The purpose of my research project is to investigate the force behavior and elasticity (plasticity) of living Drosophila embryos at different stages using an in situ PVDF (Polyvinylidene Fluoride) piezoelectric micro-force sensor with sub micronewtons resolution. The Drosophila embryo is one of the most studied organisms in biological research, genetics and developmental biology, and has implications in the cure of human diseases. It is also used to study the wiring of human brain and the nervous system. For a highly efficient and accurate microinjection of genetic material into a Drosophila embryo, it is absolutely necessary to allow close monitoring of the magnitude and direction of microinjection and other biomanipulation force acting on the embryo during the injection process. By quantitatively evaluating the elasticity of Drosophila embryos at different stages, critical information useful to biologists and geneticist for bio-injection and gene modification is obtained, thus enhancing greatly microinjection of Drosophila embryos, which remains the main focus of this project.

Another purpose of this research project is to investigate and characterize force behavior and mechanical properties of living Drosophila embryos using in situ modeled PVDF (Polyvinylidene Fluoride) piezoelectric micro force sensing tool with sub micronewtons resolution, and to improve microrobotic biomanipulation platform integrating a 2-D modeled PVDF micro sensor used to implement force sensing during microinjection of living Drosophila embryos. Based on the event synchronization for the feedback of injection video and microforce, the developed networked microrobotic platform can greatly advance operations in microinjection and biomanipulation. Also, this project demands thorough investigation on micro injection forces and membrane deformation of embryos at different stages of embryogenesis which will help in providing a critical and major step towards the development of automated biomanipulation for batch microinjection of living embryos in genetics which will help facilitate the development of medicine for the cure of human diseases.

Having said all this, in order to enhance overall efficiency, it is better develop a non linear elasticity modeling to demonstrate the impact of force, speed, trajectory and other factors as a function of success rate during a microinjection of genetic material into the living Drosophila embryo, which remains an important aspect and purpose of this research.