Summary of the Vessel Segmentation and Tracing in Mammography Project :

Background and objective :

The project aims to improve the segmentation of BACs (Breast Arterial Calcifications) in mammograms using deep learning and image processing techniques. BACs are key indicators in the diagnosis of certain diseases, and their accurate identification is crucial. The project began by adopting a pre-existing neural network, FR-Unet, initially designed to trace retinal vessels. This network was adapted to generate a "vesselness map" of vessels in mammograms.

The FR-Unet network was used to work on mammograms rather than retinal images. The network was pretrained on retinal vessels and the network generates a vesselness map highlighting areas where vessels are most likely to be present.

Having obtained the vesselness map, the next step was to develop an algorithm to refine BAC segmentation. This algorithm was inspired by a previous research paper which used classical image processing techniques, notably Principal Component Analysis (PCA), to identify and link LACs.

The code works as follows:

- BAC skeletonization: BACs are first skeletonized to identify their central structure.

- Endpoint identification: The endpoints of the skeletons are identified.

- Path following: From these end points, a path-following algorithm is used to trace paths that follow the vessels, using the vesselness map as a guide.

- Segment refinement: The traced paths are then used to connect nearby BACs that probably belong to the same vessel but were not connected during the initial segmentation.

Evaluation of results :

To evaluate the effectiveness of this method, an additional code was developed to calculate the percentage likelihood between two segmentation masks. Although the initial results showed no significant improvement over the initial segmentation, further analysis revealed that the code developed improved segmentation in the Region of Interest (ROI). The gross errors of the initial segmentation were amplified by the algorithm, but by eliminating them, it is clear that the algorithm succeeds in correctly linking BACs that belong to the same vessel.

Conclusion :

The project has succeeded in developing a method which, although perfectible, shows significant potential for improving BAC segmentation in mammograms using deep learning and conventional image processing techniques.

	EE61BA1D	EE0CA937	EE333477	EEC96467	EEB00A05	EE623566	EE503A67
% mask and BAC segmentation threshold 0.95	7.00	5.44	0	0.73	5.88	0	0
% mask and BAC segmentation threshold 0.65	11.64 (13.08)	23.04 (23.20)	14.19	14.63 (16.40)	14.67 (14.84)	0	0
% mask and path code (using 0.65)	12.85 (15.37)	21.65 (24.90)	16.97	13.42 (22.68)	24.23 (24.38)		

Summary table