# Image-to-Mesh Conversion for Arteriovenous Malformation Surgical Simulators

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**Abstract:** In this paper we present our effort to build a push button Image-to-Mesh conversion software for blood vessels pertinent to Arteriovenous Malformations (AVM). AVMs are tangled bundles of abnormal vessels. Cerebral AVMs pose a threat of hemorrhage that could cause severe morbidity or death. Due to the risk and complexity of AVM surgery, neurosurgeons need to be highly trained. A realistic simulator will significantly improve the training process of allowing surgeons to have hands-on experience without jeopardizing patients health. However, interactive surgery simulation has made few inroads in neurosurgery due to many challenges. One of those challenges is insufficiently descriptive anatomic modeling (i.e., mesh generation) of the brain and particularly critical tissues such as blood vessels.

First, we will describe the requirements analysis for AVM simulations and then the extensions of an existing general purpose mesh generation method we developed [1], for deformable registration of brain images from tumor resection using image guided neurosurgery. Our approach is based on a two-step procedure: (1) the creation of a Body-Centered Cubic (BCC) which creates a uniform structured BCC lattice and (2) the Mesh Compression step is used to smooth the BCC mesh in order to match the tissue(s) boundary. The BCC lattice is refined according to local feature size of labels in the 3D segmented image. The resolution of each tissue is automatically adjusted based on the user-defined fidelity (0, 1]. We will conclude with preliminary results and a comparison using: (i) a similar open source mesh generation method [2] and (ii) a Delaunay-based method [3], for general purpose image-to-mesh conversion. Our preliminary results indicate that we can achieve high fidelity, good gradation and quality of the elements. However, there is a trade-off between fidelity, gradation and element quality which needs to be studied in the context of Finite Element and collisions detection computations for AVM simulations --we plan to address next.

**References:**

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