POSTER SESSION 3

MGH 241, Easel 138

2:30 PM to 4:00 PM

Human-Machine Interface: Human-Intent Estimation using EMG Sensor Control

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Mentor: Santosh Devasia, Mechanical Engineering
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With the increasing application of electromyography (EMG) sensor systems (method to measure electric potential generated during muscle contraction) in automation and robotics control, investigations on an effective user-interface are essential. My goal is to investigate solutions that enable valid communications between users and a system under complex sensor behaviors. If a user is unable to complete a motion or to continuously generate the proper control signal, the interface detects the desired signal and reproduces the intended result. There are two components in this research: (i) finding the behaviors of EMG signal, which determines the way users interact with the system, and (ii) adjusting or approximating the output to an ideal signal through visual feedback. To address the first task, I have processed the EMG sensor signal by implementing an analog and digital filter system to achieve a reliable EMG signal. Towards this, I created a LabView program to generate a signal of a desired function (e.g. $A\sin(\omega t+\phi)$), by detecting the magnitude, frequency, and phase information of the input signal. Currently, my signal generation program works with a sinusoidal waveform in the presence of noise. However, physical EMG signals are not perfect sinusoidal waves. Using my program, the interface between the human-generated EMG signal and the computer generated result can be explored, with the goal of using EMG signals to control the computer generated signals. This will be accomplished by modifying the detection algorithm developed for the sinusoidal inputs.

POSTER SESSION 3

MGH 241, Easel 151

2:30 PM to 4:00 PM

Feedback Control of Temperature-Profile Induced Diameter Oscillations in Polymer Optical Fiber Production

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Specialty polymer optical fiber requires incredibly tight diameter control of ~1 um to minimize signal attenuation. Temperature profiles within cylindrical furnaces used to bring about necking of preforms to be drawn into fiber cause the formation of convective oscillating cells. The resulting variations in heat flux into the preform likewise cause oscillations in the fiber exit diameter. For preforms of sufficient diameter, matching a prescribed temperature profile within the necking region of the furnace leads to fiber diameter oscillations of predictable amplitude and frequency. The necessary temperature profile and the extent to which this affect can be achieved varies with the geometry of the inside of the furnace; namely, preform shape and diameter. To maintain ease of manufacturability, accommodating various preform diameters is necessary. By drawing fiber under temperature profiles described above, it is hoped that coupling these well-understood and reproducible oscillations with a PID feedback controller using draw speed to regulate exit diameter and tuned to these specific oscillations, we will attain diameter control within 1 um for the ideal case of a large 1" diameter preform. Preforms of varying diameters will be drawn under ideal temperature profiles, with the fiber diameter recorded. When steady oscillations are achieved, a PID controller tuned to their amplitude and frequency will be turned on, and the diameter response will be observed. Earlier work indicated that the process is highly sensitive to temperature and draw speed, and previous attempts to achieve 1 um diameter control using only PID feedback or temperature profile regulation proved inadequate. This work will determine if a combined approach advantageous, and provide insight into the more challenging control problems associated with specialty fiber preforms of smaller diameter. If achievable, this would allow inexpensive production of advanced graded-index fiber.