# CAD-BASED CONSTRUCTION OF CEREBRAL ARTERY MODEL AND CFD-BASED VISUALIZATION OF BLOOD FLOW

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## INTRODUCTION

This paper aims to simulate hemodynamics in cerebral artery network like Circle Willis using computational fluid dynamic (CFD) method and to develop an efficient method in construction of cerebral artery anatomic model by means of compute aided design (CAD) tool. Several CFD studies of hemodynamics in cerebral artery [1] have been performed to clarify the cause of rupture and creation of cerebral aneurysm. In most of these studies, however, only one part of the cerebral artery network is taken as the Region Of Interest (ROI) and is used as CFD geometric model such as cerebral aneurysm, in which influence of the cerebral artery network system is not considered.

Objective of this study is to carry out a global CFD modeling of cerebral hemodynamics in the cerebral artery network system. Since anatomic topology and geometry in the cerebral artery network is of great complexity and hereby we propose an efficient method in construction of realistic anatomic geometric model of the cerebral artery network system by means of using CAD tool.

## METHODS

Firstly, a polygon model of a cerebral artery network based on CT images is constructed automatically using commercial software (forge) as illustrated in Figure.1. It is seen that the polygon model shows quite rough surfaces of blood vessels because of the noises involved in the raw CT images. We then extract the fundamental skeleton lines of the cerebral arteries using the drawing function of the CAD as shown in Figure. 2. Furthermore, we measure the diameter of each cerebral artery, the length of each fundamental skeleton line, and the coordinates of representative points on each fundamental skeleton line. Accordingly, geometric model of the cerebral artery network with all the vessel surface smoothened is built up using the modeling function of the CAD (Figure. 3).

This CAD-based method in construction of blood vessels in complicated artery network can provide both topology and geometries for CFD-based visualization of blood flow and accordingly the grid generation is straightforward. A CFD modeling of the cerebral hemodynamics is further carried out for the constructed cerebral artery network model using an in-house NS solver [2].

## REFERENCES

1. Oshima, M., 2001, "Finite Element Simulation of Blood Flow in the Cerebral Artery", *Compt, Methods Appl. Mech. Engrg.*, Vol. 191, pp. 661-67.

2. Liu, H., 2002, "Multi-scale computation in hemodynamics", *Proc. Riken Symposium on Computational Biomechanics*, pp. 147-154.

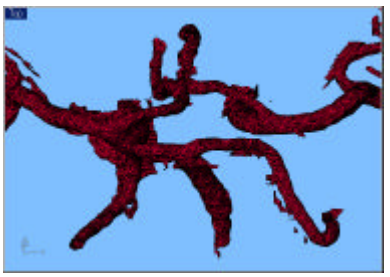

**Figure 1. Polygon model of a cerebral artery network based on CT images**

**Figure 2. Fundamental skeleton lines of cerebral**

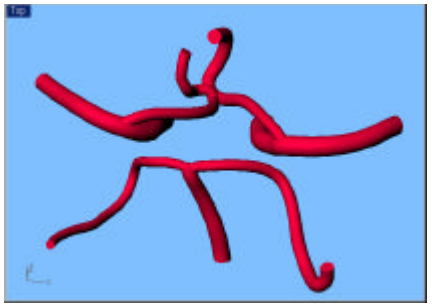

**Figure 3. Geometric model of a cerebral artery network**