TECHNISCHE UNIVERSITÄT DRESDEN

Computer Graphics and Visualization

Faculty of Computer Science Institute of Software and Multimedia Technology

MULTIMODAL MEDICAL IMAGE FUSION BY OPTIMIZING LEARNED PIXEL WEIGHTS USING STRUCTURAL SIMILARITY INDEX

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INTRODUCTION

Image-guided interventions based on preoperative and intraoperative acquired data using the neuronavigation system acts as the gold standard for surgeries.

The preoperative 3D MRI volume data provides structural information like tumor depth/location while the intraoperative 2D Thermal/RGB imaging reveal the functional information such as eloquent sites of the exposed cortex.

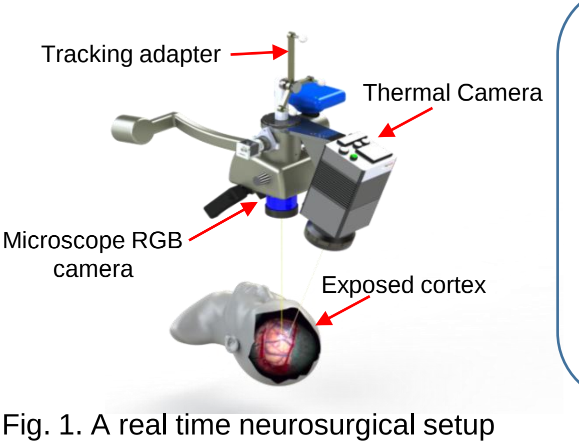

Fig. 1. A real time neurosurgical setup

However, visualization of preoperative and intraoperative modalities separately forces the surgeon to match and transfer the presented information by his own to the actual surgical field.

The 3D-2D medical image fusion helps to overcome this limitation by helping the surgeons to make faster and more accurate diagnostic decisions during the resection of pathological tissue.

METHOD

Intraoperative part of MRI volume is cropped within the trepanation boundary.

The Volume rendering projects 3D tumor on 2D rendered MRI image.

The pre-rendered MRI image is registered with the 2D intraoperative Thermal/RGB images using landmark based scaling, rotation and/or translation.

The registered image pair are fed to the pre-trained VGG-19 neural network.

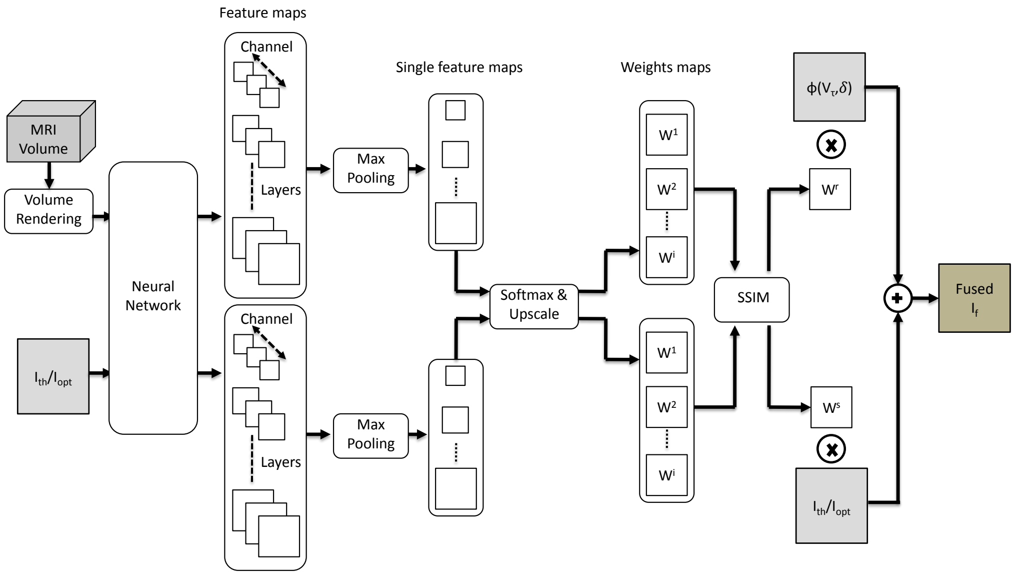

Fig. 2. The proposed Multimodal Medical Image Fusion Architecture

Feature maps from several layers are max-pooled to obtain a single feature map for each of the layers.

The single feature maps from both modalities are soft-max averaged and upscaled to get single weight maps for each of the layers .

The best weight map is finalized on the basis of highest SSIM scores.

The chosen weight map multiplied with input images to obtain the fused image.

RESULTS

The High opacity transfer function results in no visible tumor in MRI.

The Low opacity transfer function shows the ball shaped tumor.

The visual fusion results locates the tumor beneath the surface as well as thermal/visible information of the cortex.

The quantitative analysis reveals that the relu_1 layer of VGG-16 network provides the best SSIM scores than other layers for combination of the both input modalities.

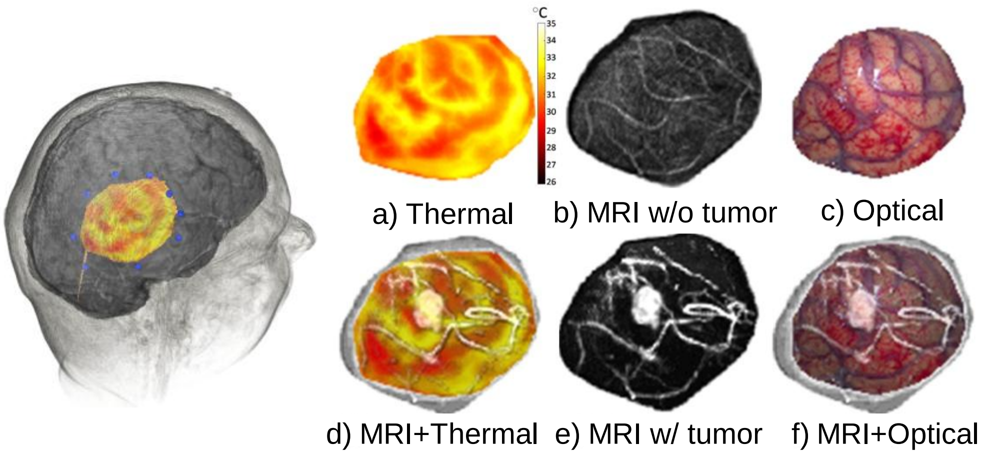

Fig. 3. Visual results of our proposed method

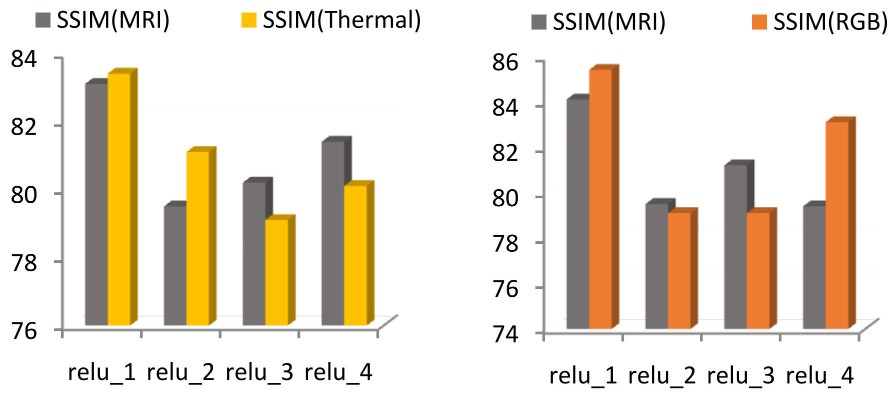

Fig. 4. Quantitative results of our proposed method

CONCLUSION

Our method is well suited for augmented reality based real time tissue characterization during surgeries.

It requires less memory with very low latency.

The Volume rendering operation results in an overload requiring high amount of the GPU computations.

We plan to replace the volume rendering by the 3D-to-2D Fusion to visualize tumor with comparatively less GPU computations.

Contact

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Carl Gustav Carus 1789 - 1869

European Union

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