Pipeline description for planned and real ablation zone comparison

Pipeline:

1. Test shape creation

To test precision of the pipeline sphere masks with different radiuses can be created. Initial radius of masks is now set to 10mm with uniform spacing and 5mm increment in diameter difference. In mask all voxels with centers satisfying sphere inequation (1) are set to 255.

(1)

Where r is radius of sphere and x,y,z denote center of voxel coordinates.

1. Registration of tumor and ablation zone mask

In case the registration matrix for the patient is given, tumor and ablation mask are registered to the same coordinate system. This is done by using itk’s “centered affine transformation” in combination with “ResampleImageFilter” and interpolation by “NearestNeighborInterpolateImageFunction”.

1. Masks are pasted into image with common size
2. Masks are saved
3. Performed are calculations of dice score, signed Maurer’s distance map, surface-to-surface distances and margins (mean, median, and smallest margin).
4. Calculation of planned ablation mask
5. Ablation mask is calculated with center of origin in coordinate system’s origin.

In mask all voxels with centers satisfying ellipsoid inequation (2) are set to 255.

(2)

Where r is radius of sphere, x, y and z denote center of voxel coordinates and a, b and c stand for radius on principal axes of ellipsoid.

1. Ablation mask is rotated to match angle of line passing through entry and target point of ablation needle. Ablation mask is then translated to target point of ablation needle. Rotation routine is the same as in point 1.

Point 5 is performed for each trajectory defined for the tumor.

1. Planned and actual ablation zones are pasted into image with common size.

Inputs:

* Ablation mask in format of single DICOM file, header file with origin and spacing of ablation mask.
* Tumor mask in format of single DICOM file, header file with origin and spacing of tumor mask.
* File with target and entry point for each trajectory
* File with ablation shape parameters for each trajectory (currently only ellipsoid, with definition of major axis and minor axes).
* File with paths of patient folders to be processed
* File with paths of reference shapes (spheres) to be created
* File with registration matrix (optional)

Outputs:

* tumorSegm and ablationSegm: single DICOM files storing aligned masks.
* sres.csv: results of measurement in following format

dice score, mean margin, median margin, smallest margin, , resulting voxel to voxel distances

* header.csv storing origin point of aligned tumor and ablation mask
* distanceMap: single DICOM file storing signed Mauer’s distance map of tumor and ablation
* ablationSegm\_aligned and predictedSegm\_aligned: single DICOM files storing aligned masks of predicted and planned ablation.

Complete directory and file structure:

Working\_directory/

histogramScr.m – script generating figures for each lesion

path.txt: paths to all folder for patients to be processed

path\_spheres.txt: paths to all sphere shapes to be generated

Pipeline\_description.docx: this file

Working\_directory/patientNameLNumber/

* ablation/

header.csv - consists of 6 rows: 3D vector for Origin and 3D vector for Spacing of DICOM file

Maks - raw segmentation obtained from system

* lesion/

header.csv - consists of 6 rows: 3D vector for Origin and 3D vector for Spacing of DICOM file

Maks - raw segmentation obtained from system

* orig/ : Used only for generated shapes.

header.csv - consists of 6 rows: 3D vector for Origin and 3D vector for Spacing of DICOM file

* figs/

hist.png : computed histogram by “histogramScr.m”

boxplot: computed boxplot by “histogramScr.m”

ablationSegm - DICOM file of preprocessed segmentation

ablationSegm\_aligned - DICOM file of preprocessed segmentation

tumorSegm - DICOM file of segmentation preprocessed

predicteSegm\_aligned - DICOM file of preprocessed segmentation

entry\_target - consists of 6 rows: 3D vector for Position of target and entry of DICOM file

header.csv - 3D vector for origin of ablationSegm and tumorSegm DICOM file

polarCoords.csv - angles and distances of ablation zone's contour voxels

sres.csv - diceIndex, meanmargin, medianMargin, MinMargin, , surface-to-surface distances

DistanceMap - Dicom file containing ablation Contour with surface-to-surface distances

ablatorParams - 7 rows: type of ablation zone, 3d vector for ellipsoid radius, 3d vector translation