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Effect of the Drawbar Force on the Dynamic Characteristics of a Spindle-Tool Holder System

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Abstract : This study presented the investigation of the influence of the tool holder interface stiffness on the dynamic characteristics of a spindle tool system. The interface stiffness was produced by drawbar force on the tool holder, which tends to affect the spindle dynamics. In order to assess the influence of interface stiffness on the vibration characteristic of spindle unit, we first created a three dimensional finite element model of a high speed spindle system integrated with tool holder. The key point for the creation of FEM model is the modeling of the rolling interface within the angular contact bearings and the tool holder interface. The former can be simulated by a introducing a series of spring elements between inner and outer rings. The contact stiffness was calculated according to Hertz contact theory and the preload applied on the bearings. The interface stiffness of the tool holder was identified through the experimental measurement and finite element modal analysis. Current results show that the dynamic stiffness was greatly influenced by the tool holder system. In addition, variations of modal damping, static stiffness and dynamic stiffness of the spindle tool system were greatly determined by the interface stiffness of the tool holder which was in turn dependent on the draw bar force applied on the tool holder. Overall, this study demonstrates that identification of the interface characteristics of spindle tool holder is of very importance for the refinement of the spindle tooling system to achieve the optimum machining performance.

Keywords : dynamic stiffness, spindle-tool holder, interface stiffness, drawbar force
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