Influence of workpiece support on the generated surface in turning

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ABSTRACT

The tailstock is used in turning operation to guide the workpiece rotation. This paper introduces an investigation for the influences of the tailstock axial force on the turning dynamics.

A set of experiments were carried out to study the effect of different axial clamping force on the vibration of the tool workpiece system and consequently on the workpiece roundness error. Vibrations generated during turning were measured in Three directions (radial, axial, and tangential). More over the resulted roundness errors on theworkpieces surfaces were also measured.

The results showed a great dependence of both vibrations existing during turning and the resulted roundness error, on the tailstock axial clamping force. The control of this force will improve the workpiece quality and detect the other errors such as chuck claming. There is an optimum value for this force that reduces the roundness error to a minimum value. Also the vibration signals in the axial direction correlates comparatively well with the tailstock clamping force than those in other directions.

KEYWORDS

Turning- Vibration- Roundness- Tailstock clamping.

1. INTRODUCTION

Rotation of the workpiece about the axis of rotation is fundamental to the operation of the majority of machine tools. For real axis of rotation the term error motion refers to the relative displacement between the tool and workpiece[1]. The final accuracy of a workpiece is influenced by many different factors [2]. Among them, those related to the machine tools. The accuracy of machine tool can be attributed to several factors: a) geometric and kinematics errors of the machine, b) spindle errors, c) thermal effects, d) static and dynamic loading, e) workpiece (stiffness, weight, clamping, and material stability).

The dynamics of the relative motion between the cutting tool and the workpiece affect directly both the quality and the productivity of metal cutting operations[3]. Hence, it reduces tool life, prevents a machine tool from operating at its full capacity, and deteriorates the quality of the workpiece surface. Therefore it has been subjected to continuous research over the last decades. Most of this work has been focussed on machine tool chatter, i.e. self-excited vibration that usually developed during large metal removal rates. This phenomenon has detrimental effects on the workpiece accuracy.

Kato, et al[4], studied the influence of tailstock center on the workpiece roundness. They studied the transferring characteristics of roundness error from the center and center hole to the ground surface in cylindrical plunge grinding operation.

This paper presents an investigation, which was carried out to study the effect of the tailstock tightening force on the dynamics of the turning operation and its effect on the workpiece roundness error.

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