VMTK: A 3D Interactive Visualization Tool for Supporting Detection of Focal Cortical Dysplasia Lesions

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Rationale:
A successful brain surgery requires the identification of the disease, a precise pre-operative planning and appropriate resection of disease with the least damage possible. Even with efforts in automating these tasks, the existing algorithms fall far short of covering a large variety of situations.

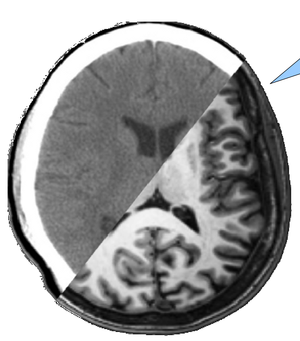
Objective:
To provide a Computer Assisted Surgery (CAS) with customizable tools that support clinical diagnosis and treatment plan processes. Our toolkit provides **user-friendly 3D interactive visualizations** and assists the neurosurgeons with tasks **in native space**, such as identifying areas of lesion, measuring regions of interest, exploring inherent brain structures and doing pre-operative planning, aiming more accurate incisions.

Methods:
To allow effective exploration and visualization of medical data, an **expert-centered interface** has been designed. The neurosurgeon is supplied with the standard 2D views (e.g. axial, coronal and sagittal) and a 3D view of 3D MRI. In addition, **easy-to-use and cutting-edge direct interaction tools** are supported:

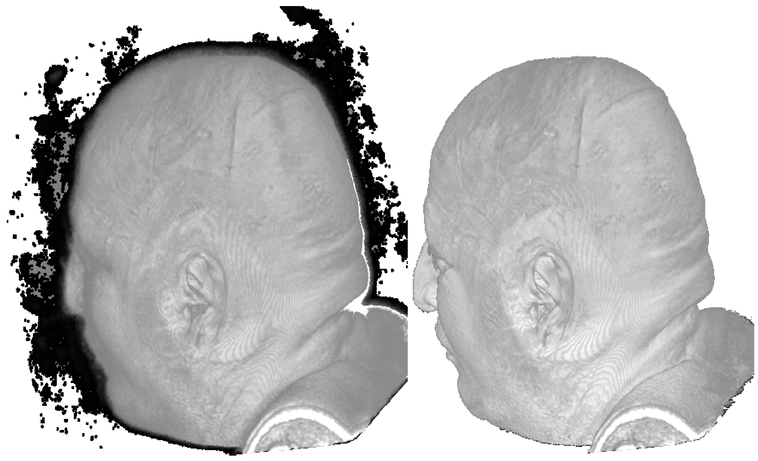
- **Curvilinear reformatting:** allows peeling off the brain, like peeling layers of an onion, revealing subtle laminar blurring patterns aligned with the head's scalp. The user paints the regions of interest over the head's scalp, and after cropping process, he can remove tissue by layer.
- **Measurement tool:** allows evaluating the size and extension of any feature of interest. The user selects a sequence of points, or draws lines over a tissue, and the distances between two adjacent points, or the sums of distances, become available to user.
- **3D eraser tool:** lets the user erase noise from 3D images and specify the outermost isosurface of interest.
- **Transfer function tool or windowing tool:** permits a customizable view, highlighting features of interest or hiding irrelevant data.

Conclusions:
As can be seen on the images, dissected regions and lesions could be identified, combined with measurements of the investigated area. This may facilitate a preoperative planning for scalp incision and craniotomy.

Results:
A prototype is being developed at School of Electrical and Computer Engineering and being evaluated at Hospital de Clínicas – UNICAMP.

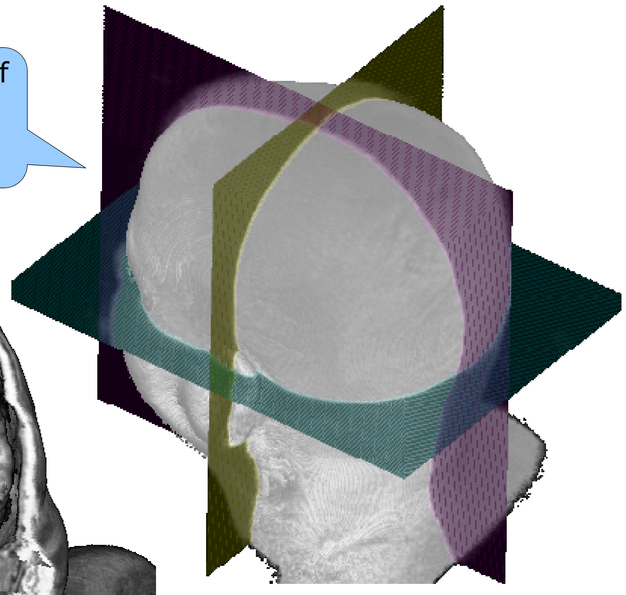


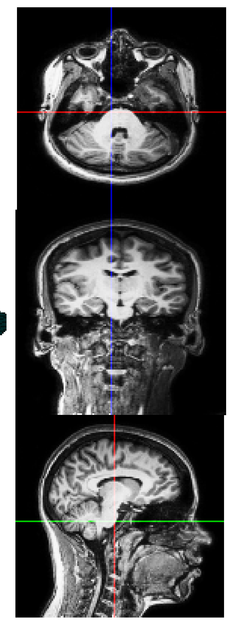
Compliance with DICOM 3.0, enabling VMTK to work with multiple modalities.

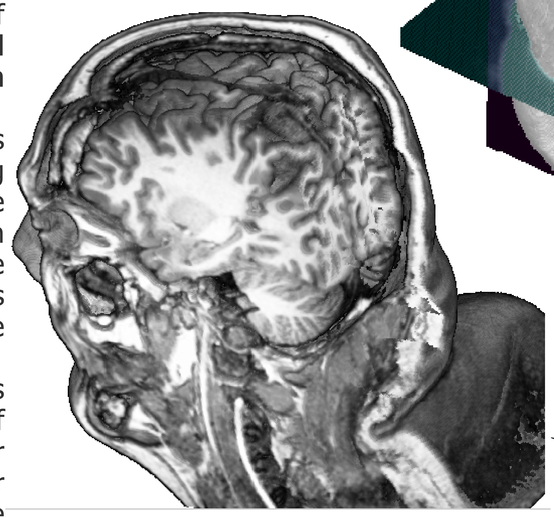


Noise removal: either through an isovalue threshold or by painting the noisy pixels.

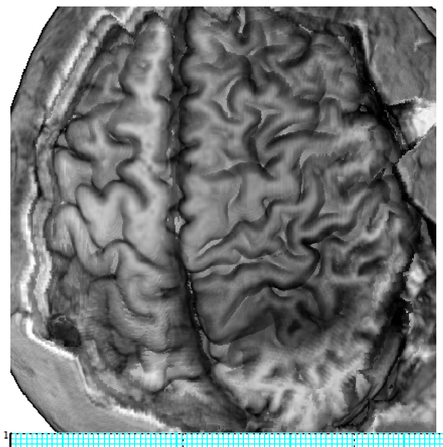
Multiple coordinate views of planar cuts and 3D data volume are highly interactive.



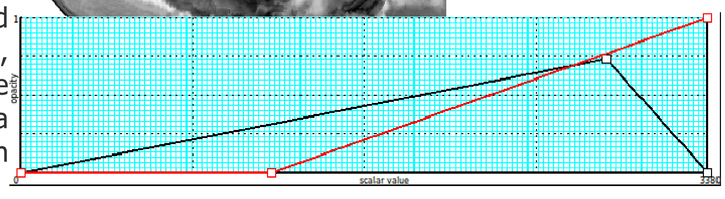


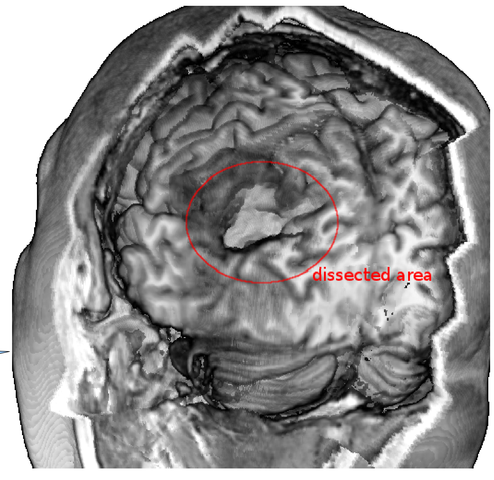


Cropping are accomplished by planar cuts, curvilinear reformatting or a combination of both.



The brightness and contrast of regions of interest, like in CT windowing, is accomplished by a fully customizable transfer function. A focal cortical dysplasia or a lesion can be highlighted.





Measurements and annotations are made directly on the exposed tissue.