COUPLED 3D MESH GENERATION AND REGISTRATION FOR THE HUMAN BRAIN

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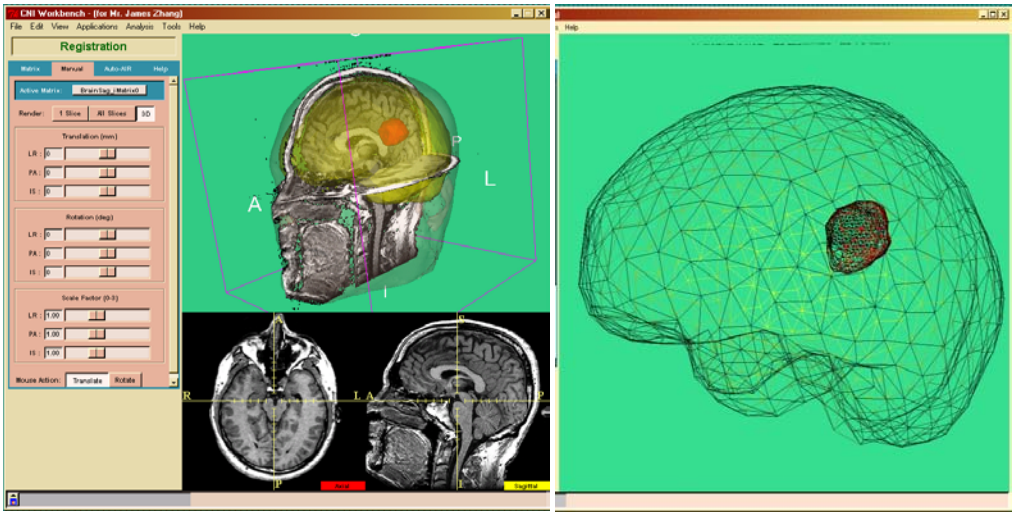
An intuitive graphical user interface was developed that provides a means to record every step of a registration process yielding an affine transformation matrix that incorporated both image data and geometry objects into the same working space. High quality aligned mesh elements are generated through the 3D automatic mesh generator.

Brain tumors are the second most common form of malignant tumors and remain very difficult to treat. An accurate 3D mesh model of a brain is fundamental for analysis and treatment simulation. Generally the raw data of a patient's brain comes from MRI images. The boundary surfaces are extracted from segmented regions on the image slices, which are used as the input for 3D volume mesh generation. The resultant volume mesh, specific to the patient's brain, may misaligned to a standardized human brain atlas for several reasons. This problem can be resolved by registration between images and geometry. Here we use inter-modality registration to align subject-specific volume mesh geometries to standard atlas images. This process registers the boundary mesh surface with MRI images initially. A volume mesh is generated from the registered boundary surface using an automatic 3D mesh generation algorithm. [1] These steps occur within an intuitive GUI that incorporates both image and geometry objects in one working space. It supports mutual registration and the reference and subject objects are exchangeable.

The brain and tumor boundary surfaces displayed were registered to a MR sagittal brain scan of 256x256x124 image volume. The 3D automatic mesh generator created the final mesh with 58,975 tetrahedral elements. One level of mesh refinement was applied around tumor boundary.



An accurate registered 3D mesh model of a brain is critical for analysis and treatment simulation. An intuitive GUI for boundary and volume mesh registration provided a means to fulfill this task.

1. Zhang, J.Q. and J.M. Sullivan, Jr., "Three dimensional mesh generation using a deltahedral building block for anatomically accurate biological models", presented: 5thUS Nat. Congress Comp Mechanics 1999, Aug. 1999.