Control parameters for key building block of bio-machines. (Mentor: Jing Xu) Our goal is to understand how to control the key building block of biological machines: molecular motors. Molecular motors are themselves nano-machines, discovered only in recent decades. We now know that the function of molecular motors underlies the framework for fundamental processes essential to life, and breakdown of these functions leads to a variety defects in biolgical machines (e.g. neurodegeneration, cancer). But we still lack nuanced understanding on the proper control venue of these nano-mahcines, thus cannot yet cure their disfunction in diseases, nor to effectively build machines as well as nature does.

In our lab, we use the state-of-the-art physical machine (optical trap) to gather data on molecular motor function, while subjected to a range of specific single molecule modifications (via chemicals). We then apply nano-meter resolution particle tracking techniques to quantitatively determine the sensitivity of molecular motor function to these parameter changes. We also combine our experimental findings with stochastic simulations techniques (Matlab) to test our hypothesis and to deepen our physical science understanding of molecular motor functions in biological machines. Undergraduate students participate in our research at various levels across various disciplines. The mentor's past undergraduate student success is well established, with several previous students co-authoring peer reviewed research papers.

In this project, initial student activities will include learning to prepare microfluidic cells/motor solutions, to carry out particle tracking analysis, or to use our current simulation codes, depending on the levels of their preparation. Depending on the students' progress, they can subsequently participate in optical trap measurements, write new Labview modules to enable new data collection, or modify our current simulation codes for new hypothesis testing.