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Investigating the Power Profile for 3- Axis Milling Machine -Case Study Analysis

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Abstract

Manufacturing and the processes involved consume substantial amounts of energy and other resources and, as a result, have a measurable impact on the environment . Reducing the energy consumption of machine tools can significantly improve the environmental performance of manufacturing processes and systems. Furthermore, given that machining processes are used in manufacturing the tooling for many consumer products, improving the energy efficiency of machining-based manufacturing systems could yield significant reduction in the environmental impact of consumer products . In this research the power consumed by Mori Seiki NV1500 DCG milling machine was investigated, where the power consumed by the machine was measured experimentally. However the spindle alone about 70% of the total idling power. the total consumed power by this machine, this power profile can be used to develop a control system to manage the energy consumption by reducing the idling time.

I. INTRODUCTION

Manufacturing has always been and will always be a compromise between different objectives like quality, cost, production time, flexibility, and sustainability. To ensure that these objectives stay in their boundaries it is necessary to control them. In order to be able to control these objectives, processes have to be monitored in manufacturing systems that become more and more complex.

Generally, monitoring techniques can be categorized as direct and indirect measurements. Indirect measuring means the information about a monitored parameter is obtained only after signal processing and model-based interpretation, whereas in direct measuring the information is directly accessible from the signal. An examplefor direct measurement is the position of an axis, which can be read directly from an absolute scale [1]. Examples for indirect measurement are the temperature of a component, which is measured by the current that is goingthrough a resistance or the acceleration of an axis, which is measured by calculating the second derivative of the position of the axis. The application of direct measurements is easier and more reliable since for indirect measurements, relationships between the actually measured parameter and the parameter to be monitored have to be understood and modeled correctly.

Another important classification in monitoring is the differentiation between in-process and out-of-process mon- itoring. An in-process sensor monitors during the process and provides real-time data on the attributes. Out-of-process monitoring, also called in-cycle monitoring, examines parameters only periodically [1]. An example of a parameter that is measured in-process is the position of an axis in a machine tool. This parameters is fed back to the controller of the machine tool and has therefore to be measured in real-time. Other parameters that can also be measured in-process include power demand, cutting forces, or vibrations.

II.

In-process monitoring has inherent benefits relative to in-cycle monitoring for many measurements of interest.When measuring an attribute in real-time, the information is accessible at the point of decision making and can be used to control the process that is being monitored more directly, which reduces response time and potentially rework and scrap. If the relationship between the process parameters and the attributes are known,one possibility is to adjust the process parameters in order to keep the attributes within the desired boundariesand the process running. For the case there is no closed-loop control, the process can be shut down in order toprevent bad parts.

III.

Unfortunately it is very difficult to measure key objectives like quality in-process, which makes it difficult to control these parameters directly. Important quality parameters like surface roughness, part dimensions, and hardness are primarily measured out-of-process, which means if a significant deviation is detected, the part has to be repaired or replaced. Usually not even every part is measured, but only samples are measured in fixed intervals. If then a parameter deviates from expectation, all the parts since the last measured value have to bereinvestigated. Keeping the quality of a product within small tolerances can be.

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