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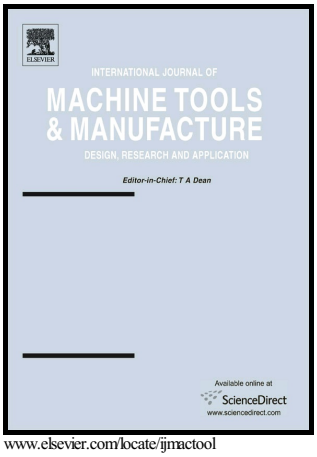

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MECHANICS OF TURN-MILLING OPERATIONS

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Abstract

Turn-milling machines, which are capable of carrying out turning and milling operations, are widely used in machining complex parts in one set-up. However, due to the complex kinematics and tool-workpiece interaction, turn milling operations are mainly carried out by relying on costly machining trials and experience. This paper presents the mechanics of turn-milling operations to predict cutting forces, torque and power requirements. Typical turn milling process involves three linear (*x*,*y*.z) and two rotary drives of the machine tool. The resulting feed vector is modeled as a function of linear velocities of the drives, and angular speeds of workpiece and tool spindles. The generalized chip thickness distribution is modeled as a function of linear feed drive motions, tool and workpiece spindle rotations. The cutting force predictions are experimentally verified for sample cylindrical and ball end mills. The identification of productive tool and workpiece spindle speeds is demonstrated using chip load limit of the tools and torque-power constraints of the turn milling machine tools.

Keywords

Turn-milling; mechanical model; multi-axes feed motion.

Nomenclature

$\mathbf{P_i}$	Tool position in WCS
$\mathbf{O_i}$	Tool orientation in WCS
f_L	Linear feed magnitude
f_t	Tool axial feed
c	Tool Feedrate
$\mathbf{f_w}$	Projected linear workpiece feed
$\mathbf{f_{L,T}}$	Total linear feed vector