**Photogrammetry of Bullfrog Hearts**

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**Overview**

The purpose of this project is to study the change in stress and pumping of a bull frog's heart during a simulated heart attack. Photogrammetry can be used to study the pumping of the frog's heart and determine how much work the organ does. Photogrammetry is a system that traces three-dimensional motions using photos and speckle patterns to compare movement of particles through every frame. Deformation of the heart is calculated from the pictures taken and a pressure transducer is injected in the ventricle to determine cavity pressure. A heart attack is the result of a blockage in one of the coronary arteries carrying blood to the heart. The lack of blood flow causes pieces of heart muscle to die. A heart attack can be simulated by freezing pieces of the heart. Comparing the healthy heart with the stimulated “heart attack” heart, can show how heart attacks change the way a heart pumps and the additional stress that is added to the heart in doing so. Research has included improving the techniques established by previous Union College students, which involved improving materials and application of the speckle pattern, lighting, and synchronizing the pressure transducer with the snapshot.

**Methods and Materials**

**Photogrammetry System (ARAMIS):** The ARAMIS is a system that measures deformation and records an object using CCD cameras. There are two cameras, which have the ability to view two separate planes. Then using a digital imaging process the machine can record 3D coordinates and deformation, as well as strain.

**Pressure Transducer:** The pressure transducer is injected into the ventricle of the heart. The pressure transducer is synched with the cameras, therefore it records the pressure in the ventricle during each part of the heartbeat.

**Speckle Pattern:** The cameras use a unique gray and white scale speckle pattern to see the deformation of the surface being studied. The speckles need to be proportional to the object being viewed.

**Bullfrog:** A frog’s heart has a single ventricle and two atria. The right atrium receives deoxygenated blood from the veins draining from different organs in the body. The left atrium receives oxygenated blood from the lungs and the skin of the frog. Both atria empty into the single ventricle.

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**Dissection**

During dissection, the frog’s brain is left untouched, so that it cannot feel pain. It is important for the frog to be alive in order to study the heartbeat. The frog breathes through its skin, so keeping it moist with a moist coffee filter helps keep the frog’s heart pumping throughout the photogrammetry process.

**Conclusions**

In conclusion, there is still a lot of work that needs to be done on the speckle pattern. It is important to determine a method for producing the speckle pattern that is uniform and precise. The current powders are still not producing enough contrast for the cameras to pick up on the changing speckle pattern. After the speckle pattern is finalized, the next step is working on simulating a heart attack in the frog and studying the change of pressure and deformation of the heart. With the rapid amount of heart disease effecting the United States population, it is important to understand the effects of heart attacks on a heart, as well as finding ways to prevent and cure heart disease.

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**References:**


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