Dimensional Accuracy in Dry Micro Wire Electrical Discharge Machining

By: Ali, MY (Ali, Mohammad Yeakub)[1]; Banu, A (Banu, Asfana)[1]; Salehan, M (Salehan, Muhammad)[1]; Adesta, EYT (Adesta, Erry Y. T.)[1]; Hazza, M (Hazza, Muataz)[1]; Shaffiq, M (Shaffiq, Muhammad)[1]

View ResearcherID and ORCID

JOURNAL OF MECHANICAL ENGINEERING AND SCIENCES
Volume: 12 Issue: 1 Pages: 3321-3329
DOI: 10.15282/jmes.12.1.2018.4.0298
Published: MAR 2018
Document Type: Article

Abstract

Dimensional accuracy is important in fabricating miniaturized product in order to reduce the material waste and machining cost as well as to achieve a better quality product. This paper presents the analysis and modelling of dimensional accuracy in dry micro wire electrical discharge machining with control parameters of gap voltage and wire tension. The investigation was performed on stainless steel using integrated multi-process micro machine tools DT 110 with compressed air as the dielectric fluid and tungsten as the wire electrode. The dimensional accuracy was determined through kerf width differences of the machined slots. The kerf width was measured using scanning electron microscope. Full factorial was used to design the experiment while analysis of variance (ANOVA) was used to analyse the results as well as to evaluate the adequacy of the developed model. Based on ANOVA, both parameters; gap voltage and wire tension have high influence on kerf width differences. The optimum machining parameters for minimum kerf width differences were found to be 85 V gap voltage and 10 % wire tension. The developed model is adequate since the percentage error (2.13 %) is relatively small. It is recommended that different type of gases should be used for further investigation in order to determine the accuracy of the dry micro wire EDM.

Keywords

Author Keywords: Dry wire EDM; Dry micro wire EDM; Dimensional accuracy; Kerf

KeyWords Plus: EDM; WEDM; OPTIMIZATION; VIBRATION

Author Information

Reprint Address: Adesta, EYT (reprint author)

Int Islamic Univ Malaysia, Dept Mfg & Mat Engn, POB 10, Kuala Lumpur 50728, Malaysia.

Addresses:

[1] Int Islamic Univ Malaysia, Dept Mfg & Mat Engn, POB 10, Kuala Lumpur 50728, Malaysia

E-mail Addresses: eadesta@iium.edu.my

Funding

Funding Agency	Grant Number
MOSTI	SF15-016-0066

View funding text

Publisher

UNIV MALAYSIA PAHANG, LEBUHRAYA TUN RAZAK, GAMBANG, KUANTAN, PAHANG, 26300, MALAYSIA

Categories / Classification

Research Areas: Engineering

Web of Science Categories: Engineering, Mechanical

See more data fields

Cited References: 44

Showing 30 of 44 **View All in Cited References page** *(from Web of Science Core Collection)*

1. **A review on current research trends in electrical discharge machining (EDM)** — Times Cited: 283
By: Abbas, Norliana Mohd; Solomon, Darius G.; Bahari, Md. Fuad
INTERNATIONAL JOURNAL OF MACHINE TOOLS & MANUFACTURE Volume: 47 Issue: 7-8 Pages: 1214-1228 Published: JUN 2007

2. **Application of Taguchi, ANFIS and grey relational analysis for studying, modeling and optimization of wire EDM process while using gaseous media** — Times Cited: 45
By: Azhiri, R. Bagherian; Teimouri, R.; Baboly, M. Ghasemi; et al.
INTERNATIONAL JOURNAL OF ADVANCED MANUFACTURING TECHNOLOGY Volume: 71 Issue: 1-4 Pages: 279-295 Published: MAR 2014

3. **A progress review in wire electrical discharge machining process** — Times Cited: 1
By: Balan, A. S. S.; Giridharan, Abimannan
INTERNATIONAL JOURNAL OF AUTOMOTIVE AND MECHANICAL ENGINEERING Volume: 14 Issue: 2 Pages: 4097-4124 Published: JUN 2017

4. **A progress review in wire electrical discharge machining process** — Times Cited: 1
By: Balan, ASS; Giridharan, A.
International Journal of Automotive and Mechanical Engineering. Volume: 14 Article Number: 2-4097-4124 Published: 2017

5. **Adesta EYT. Analysis of WEDM process parameters on surface roughness and kerf using Taguchi method** — Times Cited: 1
By: Banu, A; Bakar, MA; Ali, MY.
International Journal of Engineering Materials and Manufacture. Volume: 2 Article Number: 4-103-109 Published: 2017

6. **Electrical discharge machining (EDM): a review** — Times Cited: 1
By: Banu, A; Ali, MY.
International Journal of Engineering Materials and Manufacturing. Volume: 1 Article Number: 1-3-10 Published: 2016

7. **Experimental Investigations during Dry EDM of Inconel-718** — Times Cited: 1
By: Bhandare, A. S.; Dabade, U. A.
2ND INTERNATIONAL MANUFACTURING ENGINEERING CONFERENCE AND 3RD ASIA-PACIFIC CONFERENCE ON MANUFACTURING SYSTEMS (IMEC-APCOMS 2015) Book Series: IOP Conference Series-Materials Science and Engineering Volume: 114 Article Number: 012035 Published: 2016

8. **High-accuracy wire electrical discharge machining using artificial neural networks and optimization techniques** — Times Cited: 6
By: Conde, A.; Arriandiaga, A.; Sanchez, J. A.; et al.
ROBOTICS AND COMPUTER-INTEGRATED MANUFACTURING Volume: 49 Pages: 24-38 Published: FEB 2018

9. **Parametric Evaluation on Near-Dry Electric Discharge Machining** — Times Cited: 11
By: Dhakar, Krishnakant; Dvivedi, Akshay
MATERIALS AND MANUFACTURING PROCESSES Volume: 31 Issue: 4 Pages: 413-421 Published: MAR 11 2016

10. **Analysis of kerf width in micro-WEDM** — Times Cited: 1
By: Di, S; Chu, X; Wei, D; et al.
International Journal of Machine Tools and Manufacture. Volume: 49 Article Number: 10-788-792 Published: 2009
[Show additional data]

11. **Wire Electrical Discharge Machining** — Times Cited: 1
By: Ghodsiyeh, D; Moradi, M.
Electrical Discharge Machining (EDM) Types, Technologies and Applications Pages: 33-65 Published: 2015
Publisher: Nova Science Publishers, Inc., New York

12. **Experimental investigation on wire vibration during fine wire electrical discharge machining process** — Times Cited: 8
By: Habib, Sameh; Okada, Akira
INTERNATIONAL JOURNAL OF ADVANCED MANUFACTURING TECHNOLOGY Volume: 84 Issue: 9-12 Pages: 2265-2276 Published: JUN 2016

13. **State of the art in wire electrical discharge machining (WEDM)** — Times Cited: 262
By: Ho, KH; Newman, ST; Rahimifard, S; et al.

INTERNATIONAL JOURNAL OF MACHINE TOOLS & MANUFACTURE Volume: 44 Issue: 12-13 Pages: 1247-1259 Published: OCT 2004

14. **Kerf analysis and control in dry micro-wire electrical discharge machining** Times Cited: 5
By: Hoang, K. T.; Yang, S. H.
INTERNATIONAL JOURNAL OF ADVANCED MANUFACTURING TECHNOLOGY Volume: 78 Issue: 9-12 Pages: 1803-1812 Published: JUN 2015

15. **A study on the effect of different vibration-assisted methods in micro-WEDM** Times Cited: 15
By: Hoang, K. T.; Yang, S. H.
JOURNAL OF MATERIALS PROCESSING TECHNOLOGY Volume: 213 Issue: 9 Pages: 1616-1622 Published: SEP 2013

16. **A new approach for micro-WEDM control based on real-time estimation of material removal rate** Times Cited: 1
By: Hoang, KT; Yang, SH.
International Journal of Precision Engineering and Manufacturing. Volume: 16 Article Number: 2-241-246 Published: 2015

17. **Development of new fabrication and measurement techniques of micro-electrodes with high aspect ratio for micro EDM using typical EDM machine** Times Cited: 10
By: Hourmand, Mehdi; Sarhan, Ahmed A. D.; Yusof, Noordin Mohd
MEASUREMENT Volume: 97 Pages: 64-78 Published: FEB 2017

18. **Dimensional accuracy achievable in wire-cut electrical discharge machining** Times Cited: 1
By: Islam, MN; Rafai, NH; Subramanian, SS.
Electrical Engineering and Applied Computing Pages: 90 Published: 2011
Publisher: Springer, Dordrecht

19. **High-performance wire electrodes for wire electrical-discharge machining-a review** Times Cited: 1
By: Kapoor, J; Sigh, S; Khamba, JS.
Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture. Volume: 226 Article Number: 11-1757-1773 Published: 2012

20. **The best location for speed bump installation using experimental design methodology** Times Cited: 1
By: Khademi, A; Renani, NG; Mofarrahhi, M; et al.
Promet-Traffic & Transportation. Volume: 25 Article Number: 6-565-574 Published: 2013
[Show additional data]

21. **ELECTRODE WEAR RATE OF GRAPHITE ELECTRODES DURING ELECTRICAL DISCHARGE MACHINING PROCESSES ON TITANIUM ALLOY TI-5AL-2.5SN** Times Cited: 7
By: Khan, Md. Ashikur Rahman; Rahman, M. M.; Kadirgama, K.
INTERNATIONAL JOURNAL OF AUTOMOTIVE AND MECHANICAL ENGINEERING Volume: 9 Pages: 1782-1792 Published: JAN-JUN 2014

22. **PREDICTION OF SURFACE ROUGHNESS OF TI-6AL-4V IN ELECTRICAL DISCHARGE MACHINING: A REGRESSION MODEL** Times Cited: 25
By: Khan, Md. Ashikur Rahman; Rahman, M. M.; Kadirgama, K.; et al.
JOURNAL OF MECHANICAL ENGINEERING AND SCIENCES Volume: 1 Pages: 16-24 Published: DEC 2011

23. **Ultrasonic vibration-assisted electric discharge machining: a research review** Times Cited: 1
By: Khatri, BC; Rathod, P; Valaki, JB.
P I MECH ENG B-MANAG Pages: 1-12 Published: 2016

24. **Fabrication and analysis of micro-pillars by abrasive water Jet machining** Times Cited: 7
By: Kumar Pal, V.; Choudhury, S. K.
Procedia Materials Science Volume: 6 Pages: 61-71 Published: 2014

25. **Advancing EDM trough Fundamental Insight into the Process** Times Cited: 10
By: Kunieda, M.; Lauwers, B.; Rajurkar, K. P.; et al.
Annals of CIRP Volume: 54 Pages: 2 Published: 2005
[Show additional data]

26. **Study of dry EDM with oxygen-mixed and cryogenic cooling approaches** Times Cited: 13
By: Liqing, L.; Yingjie, S.
PROCEEDINGS OF THE SEVENTEENTH CIRP CONFERENCE ON ELECTRO PHYSICAL AND CHEMICAL MACHINING (ISEM) Book Series: Procedia CIRP Volume: 6 Pages: 344-350 Published: 2013

27. **Review of size effects in micro electrical discharge machining** Times Cited: 5
By: Liu, Qingyu; Zhang, Qinhe; Zhang, Min; et al.
PRECISION ENGINEERING-JOURNAL OF THE INTERNATIONAL SOCIETIES FOR PRECISION ENGINEERING AND NANOTECHNOLOGY Volume: 44 Pages: 29-40 Published: APR 2016

28. **Fundamental investigation of dry electrical discharge machining (DEDM) by optical emission spectroscopy and its numerical interpretation** Times Cited: 1
By: Macedo, FTB; Wiessner, M; Hollenstein, C; et al.
International Journal of Advanced Manufacturing Technology. Pages: 1-13 Published: 2016
[Show additional data]

29. **State of art in wire electrical discharge machining process and performance** Times Cited: 2
By: Mandal, A.; Dixit, A.R.
International Journal of Machining and Machinability of Materials Volume: 16 Issue: 1 Pages: 1-21 Published: 2014

30. **EDM Modelling and Simulation** Times Cited: 1
By: Maradia, U; Wegener, K.
Electrical Discharge Machining (EDM) Types, Technologies and Application Pages: 67-121 Published: 2015
Publisher: Nova Science Publishers, Inc., New York

Showing 30 of 44 **View All in Cited References page**