

List of projects I participated in

As principal investigator (Under the supervision of Nathan Intrator, Nir Sochen and Yaniv Assaf):

Beltrami imaging – We have developed a mathematical framework that provides new insights into the origin of the diffusion signal. With Yaniv Gur we have developed a novel regularization mechanism for diffusion data.

MDTV – We have developed a variational framework that fits ill-posed diffusion models, such as the multiple tensors model and the Bi-tensor model. We used this framework in order to solve the crossing fibers, and the CSF contamination problems in DTI.

Free water mapping – Using the MDTV framework we were able to quantify the amount of free water in each voxel. We use this parameter as a new contrast mechanism that helps explaining tissue changes.

Graph Tracking – With Shlomi Lifshitz, we embed tractography results on a graph and by this we are able to compact the information into a mathematical structure. We are then able to find new connections and define novel criteria for routes.

Diffusion tensor metrics – With Prof. Peter Basser (NICHD/NIH) and Dr. Ragini Verma (U-Penn) we ask the question: On what manifold do Diffusion tensors live? We have established that for intra voxel comparisons, the Euclidean metric is accurate, and have defined the "context dependent metric" for inter voxel/ inter subject comparisons.

As Co-author:

fMRI analysis – With Aviv Metzger we provide new analysis for fMRI, and provide new insights as to the source of fluctuations in the rest-fMRI signal.

DTI in aging – With Efrat Sasson we find correlation between diffusion measures such as FA and ADC to cognitive decline.

DTI in animal models – With Tamar Blumenfeld-Katzir we find that diffusion measures can predict cognitive scores in rats.

DTI of peripheral nerves – With Dan Stein we used a specialized inhomogeneity reducing apparatus, with it we were able to delineate fiber tracts that pass in the hand, with application to carpal tunnel syndrome.

DTI and fMRI – with Tom Schonberg we suggested fMRI based seed ROI selection for tractography, with application for tumor deflected fibers.

Programming projects that I led:

DiVa - I have created the DiVa Matlab toolbox. This tool provides a complete solution for diffusion analysis. It gets raw data as input, and performs all necessary pre-processing and diffusion analysis, to result with a statistics or tractography ready data. The tool also provides visualization solutions for DTI, tractography, fMRI guided tractography and q-space analysis. The tool was made for the Brain imaging unit in Sourasky medical center, Tel-Aviv (Director: Dr. Talma Hendler). It is extensively used by the clinic for pre-operative planning, and for research purposes by affiliated laboratories. The q-space analysis was added for Prof. Yoram Cohen's Supramolecular Chemistry and MRI/MRS of the Central Nervous System group. The tool has also been extensively used and developed with Yaniv Assaf's research group.

T2 and T1 analysis tools - I have been developing those tools for the NMR research group of Prof. Gil Navon (Chemistry, TAU).

NMR and Imaging analysis tools - These tools have been developed for Tel Aviv University's computational neuro-imaging center. (Prof Yoram Cohen and Dr. Yaniv Assaf).