**GA-Based Optimization in Mechatronic Systems: System Identification and Controller Design**

**Abstract:**

Fast-response and high-precision motion control is one of indispensable techniques in a wide variety of high performance mechatronic systems including micro and/or nano scale motion, such as data storage devices, machine tools, manufacturing tools for electronics components, and industrial robots, from the standpoints of high productivity, high quality of products, and total cost reduction. In those applications, the required specifications in the motion performance, e.g. response/settling time, trajectory/settling accuracy, etc., should be sufficiently achieved. In addition, the robustness against disturbances and/or uncertainties, the mechanical vibration suppression, and the adaptation capability against variations in mechanisms should be essential properties to be provided in the performance.

The keynote speech presents practical optimization techniques based on a genetic algorithm (GA) for mechatronic systems, especially focusing on auto-tuning approaches in system identification and motion controller design. Comparing to conventional manual tuning techniques, the auto-tuning technique can save the time and cost of controller tuning by skilled engineers, can reduce performance deviation among products, and can achieve higher control performance. The technique consists of two main processes: one is an autonomous system identification process, involving in the use of actual motion profiles of system. The other is, on the other hand, an autonomous control gain tuning process in the frequency and time domains, involving in the use of GA, which satisfies the required tuning control specifications, e.g., control performance, execution time, stability, and practical applicability in industries. The proposed technique has been practically evaluated through experiments performed, by giving examples in industrial applications to a galvano scanner in laser drilling manufacturing and an actual six-axis industrial robot.

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