Fly by Feel: Air Actuator System

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Background

Imagine if you could feel the sensations a bird may feel while flying. That is what the Fly by Feel system offers. The Fly by Feel system is being designed to provide tactile feedback to a pilot by monitoring properties of air flow (e.g., air pressure) across the wings. This could not only allow for an improved experience while flying but it should also allow pilots to be safer. This system is primarily being designed for sailplanes (gliders). The Fly by Feel system is being designed to take readings from sensors on the wings and translate these readings into tactile feedback (touch). There are several parts to this system; however I will be focused on the tactile feedback method. This is an innovative project that may not only allow for an incredible new way to experience flight, but may also make flying safer as the pilot could "feel" changes in wind speed and pressure.

The goal of the Fly by Feel system is to equip the wing of a glider with an array of sensors measuring air flow properties on the wing, and feed that information back to the glider pilot via a tactile feedback system. The goal of my research is to design and test a new type of actuator that will provide air based variable tactile feedback. The system will vary the amount and pressure of the air flow sent to the pilots skin based on sensor data. This system should provide more control than past designs (see Parrott, 2008; Wronski, 2008). This greater control will be achieved through adjustments of individual actuator air flow, as well using smaller air to skin contacts.

Contributions

This system has many potential benefits. As mentioned it may add to the pilots experience and may make flying safer. It also should be adaptable to simulations and unmanned aerial vehicles (UAV's), as well as allowing those who are visually impaired to better experience and enjoy flight. First and foremost it should allow for greater safety, especially when landing. The majority of accidents and crashes for aircraft occur during the landing sequence. Such landing accidents often occur when at low altitudes and low air speeds, pilots turn and stall then spin. This system would allow a pilot to feel what is going on the wings outside their cockpit, and could reduce or eliminate these stalls and spins. The ability to have tactile feedback is important, because after all tactile feedback is relied on heavily in day to day life, so why not while flying?

This system could be easily utilized with UAV's (see also Aretez et al, 2006). If a tactile system was deployed on a UAV then the pilot who is sitting at the control terminal, not in a cockpit, would be able to have a greater understanding of the environment surrounding the UAV and would be able to better pilot the vehicle. Tactile feedback could also improve training and leisure simulations by.

Method

After doing some preliminary research and reviewing past research and designs with Professor Prince, I have come up with a basic design for a new air flow actuator system. I have considered several different design possibilities, and have now settled on a basic design using flowing air controlled by variable electronic air flow control valves and possibly electronic regulators. I have yet to determine the diameter of the tubes that will be used and this will be my first step in the project. I will evaluate tubes with different diameters to determine which allows for appropriate air flow as well as suitable pressure for this project. The pressure will have to be sufficient to allow for the maximum amount of variability in air flow, yet not too high as we do not want to harm the wearer. At present we expect a tube diameter between ¼ and ½ inch. After determining the appropriate diameter for the tubes, the electronic air control valves can be purchased. We plan on using an array of 10 skin contacting tubes and air flow control valves; initially these valves will simply be controlled with a potentiometer, or variable resistor and a low voltage DC power supply. This will allow us to test our valves and air flow quickly and easily. The air supply will just be a standard air compressor, which we have already acquired, set at the correct pressure and connected to our system. Then the system can be tested and the optimum pressure found that allows for the greatest air actuator control. Once this is complete we can then assemble and/or fabricate the mounting system, which will consist of armbands connected by both elastic and a metal or plastic plate allowing for mounting the skin-contacting tubes. Then I will simply need to determine the correct height of the fixture above the skin in order for maximum variability and comfort ability. From there I can work with Professor Prince to control the system for use with a micro controller. The system can then be tested to see if it will allow for the actuator control that we are looking for.

Evaluation

Once the array of air actuators is assembled, we can then carry out testing. Our main criteria for the success of this project is based on the achieved degree of control over the air flow, as well as the actuator arrays' ability to be worn by multiple users. If the air flow is not sufficiently controllable then it will not give an accurate translation of the measurements taken by the wing sensor array.

REFERENCES

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