Optimal Parameter Design of Minimum Quantity Lubrication for Milling Process

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ABSTRACT

To save the natural resource and protect environment, future machining technology must satisfy green manufacturing such as high efficiency and low pollution. Minimum quantity lubrication (MQL) technology can reduce the amount of lubrication and it have many advantages, for example, it can improve the roughness and precision and reduce the wear of tool. A lot of research pay attention to how cutting parameters to influence the roughness, but a few thesis is about the correlation between MQL and roughness. Therefore this thesis get fifty-four set data of cutting parameters and roughness through Taguchi Methods and milling experiment, and use RBF artificial neural network methods to construct the tool to infer roughness and investigate the effect of MQL on roughness and choose the optimum cutting parameters. This thesis elect S45C as cutting workpiece, the control factors include the oil amount of MQL, cutting speed, the amount of tool blade, feedrate of every tool blade and the air pressure of MQL. Through Taguchi Methods and milling experiment by AEWA fast machining tool, we can get data of cutting parameters and roughness. Calculating S/N ratio to decide the optimum cutting parameters and using RBF artificial neural network methods to construct the tool to infer roughness. Through inferring of RBF, we can adjust the oil amount of MQL and other cutting parameters to obtain desirable roughness of workpiece, and it can cost down, improve the efficiency and protect environment.

Keywords : MQL ; Taguchi Methods ; RBF ; surface roughness

Table of Contents

REFERENCES

[1] King, R.I., “ Handbook of High – Speed Machining Technology, ” Chapman and Hall, 1985.

[2] 陳永正, “ 606 鋁合金之高速銑削行為與實驗探討 ”, 國立中興大學機械工程學研究所, 1998。

[3] 洪敬祥, “ 面銑削加工參數預測模式之建立 ”, 國立屏東科技大學機械工程研究所, 1999。

[4] 陳紹賢, “ Inconel-718 與AISI4340 銑削性探討 ”, 國立中正大學機械工程學研究所, 1999。

[5] 黃鴻明, “ 模具鋼加工性的研究 ”, 國立臺灣大學機械工程學研究所, 1994。

[6] 陳健峰, “ 微量潤滑劑之高速銑削實驗探討 ”, 國立中興大學機械工程學研究所, 2002。

[7] Nian, C.Y. et al., “ Optimization of Turning Operations with Multiple Performance Characteristics, ” Journal of Materials Processing Technology, Vol.95, Issue 1-3, pp.90-96, 1999.

[8] 陳興忠、王柏村, “ 田口法應用於最佳化設計問題 ”, 國立屏東科技大學學報, 第七卷, 第一期, 第13-20頁, 1998。

[9] Liang, M., Yeap, T., Rahmati, S., and Han, Z., “ Fuzzzy control of spindle power in end milling processes, ” International Journal of Machine Tools and Manufacture, Vol.42, pp.1487-1496, 2002.
[10] Juan, H., Yu, S.F., and Lee, B.Y., “ The optimal cutting-parameter selection of production cost in HSM for SKD61 tool steels, ” International Journal of Machine Tools and Manufacture, Vol.43, pp.679-686, 2003.
[11] Tarng, Y.S. et al., “ The Use of Neural Networks in Prediction Turning Forces, ” Journal of Materials Processing Technology, 47, pp.273-289, 1995.
[12] 溫程雄，“ 工具機最佳加工參數的設定 ”，國立中興大學機械工程學研究所，1998。
[13] 林仁照，“ 面銑削刀具磨耗預測之監測 “，碩士論文，國立清華大學機械動力工程學研究所，1992。
[14] Matsumura, T., Shirakashi, T., Obikawa, T., and Usui, E., “ Autonomous Turning Operation Planning with Adaptive Pre-diction of Tool Wear and Surface Roughness, ” Journal of Manufacturing Systems, Vol.12, No.3, pp.253-262, 1993.
[15] 劉鶴崗，“ 高速端銑削模具鋼之現象分析 ”，國立台灣大學機械工程學研究所，1999。
[16] Yang, W.H., and Tarng, Y.S., “ Design Optimization of Cutting Parameters for Turning Operations Based on the Taguchi Method, ” Journal of Materials Processing Technology, Vol. 84, pp. 122-129, 1998.
[17] Luong, L.H.S., Spedding, T.A., “ A Neural-Network System for Predicting Machining Behaviour, ” Journal of Materials Processing Technology, Vol. 52, pp. 585-591, 1995.
[18] Manabu Yasuoka, Toshiyuki, “ MQL Machining Technology (2) Highly Efficient Cutting with Lesser Environmental Impact, ” NACHI-BUSINESS Machining news, VOL.6, A2 , 2005 [19] Kondo, T., “ Environmentally Friendly Machining Technology, ” Proceedings of the 7th International conference on Machine on Tool Engineering, PP245-257.
[20] 谷和弘，精密工學會誌，Vol1.71, No5, P650, 2005。
[21] http://www.taco-ltd.com/jpn/index.html [22] Chen, S., and Billings, S.A., “ Neural Networks for Nonlinear Dynamic System Modeling and Identification, ” International Journal of Control, Vol. 56, No.2, pp. 319-346, 1992.
[23] Broomhead, DS., and Lowe, D., “ Multivariable Functional Interpolation and Adaptive Networks, ” Complex System, Vol. 2, pp.321-355, 1988.
[24] Moody, J. and Darken, C., “ Fast-learning in Networks of Locallyturned Processing Units, ” Neual Computation, Vol 1, pp. 281-294, 1989.
[25] 李阿卻，“ 切削刀具學 ”，全華科技圖書股份有限公司，1994。