In modern manufacturing industries, many applications require precision motion control of multi-agent systems, such as multi-joint robot arms and multi-axis machine tools. For such applications, the cutter (end effector) should stay as close as possible to the desired tool path to ensure the quality of the final product. In conventional computer numerical control (CNC), individual servomechanism is designed independently without considering the performance of other axes. As such, the lack of coordination among axes may result in performance degradation in contour following task, even when the performance of each servomechanism is high. This dissertation studies the control of multi-axis machine tools with focus on reducing the contour error. The proposed research explicitly addresses the reduction of contour error and treats the multi-axis machine tool as one multi-input-multi-output (MIMO) system instead of several decoupled single-input-single-output (SISO) systems. New control schemes are developed to achieve superior contour following performance in the presence of disturbances. This study also extends the applications of the proposed system from plane curves to regular curves in $\mathbb{R}^3$. The effectiveness of the developed control systems is experimentally verified on micro-mill machines.

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The public is welcome to attend.