Development of Intelligent Grinding Database

R. Cai¹,a and M.N. Morgan¹

¹AMTReL, General Engineering Research Institute, Faculty of Technology and Environment, Liverpool John Moores University, Byrom Street, Liverpool, L3 3AF, UK

a r.cai@livjm.ac.uk

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Abstract. This paper describes the structure, content and relations employed in the development of an intelligent grinding database. The intelligent database has been constructed in MS Access with Visual Basic support code. The database was developed as an integral feature of an intelligent grinding assistant (IGA®). The IGA® has been implemented and evaluated on a cooperating partners CNC machine tool.

Introduction

In the field of grinding, the application of Artificial Intelligence was well summarized by Rowe [1]. Five techniques were categorized including: knowledge-based expert systems, fuzzy logic, neural networks, genetic algorithms and adaptive control for optimisation. Artificial Intelligence techniques are applied in process models and wheel selection systems, for machining parameter selection, process monitoring, process control, AC optimisation, and database creation.

Li [2] reviewed the use of intelligent control and optimisation techniques in grinding and proposed the incorporation of intelligent techniques into computer numerical controls (CNCs). Intelligent CNC with integrated adaptive control has been shown to provide significant improvements in productivity, providing potential to greatly reduce set-up time, process proving time and the extent of operator intervention [3].

The Intelligent Database described in this paper was based on the systems proposed by Chen [4] - ‘Generic Intelligent Control System for Grinding’ and Li [5] – ‘Intelligent Selection of Grinding Conditions’. The database was implemented on a cooperating partners production CNC universal grinding machine. The CNC, machine tool instrumentation, process monitoring / data analysis systems and control strategies were linked with a purpose designed software system referred to as the ‘Intelligent Grinding Assistant’ (IGA®). The IGA® analyses, in real time, the grinding performance of the machine. On the basis of results produced by algorithms incorporated within the software the IGA® will make recommendations to the CNC to alter grinding parameters to improve the grinding performance.

The grinding database is needed to store the adaptive control algorithms data and process data required for IGA® system implementation. Optimised cycle data is sent directly to the CNC and is used to produce the next component. A decision-making system for the selection of initial grinding parameters is also integrated into the database.

Structure of Intelligent Grinding Database

The database has been developed in Access 2000. The structure of the database has been designed based on the following elements:

Machine Data: This provides details of Machine parameters and will generally be uploaded from the CNC interfaced to the system.

Cycle Data: This provides details of Work Material, Work Diameter, Coolant, Wheel Type and Grinding Parameters for each part and will generally be uploaded from the CNC interfaced to the system. Cycles for a specified part that have been optimised to improve the performance of the machine can be used in the future production of those parts.