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Gain-Scheduling Control of Machine Tools with Varying Structural Flexibilities

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The high accelerations of present-day machine tools are likely to excite the vibration modes of the machine structure of these tools. Therefore structural eigenfrequencies need to be incorporated in the controller design. An additional complication with machine tools is that the structural eigenfrequencies are not constant but depend on the position of the tool in the workspace of the machine tool, with as consequence that the machine model is position dependent. To control such linear time varying (LTV) systems, two approaches are possible: (i) the controller is robust with respect to system variations, and (ii) the controller incorporates the system variations, e.g. by gain-scheduling. In this paper a flexible beam with varying stiffness is controlled based on the gain-scheduling approach. Next to an ad-hoc scheduled H-infinity controller, analytically scheduled controllers are designed using a global LTV model of the set-up. Experiments finally show that gain-scheduling is necessary if high-performance is demanded.

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