

## SART 3.5D - Recovering cerebrovascular hemodynamics from standard 3D digital subtraction angiography cone-beam CT data-sets

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### Background

Brain vasculature visualization is gaining more and more importance in neuroimaging and neurosurgery in both pre-operative and intra-operative phases. The contrast dynamics through the various districts can be informative for various pathologies and also provides

keys to distinguish arteries and veins (A/V) in surgical planning. Further light is also shed over the dynamic feature of arterial and venous cerebral flow phases.

### Method

SART 3.5D<sup>1</sup> is a modified simultaneous algebraic reconstruction technique (SART)<sup>2</sup> which post-processes the contrast enhanced (CE) cone-beam CT (CBCT) data<sup>3</sup> extracting the contrast medium (CM) dynamics in the previously segmented 3D angiography. Voxel wise Time Intensity Curves (TICs) are modelled as a linear combination of temporal basis functions. The voxel-wise A/V classification require the venous area under the curve (AUC<sub>V</sub>) to be computed, after the subject specific tuning of A/V separation time based on clustering.

### Results

Ten data-sets were considered for the validation against manually annotated

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ROIs. The overall statistics (median and interquartile range) is reported below. Sensitivity has a median value of 0.91 [0.82-0.93] (first and third quartile in brackets). Specificity has a median value of 0.82 [0.74-0.92]. While for the accuracy, a median value of 0.85 was obtained with an IQ range [0.82-0.86].

### Conclusions

Results on clinical data confirmed applicability and robustness of the method (Figure 1). Moreover, possible extension of the method for a time-resolved 3D angiography might come from a CM arrival time surrogate given by  $1 - \text{AUC}_V / \text{AUC}$ . Future improvement considers the inclusion of spatial continuity criteria for a spatio-temporal classifier.

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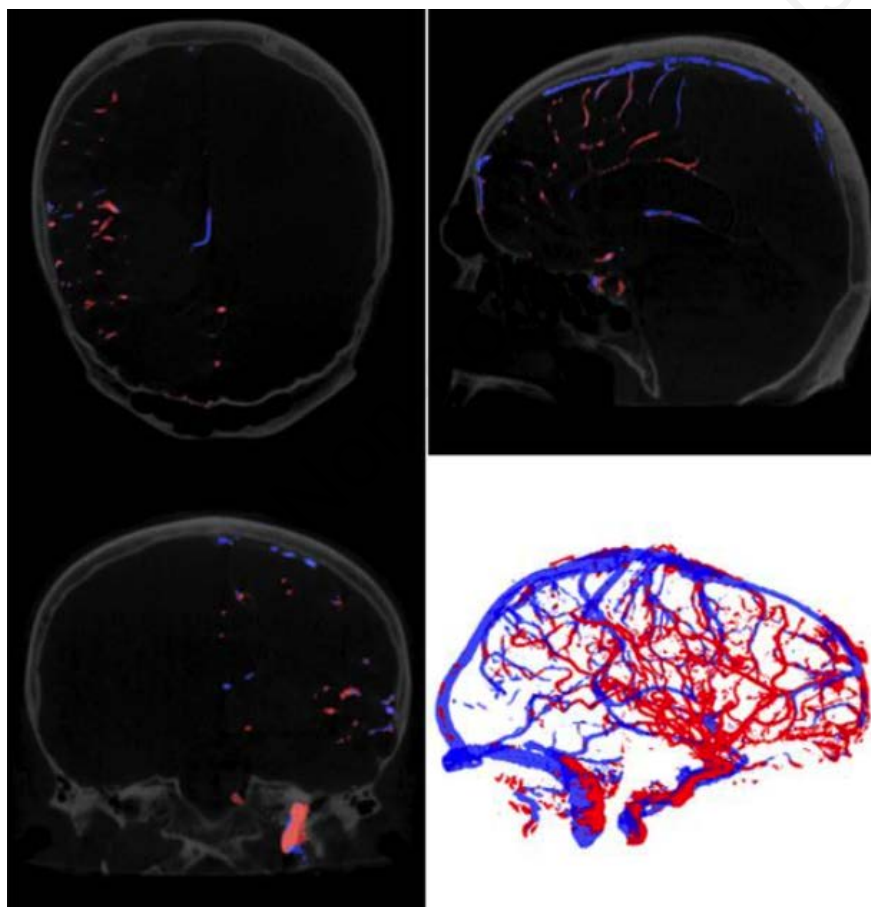


Figure 1. Example of classification of arteries (red) and veins (blue). Bottom-Left) DSA with O-arm<sup>TM</sup> CB-CT for stereo-EEG planning labelled. The first three panels report the sagittal, coronal and axial view of a 3D CE-mask with the voxels labelled as arteries or veins in red and blue, respectively. The latter represent a volume rendering of the labelled 3D DSA.