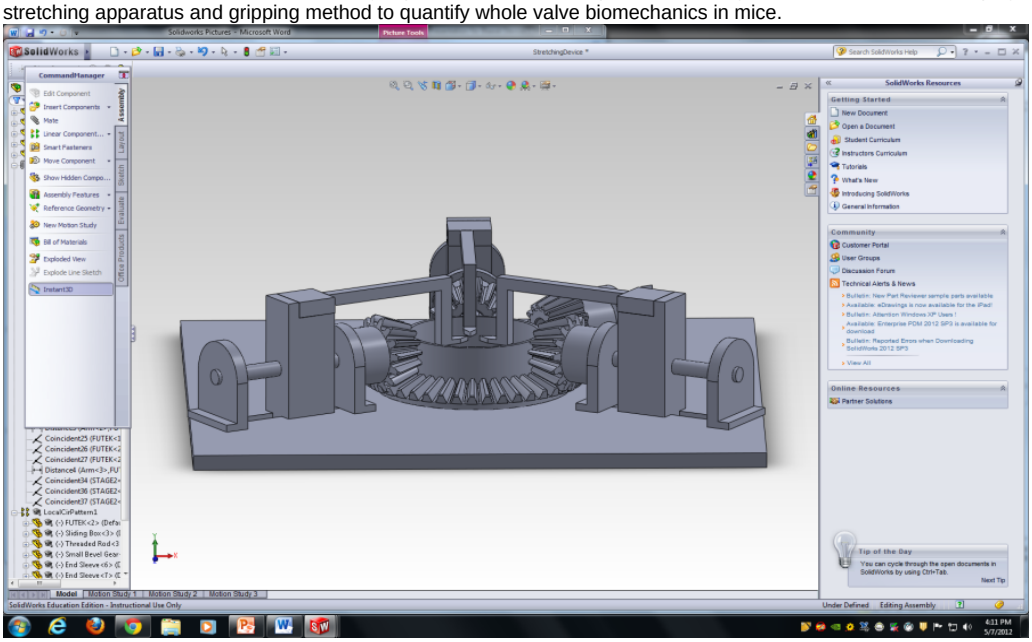
Micro-scale Multi-axial mechanical tester for soft tissues

MEng Design Project Announcement – 2016-17
MEng Project Description Biomedical Engineering/Mechanical Engineering
Meng Project Title: Micro-scale Multi-axial mechanical tester for soft tissues
Project Description:
Mitral valve degeneration is one of the leading causes of valvular morbidity and mortality and frequent cause of heart failure globally. It is characterized by progressive collagen fiber disorganization which leads to gross biomechanical changes, causing disease.
Mouse models are critical for understanding the mechanical and functional changes that occur in both healthy and diseased mitral valves. The ability to investigate the integration of mechanics and genetics in small animal models at a global tissue level is a powerful tool for quantifying functional consequences of specific mutations. However, the mouse mitral valve is an extremely thin tissue, with an average thickness in the mid region of 30–40 μm (4–5 cells thick). Performing a global strain test is a challenging task due to the difficulty with attaching small tissues (0.2 mm–2 mm) and measuring small, forces (10 μN–10 mN).
Previously, our lab quantified underlying cellular deformation, fiber alignment, and valve architecture in mutant mouse species under loaded conditions by uniaxially stretching mouse mitral valves under confocal microscopy with a strip test. We would like to further evaluate these biomechanical and cell-matrix interactions at the whole valve scale by improving our uniaxial strip test for strain to a computer controlled biaxial strain device. We have a prototype of this biaxial device, but it needs to be integrated with the correct force sensors and software, how to adhere the valve needs to be determined, accurate deformation needs to occur and be reliably replicated, and these experimental designs need to be tested. This project will design and test a novel, biaxial, stretching apparatus and gripping method to quantify whole valve biomechanics in mice.



Outside Field Advisor Name (if applicable): Jonathan Butcher (faculty in Mechanical Engineering and Biomedical Engineering)
Email - jtb47@cornell.edu
Phone - 255-3575
Office - Cardiovascular Developmental Bioengineering Laboratory Weill Hall, Room 304
Number of MEng Students Needed: 2-4
Required Skills: Device design, CAD drawing, software integration. Programming skills a plus.