College of Engineering
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MSEE Thesis Proposal

Adaptive Neural Control of a Gimbaled Laser Targeting System with Resilient Benchmarks

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The Adaptive Neural Control (ANC) system, first proposed by D.C. Hyland, is a neural control system within a Model Reference Control (MRAC) architecture. It is composed of five separate neural networks, two of which are used to replicate an unknown plant, while the remaining three are used to control the plant's output to match that of an ideal reference system. The system has been successfully used in hardware such as the NASA / LaRC Mini-MAST testbed and the ASTREX testbed at Airforce Philips Laboratory. It has been shown to be very effective in terms of robustness, fault tolerance, and optimality. The resiliency, defined in terms of how the controller maintains operational normalcy in response to anomalies, both unexpected and malicious, has not been extensively studied. We wish to apply the ANC system to the problem of pointing and tracking the line of sight of a laser targeting testbed, while examining the system's resiliency. Therefore, the goal of this study is to implement the ANC system in hardware and examine its resiliency to anomalies. These anomalies will be in the form of added latencies, plant parameter changes, false data injection, and sensor data alteration. Currently, the ANC system is implemented in hardware using a dSpace control board. Preliminary results show that the controller fails when the system is subjected to small disturbances. This is due to the high sample time at which the controller executes, which is, in turn, due to the computational complexity of the ANC system. Therefore, we propose to implement the controller on a field programmable gate array (FPGA), which has the parallel processing capabilities to handle simultaneously updating the weights as well as evaluating the neural functions. We will compare the performance, in terms of both control and resiliency, of the ANC system implemented on the FPGA to the same system on a sequential processor.