Modelling data collected from the primate visual cortex has served to advance both a biological understanding of the brain as well as engineering techniques for smarter vision systems. Most well understood are the mechanisms for simple feature extraction by contrast and edge detection. Less well understood are the higher order mechanisms for isolated motion and optic flow. For my Master's thesis I plan to work with Dr. Gaborski on Modelling MST Receptive Fields.

A brief background: receptive fields are regions of the retina, that when presented with particular stimuli, have been correlated with the excitation of particular cortical neurons. Examples include the fine-resolution contrast-sensitive receptive fields modeled by a difference of gaussians filter, the less-fine-resolution edge detection receptive fields modeled by gabor filters, and some MT receptive fields modeled by many-dimensional gaussian models.

Neurons in MST have been found to respond to particular patterns of optic flow. Generally, optic flows are broad patterns of motion across the entire or almost entire visual field. They are individually characterized by what type of self-motion would produce such a pattern of visual motion. For instance, outward radial motion across the entire visual scene is almost exclusively the result of forward self-motion in the environment. Uniform leftward motion indicates rightward strafing or clockwise turning.

It is worth noting the biological context. The human brain does not compute sequentially but massively in parallel and the interaction amongst brain regions cannot be downplayed. Nonetheless, attempts to mathematically generalize the behavior of neurons in simpler brain regions have been successful and the development of more descriptive MST RF models will be useful; useful for the engineering of autonomous robots and other non-linear control problems and useful to psychologists wishing to understand a brain region distinguished by its early role in the more phenomenal sensory-motor loop.

We have access to a set of neuroscience data collected by Dr. Duffy and his team at the University of Rochester. Adult Rhesus Macaques were presented with simulated optic flow patterns on a viewing screen while recordings were taken of individual neurons in MST. There are three different classes of data available, each with different stimuli but with recordings from the same neurons for each. Full optic flow data: the screen is divided up into nine equal subregions and each region contains a motion pattern in a particular direction. In concert they correspond with 'natural' patterns of optic flow. Singles data: the entire screen is without stimulus except for a particular subregion with motion in a particular direction. These stimuli excite different MST neurons to various degrees but generally to a much lesser degree than full optic flow. Doubles data: Similar to singles but with two regions of simultaneous stimulus in varying directions. The task can be summed up: *given singles and doubles data, can we predict optic flow responses*?

Another student in the department has been working on this project for the past year and has published. However, there is some room for improvement; some neurons' behavior was modelled more aptly than others. For my thesis, I plan to investigate some non-traditional models of the antecedent MT in the literature and attempt to apply them to MST data. Specifically, non-uniform summation of MT outputs may be able to maintain the good fits of previous work in the department while closing the gap on the few more poorly modeled neurons. Furthermore, I hope to investigate a possible explanation of MST as a competition between fourier components which has been published with respect to MT.