Integrated approach for optimising machining parameters, tool wear and surface quality in multi-passturning operations

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Abstract

This paper implements a holistic decision approach for determining tool wear and surface quality together with machining parameters such as cutting speed, feed rate, depth of cut, and cutting passes during turning operations. As a consequence, two machining optimisation models are formulated with the objectives of maximising the material removal rate and minimising the production cost so that the decisions regarding machining parameters can be determined as well as the status of tool wear and surface quality between intermediate cutting passes. The feasibility and applicability of the formulated models have been tested through computational analyses, and a comparison made between the two performance objectives. The results show that the integrated decisions of machining parameters, tool wear and surface quality can be made and thus avoid the application of expensive on-line equipment for measuring tool wear and surface quality. Furthermore, the feasible removal of material during turning operations can be achieved through proper selection of depths of cut and number of cutting passes. The proposed optimisation models can also be used to provide tool replacement schedules based on the number of processing parts and cutting passes.

Keywords: Turning operations; Machining parameters; Tool wear; Surface quality; Optimisation.