float>]

**Required argument:**

-i or -input <input-image>.nii: Input image should be a 3D T1-weighted structural MRI in ‘n+1’ NIFTI1 format of type short or unsigned short.

**Optional arguments:**

-v or -verbose: Enables verbose mode

-h or -help: Prints a help message

-center-AC: places the FOV center at AC.

-output-orient <output-orientation-code>: specifies the orientation of the output image (default: same as the <input-image>.nii)

-nx <integer>: number of voxels in i direction (fastest varying index) of the output image (default: same as the input image in this anatomical direction)

-ny <integer>: number of voxels in j direction (2nd fastest varying index) of the output image (default: same as the input image in this anatomical direction)

-nz <integer>: number of voxels in k direction (slowest varying index) of the output image (default: same as the input image in this anatomical direction)

-dx <float>: voxel size (mm) in i direction (fastest varying index) of the output image (default: same as the input image in this anatomical direction)

-dy <float>: voxel size (mm) in j direction (2nd fastest varying index) of the output image (default: same as the input image in this anatomical direction)

-dz <float>: voxel size (mm) in k direction (slowest varying index) of the output image (default: same as the input image in this anatomical direction)

-noppm: suppresses outputting \*.ppm images

-nopng: suppresses outputting \*.png images

-notxt: suppresess outputting \*.txt files

-landmarks (-lm) <landmarks-file>: (i,j,k) coordinates of AC, PC and VSPS landmarks are manually specified in the <landmarks-file>; suppresses automatic detection of these landmarks; this is useful when automatic detection fails

-standard: tilt-correction is performed without using the Orion landmarks

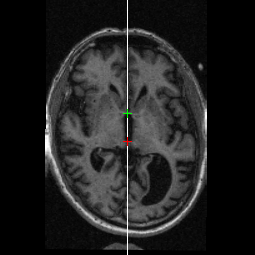
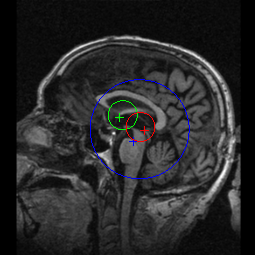
-do-no-reorient: the output image is not reoriented, but the sform and qform matrices are updated to reflect registration to a tilt-corrected orientation; this option is useful for applications that would like to use acpcdetect for obtaining an initial transformation to a standard space without interpolating the original data.

-nn: use nearest neighbor interpolation

-rac <float>: Search radius for the AC (default: 15 mm)

-rpc <float>: Search radius for the PC (default: 15 mm)

-rvsps <float>: Search radius for the VSPS (default: 50 mm)

Example 1: In this example, we apply the acpcdetect program to the v1.nii image in $ARTHOME/example1 with no other options except–v to put the program in verbose mode. With this option, the program prints the name of the inputted image, its orientation (in this case ASL: Anterior-Superior-Left) and the size of the matrix (256x256x128) and voxels size (1x1x1.25 mm3) of the input volume. It also prints the name, orientation, matrix and voxel size of the computed output volume. Since no other option specified at the command line, the output volume will have the same matrix and voxel size and orientation (ASL) as the input volume. The name of the output volume will by default be: <input image name>\_<output orientation>.nii, which in this example is v1\_ASL.nii. The output volume will be written in the same directory as the input volume.

$ acpcdetect -i $ARTHOME/example1/v1.nii -v

Input image: /Users/ardekb01/babak\_lib/example1/v1.nii

Input image orientation: ASL

Input image matrix size: 256 x 256 x 128

Input image voxel size: 1.0000 x 1.0000 x 1.2500

Output image: /Users/ardekb01/babak\_lib/example1/v1\_ASL.nii

Output image matrix size: 256 x 256 x 128

Output image voxel size: 1.0000 x 1.0000 x 1.2500

Output image orientation: ASL

Output transformation matrix: /Users/ardekb01/babak\_lib/example1/v1.mrx

Output transformation matrix (FSL format): /Users/ardekb01/babak\_lib/example1/v1\_FSL.mat

Example 2:

$ acpcdetect -i $ARTHOME/example1/v1.nii –v --output-orient LAI

Input image: /Users/ardekb01/babak\_lib/example1/v1.nii

Input image orientation: ASL

Input image matrix size: 256 x 256 x 128

Input image voxel size: 1.0000 x 1.0000 x 1.2500

Output image: /Users/ardekb01/babak\_lib/example1/v1\_LAI.nii

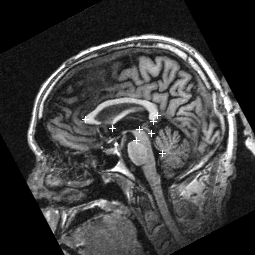
Output image matrix size: 128 x 256 x 256

Output image voxel size: 1.2500 x 1.0000 x 1.0000

Output image orientation: LAI

Output transformation matrix: /Users/ardekb01/babak\_lib/example1/v1.mrx

Output transformation matrix (FSL format): /Users/ardekb01/babak\_lib/example1/v1\_FSL.mat



1. Actually, one of the 8 Orion landmarks happens to be very close to the AC. [↑](#footnote-ref-1)