Abstract

Model-Free Adaptive (MFA) control is a technology that has made a major impact on the automatic control industry. MFA control users have successfully solved many industry-wide control problems in various applications and achieved significant economic benefits. Now, the challenge is extending the many advantages of MFA control technology to diverse and fragmented markets, which could benefit from its unique capabilities. Since single-loop MFA controllers can directly replace legacy PID controllers without the need for "system" redesign (plug-and play), they are readily embeddable in various instruments, equipment, and smart control valves. This alleviates concerns relative to cost of change and also makes MFA an appealing tool for OEM applications on a large scale. Embedding advanced control algorithms into a platform of hardware and software is not a trivial task, especially if the product is for high-speed control applications. The algorithm computation time, the static and dynamic memory required, CPU type, floating-point calculation capability, compiler tools, and operating system can all impact the development cost and product performance. In this thesis, embedding MFA controllers into PLC, FPGA, and application-specific control devices will be discussed and demonstrated. The implementation of digital controllers on FPGAs has been adopted intensively by most of the reputed manufacturers. This is mainly because of the distinctive inherited properties of FPGA devices. These properties include the high clock rates at which these devices can operate high reliability when working in harsh environment and more importantly is their fascinating ability to be programmed at “run time”. In this thesis the author will be trying to combine all the advantages of these sophisticated devices (FPGA’s) with the features and properties of the most advanced control methods such as MFA control. He is hopeful to reach the ultimate target of his objective which is to force an output of the process to track a setpoint regardless of the impact of any disturbances on that setpoint.