Ghost Imaging:

Using mirror symmetry for imaging obscure vascular obstructions in acute stroke patients

Acute ischemic stroke is the rapidly developing loss of brain function caused by a blockage of a brain-supplying artery. Currently, intravenous thrombolysis is the only widely accepted treatment. However, this treatment may fail, and alternative treatments such as intra-arterial thrombolysis or mechanical clot removal may be preferred. Currently, it is being studied which patient-specific treatment is optimal. The **relative position** and **extent of the thrombus** that is causing the blockage is considered one of the important predictors of patient outcome, and may, therefore, support treatment selection.

When a patient with suspected stroke is administered at the AMC's emergency room, a series of CT scans are made, amongst which a CT angiogram. In a CT angiogram, the vessels are highlighted due to the administration of an iodinated contrast medium. Unfortunately, it is rather difficult to precisely visualize the thrombus in CTA images: At the position of the thrombus, no contrast medium is present, and it is characterized by the **absence of signal** rather than its presence (see Figure 1).

The speed of analyzes is very important. The faster the blood flow is restored, the smaller part of the brain is infarcted. Therefore, analysis tools to help to quickly determine the thrombus characteristics is of great importance and automated medical image processing techniques may come of help. Image processing is commonly used to segment and quantify **visible** structures in images. To measure the thrombus we are faced with the task to characterize the **invisible**. We therefore need to come up with new, innovative approaches. For this assignment we want to research the use of the mirror symmetry of the cerebral vascular structure to detect the anomalous structure in the two mirror symmetric parts of the arteries. In other words: the quantification of the difference in the left and right part of the vascular bed is an indication of the present thrombus. We look for a creative and ambitious student with an interest in medical image processing to tackle this problem.

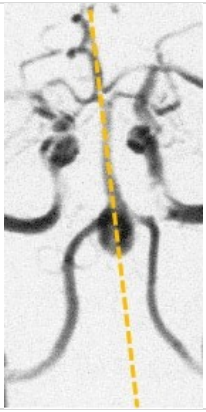

Figure 1. At the left the absence of signal due to the presence of a thrombus is illustrated (cyan ellipse). It is the aim of this assignment to detect and quantify the absence of the signal. At the right, the mirror symmetry of the cerebral vascular structure is illustrated.

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