INTRODUCTION

Heart disease is the leading cause of death in the United States. Factors that increase the risk of heart disease include obesity and smoking, both of which are prevalent in today's society. In 2004, cardiovascular disease claimed 36.3% of all lives lost, while coronary heart disease took about 452,300 lives. Coronary heart disease is the single leading cause of death in America nowadays. 15,800,000 people alive today have a history of heart attack, angina pectoris or both. [1]

These disturbing trends continue to make it increasingly obvious that heart attack research is an incredibly important field of study. This project was started in an effort to contribute to the advances that have already been made in heart attack research. The stresses and strains of Bullfrog hearts were studied in vivo with the ARAMIS Photogrammetry System, in conjunction with a pressure transducer. Bullfrogs were chosen for this experiment because their hearts can easily be studied in vivo, and because their structure is similar enough to relate to human hearts.

THE ARAMIS PHOTOGRAMMETRY SYSTEM

The ARAMIS Photogrammetry System employs two high speed cameras (which have the capacity to capture 8000 frames per second), to accurately measure the strains on any object over a certain period of time. In order to do so, first, a unique speckle pattern needs to be overlaid on the object of interest.

The speckle pattern consists of a white base coat which is applied to the entire surface of the object. Then, black speckles are laid over the white base coat. Usually, spray paint is used to make the speckle pattern. However, for this particular project, spray paint could not be used because of its damaging properties on the frog heart. Instead, a white silicon based powder and a black charcoal powder were used to create the speckle pattern.

Once the speckle pattern is applied, the cameras take a series of images (at 100 frames per second for this project). The system is then able to use an algorithm, tracing the deformation of the unique speckle pattern, to calculate the strain of the object at each frame. Also, a pressure transducer can be synchronized with the data acquisition portion of the Photogrammetry system to produce stress data at each frame. The data can then be processed to yield useful videos and images which clearly show where the areas of high stress and strain are located on the beating heart.

RESULTS

Figure 1: The Minor Strain on the heart.

Figure 2: The Major Strain on the heart.

Figure 3: The Z displacement of the heart.

Figure 4: A 3-D view from the side of the heart.

CONCLUSIONS

It has been determined that the ARAMIS Photogrammetry System is capable of accurately measuring a beating frog heart at 100 frames per second, and a pressure transducer will be able to measure stress as well. In future research, part of the heart will be frozen with liquid nitrogen, simulating a heart attack. The stresses and strains on a frog heart undergoing a simulated heart attack will be compared and contrasted to the current data of a normally beating heart. Also, the Conus Arteriosus will be studied to determine its properties when the heart is beating normally and when a simulated heart attack is occurring.

REFERENCES