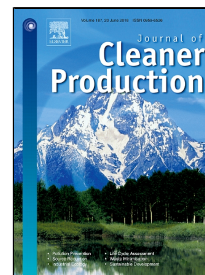


Accepted Manuscript

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PII: S0959-6526(18)31307-6
DOI: 10.1016/j.jclepro.2018.04.265
Reference: JCLP 12846
To appear in: *Journal of Cleaner Production*
Received Date: 21 April 2017
Revised Date: 26 March 2018
Accepted Date: 29 April 2018

Please cite this article as: Yun Cai, Xinhua Shi, Hua Shao, Ran Wang, Shuheng Liao, Energy Efficiency State Identification in Milling Processes Based on Information Reasoning and Hidden Markov Model, *Journal of Cleaner Production* (2018), doi: 10.1016/j.jclepro.2018.04.265

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Amount of words: 8501

Energy Efficiency State Identification in Milling Processes Based on Information Reasoning and Hidden Markov Model

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Abstract

Energy efficiency state identification of milling process plays an important role in energy saving efforts for manufacturing systems. However, it is very difficult to track energy efficiency state in machining processes based on traditional signal processing strategies due to the fact that energy state is usually coupled with a lot of factors like machine tool states, tool conditions, and cutting conditions. An identification method of information reasoning and Hidden Markov model for energy efficiency state is proposed in this paper. Utilizing cutting conditions, empirical models of the energy efficiency, experimental data and signal features, an expert system is established for initial probability optimization and the state is further identified by Hidden Markov model. The experiments show that energy efficiency state can be identified with this method.

Keywords: Energy efficiency; specific energy consumption; Milling process; Condition monitoring; Information reasoning; Hidden Markov model.

1. Introduction

Energy efficiency state identification of machining processes plays an important role in energy saving efforts for manufacturing systems. Energy efficiency state is directly related to cutting conditions, tool wear and machine tool condition, which makes it very difficult to track energy efficiency state in machining processes based on traditional signal processing strategies.

In the past decades, many efforts have been made on the modeling of machining energy consumption with the objective of lower power consumption in machining processes. The energy consumption model or energy efficiency model can be grouped into two main categories: system models and process models. System models are to evaluate energy consumption of machine tools based on energy modelling of subsystems. Philipp Eberspächer[1] present an approach to combine power measurements, control signals and information with consumption simulation models to provide the operators with highly detailed power consumption data and how it is distributed over the components of their machine tools. The study of [2] and [3] is similar. Konstantinos Salonitis[4] presented an overview of energy efficiency approaches, focusing on both production and machine tool level and how these two can be integrated together. Furthermore, the main challenges towards energy efficient manufacturing are discussed identifying the major barriers

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