Project Outline:

Epilepsy is a common neurological disorder affecting 1% of the population. Around a third of patients are refractory to treatment with medication and some may be suitable for surgical treatment. However in patients with focal epilepsy, MRI brain scans appear normal in around a third. This means expensive and invasive tests are required to consider surgery [1].

Voxel-based imaging techniques in which individual patients are compared to a group of healthy controls on a voxelwise basis may be helpful [2,3,4] but are limited by low sensitivity and specificity. However newer imaging techniques may be more sensitive [5] and combining multiple modalities in a multispectral analysis may improve specificity [6].

This project would be to compare the MRI brain scans of individual patients with focal epilepsy to a group of healthy controls by combining several different types of scan (T1, T2, FLAIR, SWI, DTI, NODDI, ASL) in an existing multispectral analysis and then modifying the algorithm further to improve performance.

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Project Title: Multispectral analysis to detect focal abnormalities in epilepsy

Keywords: Medical Image Processing, Machine Learning, Computer-assisted Surgery, Epilepsy

Project Goals (can accommodate more than one student):

1. To compare multimodal MRI brain scans in individuals with epilepsy to focal controls using multispectral analysis and compare findings to clinical metadata
2. To develop the approach as desired using machine learning approaches

Experimental Approaches:

Multimodal MRI data are available on 60 healthy controls and 60 patients with focal epilepsy whose scans appear normal. Other metadata is available (including clinical, psychology, PET, SPECT, scalp and stereo-EEG) to suggest the focus for the seizures. The initial task would be to apply multispectral voxel-based analysis to compare individual patients to a group of controls.

The project could then be developed further using machine learning approaches for surface-based and voxel based analysis. An additional 60 patients with focal epilepsy with visible lesions and manually drawn lesion masks are available that could act as a training dataset for machine learning approaches.

Impact:

The aim is to improve the detection of brain abnormalities in patients with focal epilepsy and normal MRI brain scans by combining different imaging techniques with multispectral analysis and ultimately reduce the cost of medical investigations.

References:

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[6] Kotikalapudi R et al, AJNR 2018;39:2014 (PMID 30337431)

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