Development of Burr Prediction System for End Milling

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Thesis Abstract

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Thesis Title	Development of Burr Prediction System for End Milling		

Thesis Summary

To date, various methods have been proposed for the development of burr prediction systems; however, there is no unique system that can be used as a preventive method and that can be applied in practical use. The objectives of this study is to develop a system for predicting the position and dimensions of the burrs and determining tool paths to minimize the burr in the end milling process. This system predicts the position and dimensions of the burrs based on workpiece material properties, tool geometry data, a cutting force model, cutting conditions, and a burr formation model. This approach can be used to optimize the factors that affect burr formation, and thus burrs can be minimized.

Chapter 1 gives an overview of the issues related to burrs and the objectives of this study. A review of previous studies on burr formation is also provided.

Chapter 2 describes the basic knowledge of burr formation and the parameters that influence burrs. The definition of a burr and the types of burrs that form in end milling are given. Two kinds of burr models, namely the Poisson burr and rollover burr models, are discussed in detail, with two types of cutting processes, orthogonal cutting and oblique cutting. A burr measurement method is also illustrated.

Chapter 3 describes the classification of burrs in end milling and the application of a burr model to each burr type. The burrs found in end milling are classified as entrance burrs, entrance side burrs, top burrs, exit burrs, and exit side burrs. This classification is based on the cutting tool motion when intruding into a workpiece. Two kinds of burr models were used in this study. A Poisson burr was used when the cutting tool edge was pushing into the workpiece edge, while a rollover burr was used when the cutting tool edge was leaving the workpiece edge. The orthogonal and oblique cutting processes were applied based on the cutting tool edge motion and workpiece edge position.

Chapter 4 describes the burr prediction method and development of the burr prediction system. The development of a geometric simulator, including a Z-map model, NC program analysis model, and the identification of up milling and down milling, is proposed. The mechanistic forces model, which is an important factor that influences burrs, is illustrated in detail. The identification of the burrs formed in the NC simulation is also explained, and the burr models are applied in end milling. Tool path planning for burr minimization is conducted. The influence of the flank wear on burr formation was identified using a tool nose wear analytical model.

Chapter 5 proves the burr prediction system proposed in Chapter 3 and Chapter 4 to have the ability to estimate burr sizes and locations in the end milling process. The system verification is discussed. Ten simulation and experimental tests for carbon steel and aluminum alloy were conducted using an end mill tool with two flutes. An evaluation of burr prediction based on flank wear was also conducted using the two flute end mill in relation to the flank wear dimensions. Comparisons of the burr prediction results were made for all cases, and both the predicted and experimental results were found to agree under most of the cutting conditions. In addition, a comparison of the burr prediction results based on flank wear shows that the proposed model can help in predicting the burr size under the effect of tool flank wear with high accuracy.

Chapter 6 presents the concluding remarks and a summary of the study.