International Journal of Recent Trends in Engineering & Research
ISSN (ONLINE) : 2455 – 1457 IMPACT FACTOR : 4.101

Review Of Surface Roughness Prediction In Machining Process By Using Various Parameters

B.Radha Krishnan
Assistant Professor,Department of Mechanical Engineering,
Nadar Saraswathi College of Engineering and Technology, Theni

Abstract— In recent years machine vision system set remarkable achievements, in the inspection process, a few examples like sorting the products in conveyer for the rapid manufacturing process. Even most of the industries following the conventional surface testing methods like stylus profilometer. This review paper has been proposed the list of parameters for Roughness testing and it will be evaluating then matching with suitable methodologies. Most of the research articles deal with Average Value (Ra), Root means Square (Rz), Peak to Valley (Rt). Here we see the details about parameters and various types of algorithms for measuring the surface roughness. As a result, this review concept as used to do the research in various aspects based on the various parameters.
Keywords*;* Quality, Surface measuring parameter, Algorithms, Methodology, Software.

I. INTRODUCTION

The prediction of surface roughness of rotating parts has been somewhat difficult compare with flat surfaces. The following research as used to analyse the above decade. B.Y.Lee , S.F. Yu and H.Juan (2002) the images of specimens grabbed by the computer vision system could be treated by some techniques to get the features of image texture (major peak frequency F 1, principal component magnitude squared value F 2, and the standard deviation of grey level STD). These features could be used as input data of an abductive network. Using the trained abductive network, the experimental result had shown that the surface roughness of turned parts measured by computer vision system over a wide range of turning conditions could be got with reasonable accuracy compared with those measured by traditional stylus method. B.M.Kumar and M.M.Ratnam (2015) A commercial digital single-lens-reflex camera with high shutter speed and backlight were used to capture a silhouette of the rotating workpiece profile. The roughness profile was extracted at sub-pixel accuracy from the captured images using the moment invariant method of edge detection. The average (Ra), root-mean-square (Rq) and peak-to-valley (Rt) roughness parameters were measured for ten different specimens at spindle speeds of up to 4,000 rpm. The roughness values measured using the proposed machine vision system were verified using the stylus profilometer. Shinn-Ying Ho a, Kuang-Chyi Lee b, Shih-Shin Chen b, Shinn-Jang Hob (2002). Modelling and prediction of surface roughness of a workpiece by computer vision in turning operations play an important role in the manufacturing industry. This paper proposes a method using an adaptive neuro-fuzzy inference system (ANFIS) to accurately establish the relationship between the features of the surface image and the actual surface roughness and consequently can effectively predict surface roughness using cutting parameters (cutting speed, feed rate, and depth of cut) and gray level of the surface image. Experimental results show that the proposed ANFIS-based method outperforms the existing polynomial network-based method in terms of modeling and prediction accuracy

II. EXPERIMENTAL SETUP

In Recently published work (B.M.Kumar and M.M Ratnam) , The basic components of the system setup comprise a positioning mechanism, backlighting and a 10.2-megapixel DSLR camera (model: SONY _-230) having a picture resolution of 3,872 _ 2,592 pixels. The camera was fitted with a 4X close-up lens and connected via USB cable to a personal computer. The camera was mounted on an *X–Y*-axis motion camera mount. The *X–Y* axes were adjusted to ensure that the image is sharply in focus (Figure 1). The machine tool used is the *Optimum Vario D320 _ 630* conventional lathes, and the workpiece material is *AISI* 304 stainless steel rods of 14-mm diameter. The camera was set to a maximum shutter speed of 1/4000 s so that blurring caused by the rotation of workpiece can be prevented. At this shutter speed, the workpiece will rotate 6° at the maximum spindle speed of 4,000 rpm. Because the workpiece was produced by turning at a feed rate of 0.25 mm/ revolutions and, thus, has a helically shaped surface, the rotation during the exposure will cause a lateral shift in the image by only 4.1 um.

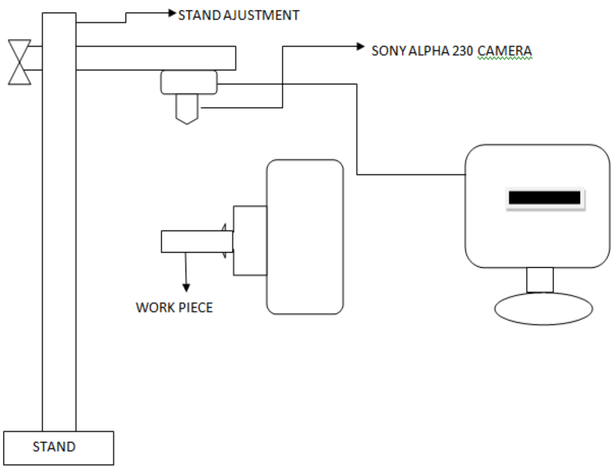

Fig . 1 . Setup of Machine Vision System

A. *Maintaining the Integrity of the Specifications*

The template is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them. You may note peculiarities. For example, the head margin in this template measures proportionately more than is customary. This measurement and others are deliberate, using specifications that anticipate your paper as one part of the entire proceedings, and not as an independent document. Please do not revise any of the current designations.

III. SURFACE ROUGHNESS PARAMETERS

A. *Ra - Average Roughness*

The average roughness is the area between the roughness profile and its mean line, or the integral of the absolute value of the roughness profile height over the evaluation length:

$$R_a = \frac{1}{L}\int_0^L |r(x)|\,dx$$

When evaluated from digital data, the integral is normally approximated by a trapezoidal rule:

$$R_a = \frac{1}{N}\sum_{n=1}^{N} |r_n|$$

B. *Rq-Root Mean Square Roughness*

The root-mean-square (RMS) average roughness of a surface is calculated from another integral of the roughness profile:

$$R_q = \sqrt{\frac{1}{L}\int_0^L r^2(x)\,dx}$$

C. ***Rt, Rp, and Rv***

The peak roughness Rp is the height of the highest peak in the roughness profile over the evaluation length (p1 below). Similarly, Rv is the depth of the deepest valley in the roughness profile over the evaluation length (v1). The total roughness, Rt, is the sum of these two, or the vertical distance from the deepest valley to the highest peak.

$$R_v = \left|\min\left[r(x)\right]\right|, \quad 0 < x < L$$
$$R_p = \left|\max\left[r(x)\right]\right|, \quad 0 < x < L$$
$$R_t = R_p + R_v$$

These three extreme parameters will succeed in finding unusual conditions: a sharp spike or burr on the surface that would be detrimental to a seal for example, or a crack or scratch that might be indicative of poor material or poor processing.

D. ***RTM, Rpm and Rvm***

These three parameters are mean parameters, meaning they are averages of the sample lengths. For example, define the maximum height for the ith sample length as Rpi. Then Rpm is:

$$R_{pm} = \frac{1}{M}\sum_{i=1}^{M} R_{pi}$$
$$R_{vm} = \frac{1}{M}\sum_{i=1}^{M} R_{vi}$$
$$R_{tm} = \frac{1}{M}\sum_{i=1}^{M} R_{ti} = R_{pm} + R_{vm}$$

E. ***Sm - Mean Spacing***

Sm is the mean spacing between peaks, now with a peak defined relative to the mean line. A peak must cross above the mean line and then back below it.

$$S_m = \sum_{n=1}^{N} S_n$$

F. ***λa - Average Wavelength***

The average wavelength of the surface is defined as follows:

$$\lambda_a = 2\pi \frac{R_a}{\Delta_a}$$

This parameter is analogous to Sm in that it measures the mean distance between features, but it is a mean that is weighted by the amplitude of the individual wavelengths, whereas Sm will find the predominant wavelength

G. ***Δa - Average Absolute Slope***

This parameter is the average of the absolute value of the slope of the roughness profile over the evaluation length:

$$\Delta_a = \frac{1}{L}\int_0^L \left|\frac{d\,r(x)}{d\,x}\right| d\,x$$

It is not so straightforward to evaluate this parameter for digital data. Numerical differentiation is a difficult problem in any application. Some instrument manufacturers have applied advanced formulas to approximate DZ/dx digitally, but the simplest approach is to apply a simple difference formula to points with a specified spacing L/N:

$$\Delta_a = \frac{1}{L}\sum_{n=1}^{N} |r_{n+1} - r_n|$$

If this approach is used, the value of LIN must be specified since it greatly influences the result of the approximation. Ordinarily, LIN will be quite a bit larger than the raw data spacing from the instrument.

IV. LITERATURE SURVEY

Author/ Year	Title	Methodology	Result
B.Y.Lee , H.Juan & S.F. Yu / 2002	A study of computer vision for measuring surface roughness in turning process	Polynomial network	Ra (surface roughness) by machine vision and stylus probe.
Anand Kumar, M.M. Mahapatra & P.K. Jha / 2014	Effect of machining parameters on cutting force and surface roughness of in situ Al-4.5%Cu/TiC metal matrix composites.	BUE and Chips are Examined by a Scanning electron microscope.	Surface Roughness
B.Y.Lee , S.F.Yu & H.Juan / 2004	The model of surface roughness inspection by the vision system in turning.	Abductive network (polynomial nodes).	Ra (surface roughness) by machine vision and stylus probe.
Y.S. Tarng & B.Y. Lee / 2001	Surface roughness inspection by computer vision in turning operation.	Polynomial network	Ra (surface roughness) by machine vision and stylus probe.
B.M. Kumar & M.M.Ratnam / 2015	Machine vision Method for non-contact measurement of surface roughness of a rotating workpiece.	Artificial neural network	Ra (surface roughness) by machine vision and stylus probe.
B.Dhanasekar & B.Ramamorthy / 2010	Restoration of blurred image for surface roughness evaluation using machine vision(milling)	Artificial neural network	Roughness parameters calculated from image texture before and after image restoration.
Shinn-Ying Ho , Kuang-Chyi Lee , Shih-Shin Chen , Shinn-Jang Ho . (2002)	Accurate modeling and prediction of surface roughness by computer vision in turning operations using an adaptive neuro-fuzzy inference system	Adaptive neuro-fuzzy inference system (ANFIS)	predict surface roughness using cutting parameters (cutting speed, feed rate, and depth of cut) and the gray level of the surface image

Vedang Chauhan and Brian Surgenor (2015)	A Comparative Study of Machine Vision-Based Methods for Fault Detection in an Automated Assembly Machine	Gaussian mixture models with blob analysis, optical flow and running average.	Faults Detection.
YD Chethana, H V Ravindrab, Y T Krishne gowdac and Bharath Kumar Sd.(2015)	Machine vision for tool status monitoring in turning Inconel 718 using blob analysis.	blob analysis	Tool status monitoring is done by first capture images of the drill bit, extracting image feature before and after cutting using the machine vision system
P.G. Benardos, G.C. Vosniakos	Prediction of surface roughness in CNC face milling using neural networks and Taguchi's design of experiments	Artificial neural networks	successfully and very accurately for the modeling of the surface roughness formation mechanism and the prediction of its value in face milling.

Following table a few important papers only list out, all the papers are deals in upcoming reference topic. Above papers show the most of the parameters are arithmetic mean value, peak to valley and Root mean Square.

V. CONCLUSION

The review in the present paper can be extended towards two different directions. Firstly, by Derive the list of parameters for identified the surface roughness. Another thing is, to choose the correct methodology for the particular surface roughness parameter. Based on this literature survey we can choose the different parameters for various methodologies. Here most of the research papers choose the Ra, Rq and Rt Parameters, so this review paper at useful to do the research apart from these parameters and achieving well improvement in surface roughness.

REFERENCES

I. Vedang Chauhan and Brian Surgenor, "A Comparative Study of Machine Vision-Based Methods for Fault Detection in an Automated Assembly Machine," Volume 1, 2015, Pages 416–428.
II. N Saran Kumar, N Kaleeswaran, B Radha Krishnan, "Review on optimization parametrs in Abrasive Jet Machining process" , International Journal of Recent Trends in Engineering and Research, Volume 04, Issue 10; October- 2018 [ISSN: 2455-1457]. DOI:10.23883/IJRTER.2018.4388.HTNOQ
III. Radha Krishnan, B., Vijayan, V., Parameshwaran Pillai, T. and Sathish, T., 2019. Influence of surface roughness in turning process—an analysis using artificial neural network. Transactions of the Canadian Society for Mechanical Engineering, 43(4), pp.509-514.
IV. Krishnan, B.R., Vijayan, V. and Senthilkumar, G., 2018. Performance analysis of surface roughness modelling using soft computing approaches. Applied Mathematics and Information Sci, 12(6), pp.1209-1217.
V. Krishnan, B.R. and Ramesh, M., 2019. Optimization of machining process parameters in CNC turning process of IS2062 E250 Steel using coated carbide cutting tool. Materials Today: Proceedings.
VI. S.Sundar, T.Sudarsanan, B.Radha Krishnan, "Review of Design and Fabrication of four wheel Steering system", International Journal of Recent Trends in Engineering and Research, Volume 04, Issue 10; October- 2018 [ISSN: 2455-1457]. DOI:10.23883/IJRTER.2018.4386.3THDB
VII. B. Radha Krishnan, et al. "Design and Analysis of Modified Idler in Drag Chain Conveyor." in International Journal of Mechanical Engineering and Technology, Volume 9, Issue 1, pp. 378–387.
VIII. Krishnan, B.R. and Ramesh, M., 2019. Experimental evaluation of Al-Zn-Al2O3 composite on piston analysis by CAE tools. Mechanics and Mechanical Engineering, 23(1), pp.212-217.

IX. B.Radha Krishnan, C.Mathalai Sundaram, A.Vembathurajesh, “Review of Surface Roughness Prediction in Cylindrical Grinding process by using RSM and ANN”, International Journal of Recent Trends in Engineering and Research, Volume 04, Issue 12; December- 2018 [ISSN: 2455-1457]. DOI : 10.23883/IJRTER.2018.4423.3DRTL
X. Sathish, T., OPTIMISATION OF SURFACE ROUGHNESS IN CNC MILLING PROCESS USING RSM.
XI. B. Radha Krishnan, R. Aravindh, M. Barathkumar, “Prediction of Surface Roughness (AISI 4140 Steel) in Cylindrical Grinding Operation by RSM”, ResearchGate, Volume-9, Issue-3(Mar-18) ISSN (O): - 2349-3585.
XII. Prasath, K. Arun, B. Radha Krishnan, and Corresponding K. Arun. "Mechanical properties of woven fabric Basalt/jute fibre reinforced polymer hybrid composites." Int. J. Mech. Eng 2, no. 4 (2013): 279-290.
XIII. R. Krishnan and A. Prasath. Six sigma concept and dmaic implementation. International Journal of Business Management and Research (IJBMR), 3(2):111–114, 2013.
XIV. J Monica Carfagni, Rocco Furferi , Lapo Governi, “A real-time machine vision system for monitoring textile raising processes, Computers in Industry 56 (2005) 831–842.
XV. I.S. Jacobs and C.P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.
XVI. Shahabi, H.H. and Ratnam, M.M. (2010), “Non-contact roughness measurement of turned parts using machine vision”, International Journal of Advanced Manufacturing *Technology*, Vol. 46, pp. 275-284.
XVII. Suksawat, B. (2011), “Development of in-process surface roughness evaluation system for cast nylon 6 turning operation”, *Procedia Engineering*, Vol. 15, pp. 4841-4846.
XVIII. Tabatabai, A.J. and Mitchell, O.R. (1984), “Edge location to subpixel values in digital imagery”, *IEEE Transactions on Pattern Analysis Machine Intelligence*, Vol. 6 No. 2, pp. 188-201.
XIX. Wang, W., Wong, P.L., Luo, J.B. and Zhang, Z. (1998), “A new optical technique for roughness measurement on moving surface”, *Tribology International*, Vol. 31 No. 5, pp. 281-287.
XX. Wong, P.L. and Li, K.Y. (1999), “In-process roughness measurement on moving surfaces”, *Optics and Laser Technology*, Vol. 31 No. 8, pp. 543-548.
XXI. Zain, A. M., Haron, H., & Sharif, S. (2010). Prediction of surface roughness in the end milling machining using Artificial. Neural Network. Expert Systems with Applications, 37(2), 1755–1768.
XXII. Chou, Y. K., Evans, C. J., & Barash, M. M. (2002). Experimental investigation on CBN turning of hardened AISI 52100 steel. Journal of Materials Processing Technology, 124, 274–283.
XXIII. Feng, C. X., & Wang, X. (2002). Development of empirical models for surface roughness prediction in finish turning. International Journal of Manufacturing Technology, 20, 348–356.
XXIV. Luk F, Huynh V, North W. Measurement of surface roughness by a machine vision. Journal of Physics E: Scientific Instruments 1989;22:977–80.
XXV. Al-kindi GA, Baul RM, Gill KF. An application of machine vision in the automated inspection of engineering surfaces. International Journal of Production Research 1992;2:241–53.
XXVI. Kiran M, Ramamoorthy B, Radhakrishnan V. Evaluation of surface roughness by the vision system. International Journal for Machine tools and Manufacture 1998;38:685–90.
XXVII. Bradley C, Kurada. Machine vision monitoring for automated surface finishing. Journal of Manufacturing Science and Engineering 1999;121: 457–65.
XXVIII. Lee KC, Ho SJ, Ho SY. Accurate estimation of surface roughness from texture features of the surface image using an adaptive neuro-fuzzy inference system. International Journal of Precision Engineering 2004;29:95–100.
XXIX. Gadelmawla ES. A vision system for surface roughness characterization using the gray level co-occurrence matrix. NDT&E international 2004;37:577–88.
XXX. Al-Kindi GA, Shirinzadeh B. An evaluation of surface roughness parameters measurements using vision-data. International Journal of Machine Tools and Manufacture 2007;47:697–708.
XXXI. Persson U. Surface roughness measurement on machined surfaces using angular speckle correlation. Journal of Materials Processing Technology 2006;180:233–8
XXXII. Slepian. Restoration of photographs blurred by image motion. Bell System Technical Journal 1967;46:2353–62.

