Title: Airflow Measuring Sensor Array for a Sailplane Wing: Hardware
Student: Usama Nasir; **Faculty Sponsor**: Christopher G. Prince

Background

The project is pertaining experiencing the airflow changes on an aircraft wing during flight, as if the pilot were a bird or a bat (e.g., see Zook, 2005). The long-term goal of this research project is to take real-time input from pressure sensors, process the information, and then produce an output on a tactile (touch sensation) output device that would be worn by the pilot and/or the flying crew.

The overall research project is called the Fly by Feel project, and includes both hardware and software. The Core processing software currently accepts multiple possible sources of input. These sources vary between simulated sensors from computational fluid mechanics, flight simulator dynamic input and flight simulator logged files. The input is processed by the core system software, and then the corresponding output is sent to one of multiple possible devices. These output devices include the computer screen for visual rendering (for debugging) a TN Games commercial tactile feedback vest (Sebesta, 2008), fan tactile output sleeves (Wronski, 2008) and pager motor tactile output sleeves (Parrott, 2008). A sensory array technology for deployment on an aircraft wing that might suit our needs is commercially available (Caitlin, et al., 2002; Sensors, 2008). Our hope is to develop our own in-house sensory technology and when we have sufficient work completed, apply for a grant so we can compare our sensory array against this commercial available array.

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Methods

Currently in the Fly by Feel project, there is no way to measure the airflow at a location on the aircraft. Presently, the data being used as input is from simulated sources. To take this project to the next level, I want to design a physical sensor array that can be placed on the aircraft wings during flight time where they can generate continuous output. These physical sensors will be composed of MEMS sensors (Micro Electro Mechanical Systems sensors) that are barometric pressure sensors. I will be working on the physical, hardware side while a second student collaborator (Sonja Foss) is co-submitting a second UROP proposal to take care of the software side of the sensory array.

After careful analysis and discussion with my faculty sponsor, I plan to use Microchip 18f4550 microcontroller as an interface for the MEMS sensors. The SPI (Serial Peripheral Interface) protocol will be used to interface with the sensors. I will be using flash memory to store data for subsequent download. Since this microcontroller has both a USB hardware port and SPI interface capabilities, it is the right fit.

Evaluation

The system that will be created by these two proposed UROP projects can be tested to give output signals for varying pressures by driving up and down Duluth hills as well as rides in amusement parks. It can also be put on a wing segment in a wind tunnel, to generate varying output across the sensors. We will also be able to

log the data resulting from the sensors and use that logged data, offline, to drive tactile feedback devices using the existing Core software.

Contribution

This research project will contribute positively to society. It may increase flight safety by giving input to the pilot in order to make him or her more aware of the changes in the airflow on the wing of the aircraft. This airflow information may improve the pilot's detection of stall and spin conditions. It may also contribute to a better flying experience for the flight crew.

Personal Motivation

I am submitting a research proposal for which we are requesting funding from your committee. This funding is requested for Summer 09 and potentially Fall 09. The research project, headed by Dr. Chris Prince, is already in progress and swiftly moving towards completion.