



**CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY**

Name(s) Anshu Vaish	Project Number S0232
Project Title Magnetorheological Fluid Based Links in Morphing Aircraft Structure	
Abstract Objectives/Goals The project aims to create an active hinge link to move the internal load carrying structure of the morphing aircraft wing based on magnetorheological principles. The research estimates the level of resistance (rotational shear stress) of magnetorheological fluid as a function of a varying strength external magnetic field and amount of fluid. Methods/Materials Rotational shear stress was determined by attaching a plastic spindle to the electromagnet. Wooden dowels of varying diameters (1.0 cm, 1.5 cm, and 2.0 cm) were obtained to vary the amounts of magnetorheological fluid and test the subsequent effect on the fluid's rotational shear stress. Each dowel was cut in two pieces with one piece attached horizontally to the other vertical piece and strings were attached to the horizontal pieces. An external dual pulley system was also erected. The dowel was then inserted into the spindle and the gap between the spindle and dowel was filled with magnetorheological fluid. For each dowel tested the electromagnet had varying voltages in 5.0 V increments up to 30.0 V run through it and identical masses were attached to each pulley until the dowel rotated five degrees. This procedure was repeated for each different diameter dowel and the masses were recorded. Results The rotational shear stress of the fluid stayed constant to the 20.0 V mark (10.0 g mass was needed on each pulley) and then increased to 20.0 g where it stayed constant to the final 30.0 V mark. This was true in each of the different diameter dowel experiments. Because of identical results in all three different diameter dowel experiments, it was found that rotational shear stress was not affected by the amount of magnetorheological fluid. Conclusions/Discussion Since rotational shear stress did eventually increase, the fluid's application in an active hinge link in aeronautics is viable. Future research would involve developing a morphing wing based on a bird's wing. This wing would contain active hinge links with magnetorheological fluid each link's rotational axis. The magnetorheological fluid would be the agent which locks the hinge in different angles. The hinge angles would be controlled by onboard computers and would change to best suit external flight conditions. By changing these angles, the overall internal structure of the wing can be morphed.	
Summary Statement The project aims to create active hinge links based on magnetorheological principles to morph airplane wings.	
Help Received Dr. Shiv P. Joshi helped me in designing the project	