UNIVERSITI PUTRA MALAYSIA

OPTIMIZATION OF MICRO-END MILLING PROCESS PARAMETERS OF TITANIUM ALLOY USING NON-DOMINATED SORTING GENETIC ALGORITHM

ABOLFAZL GOLSHAN

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By

ABOLFAZL GOLSHAN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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ABOLFAZL GOLSHAN

November 2013

Chair: B.T. Hang Tuah Bin Baharudin, PhD

Faculty: Engineering

The selection of optimal cutting parameters has always presented a critical quality concern in the micromachining process. This study examines the effects of three process parameters which are spindle speed, feed rate and depth of cut on the process outputs. The outputs are the surface area roughness and burr formation in micro-end milling of Ti-6Al-4V titanium alloy. Response surface methodology was utilized to develop mathematical models of the process outputs. In addition, analysis of variance and confirmation runs were employed to verify the precision of the mathematical models. Finally, non-dominated sorting genetic algorithm-II as evolutionary optimization approach was used for multi-objective optimization of the micro-end milling process. The optimization results demonstrate the high performance of this method to obtain the Pareto optimal set of solutions in the micro-end milling process. With the optimal parameter sets, an operator can select a suitable combination of variables to obtain a better surface finish or lower burr formation. Optimal machining parameters were the spindle speed of 40000 rpm, the feed rate of 61-75 mm/min, and the depth of cut of 86-92 μm.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENGOPTIMUMAN PARAMETER PROSES PEMESINAN MIKRO TERHADAP ALOI TITANIUM MENGGUNAKAN ALGORITMA GENETIC PENGISIHAN TIDAK DIDOMINASI

Oleh

ABOLFAZL GOLSHAN

November 2013

Pengerusi: B.T. Hang Tuah Bin Baharudin, PhD

Fakulti: Kejuruteraan

Pemilihan parameter pemotongan optimum sentiasa menjadi punca kebimbangan tentang kualiti yang kritikal dalam proses pemesinan mikro. Kajian ini mengkaji kesan kepada hasil proses oleh tiga parameter proses iaitu kelajuan gelendong, kadar suapan dan kedalaman pemotongan. Hasil pemesinan adalah kekasaran kawasan permukaan dan pembentukan duri dalam pengilangan mikro-akhir aloi titanium. Kaedah gerak balas permukaan telah digunakan untuk membangunkan model matematik hasil proses. Di samping itu, analisis varians dan pengesahan telah digunakan untuk mengesahkan ketepatan model matematik tersebut. Akhirnya, kaedah penyusunan bukan didominasi genetik algoritma-II digunakan sebagai pendekatan pengoptimuman evolusi untuk pengoptimuman pelbagai objektif proses pengilangan mikro-akhir tersebut.. Keputusan pengoptimuman menunjukkan prestasi yang tinggi dicapai oleh kaedah ini untuk mendapatkan set optimum Pareto untuk penyelesaian dalam proses pengilangan mikro-end. Dengan set parameter optimum, pengendali boleh memilih kombinasi pembolehubah yang sesuai untuk mendapatkan kemasan permukaan yang lebih baik atau lebih rendah pembentukan duri. Parameter pemesinan yang optimum adalah pada kelajuan gelendong 40000 putaran seminit dengan, kadar suapan 61-75 mm / min dan kedalaman pemotongan 86-92 μm.

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I certify that an Examination Committee has met on 08 November 2013 to conduct the final examination of Abolfazl Golshan on his Master of Science thesis entitled "Optimization of Micro-end Milling Process Parameters of Titanium Alloy Using Non-dominated Sorting Genetic Algorithm" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the Master of Science Degree.

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Universiti Putra Malaysia
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Safian bin Sharif, PhD
Professor,
Faculty of Engineering
Universiti Putra Malaysia
(External Examiner)

NORITAH OMAR, PhD
Associate Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 17 February 2014

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science.

The members of the Supervisory Committee were as follows:

B.T. Hang Tuah Bin Baharudin, PhD
Associate Professor,
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Mohd Khairol Anur Ariffin, PhD
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
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BUJANG BIN KIM HUAT, PhD
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