Progress Report 11: November 24th to November 30th, 2008

Centrifugal Pump Design for Neuroendoscopy

Client: Dr. Joshua Medow, MD, Dept. of Neurological Surgery
Advisor: Professor William Murphy, Biomedical Engineering
Team Members: Jenna Spaeth (Leader)
Kellen Sheedy (Communicator)
Laura Piechura (BWIG)
Holly Liske (BSAC)

Problem Statement

Neuroendoscopy is a surgical procedure that uses endoscopes or tube-like instruments to view the internal surface of the brain. A continuous (non-peristaltic) flow of saline is necessary to visualize and navigate throughout the surgical field. If not maintained, variable saline pressures may lead to flooding of the brain or visibility issues with the endoscope lens. Currently, this continuous flow of saline is created through a pressurized bag of saline; however, due to lengthy procedures, the saline bags must be replaced frequently causing disruptions during the surgery. Our client, Dr. Joshua Medow, would like to use a centrifugal pump to control the constant flow of saline. The pump that has been chosen was originally designed for cardiac surgery, having a saline flow of 5.0 L/min, much higher than the 150-mL/min flow required for the rinsing the brain. Dr. Medow would like us to design the circuitry for the centrifugal pump as to create a negative feedback system to control the saline flow when instruments are inserted and removed from the endoscope during the procedure and to reduce the overall flow rate to the appropriate level.

Last Week's Goals

- Measure transient response of the system to define potential limitations (11/21)
- Test circuit in BME 310 lab using Lab View to verify predicted output voltages (11/20)
- Transport circuit to the VA lab and test with the pump system (11/21)
- Use data from system to define fuse for safety purposes and integrate it into the design
- Start modifying the PDS to match design choice
- Start writing final report

Summary of Accomplishments

- On Thursday, Nov. 20th, our team met in the BME 310 lab to test the output voltage values using Lab View. Holly was able to download the Lab View software on her laptop and an ELVIS board was used to power the circuit. After some initial trial and error, the appropriate output voltage for the control, sensor, and final voltage were achieved and represented on the real-time graphs.

- On Friday, Nov. 21st, our team met in the VA hospital lab to test the circuit with the centrifugal pump system. An ELVIS board was borrowed from the BME 310 lab to power the circuit and a multimeter from the VA lab was used to verify voltage output signals. Lab View via Holly's computer was once again used to collect real-time data. Although there was moderate noise on the output graph, the system operated properly, both attenuating the signal and providing a negative feedback loop to maintain a constant flow rate. The circuit was tested using a wide range of voltage values from the system and yielded similar positive results. The transient response of the system was quite fast; Dr. Medow pinched off a section of the tubing and was able to almost instantaneously hear the motor speed increase to accommodate for the loss of flow. The actual transient response time will be quantified through further testing this coming week.

- On Monday, Nov. 24th, the circuit system was once again hooked up to the centrifugal pump system in the VA lab. Installing a low pass filter within the circuit attenuated the noise from the system. Items for the permanent circuit were also purchased from Radio Shack that night.

- On Tuesday, Nov. 25th, Holly met with Prof. Webster to try to understand the real-time plots we were obtaining from the system. He told her that the summing amplifier was not necessary within our design, and it was removed.

- On Wednesday, Nov. 26th, Holly and Laura met to build the circuit on a series of stacked boards that could be fit into a small box. A manual switch was also installed within the circuit for safety purposes.

- Accomplishments over Thanksgiving break:
    - Holly: Finished putting the circuit together on the series of stacked boards, prepared a protocol for testing (12/1) before & with Dr. Medow, analyzed our data & cleaned up the plots, and wrote the final design & testing sections for the paper.
    - Laura: Prepared poster for presentation on (12/5)
    - Kellen: Final report: design sections
    - Jenna: Final report: formatting, abstract, problem statement, background, and client requirements

- On Monday, Dec. 1st, our team met with Dr. Medow to test our circuit design with the centrifugal pump and the endoscopes that Dr. Medow checked out of the hospital for us to use. The newly constructed circuit was not operational and will be rebuilt before our rescheduled meeting with Dr. Medow on Tuesday, Dec. 2nd.

The Week's Goals

- Test circuit design with system while using actual endoscopes—using protocols (12/2)
- Modify the PDS
- Poster presentation prep
- Final Report

Project Difficulties

None, timing is working out well.

Activities

See "Accomplishments over Thanksgiving break" section above

Project Timeline