Investigation of condition monitoring of the Radial Drilling Machine –A Research Proposal

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Abstract: Context– Investigation of condition monitoring of the Radial Drilling Machine is vital for to increase productivity and promoting automation in metal cutting process.
Purpose – Purpose of this paper is to present a research proposal on Investigation of condition monitoring of the Radial Drilling Machine like different ranges of cutting speed, feed-rate and drill diameter of typical manufacturing processes.
Design/methodology/approach-The research proposal includes the methodology of Literature Survey, Problem Definition, Hypothesis statements, Data Collection plan, Plan for Various test Analysis, Hypothesis Tests, Experiments planned, Research Plan, Technical Feasibility check and Economic Viability check, Plan for use of record data and validation.
Findings – The paper presents a complete proposal for the research undertaken on Investigation of condition monitoring of the Radial Drilling Machine cutting speed, feed-rate and tool wear of the Radial Drilling Machine in typical manufacturing for Mechanical component application.
Conclusion-This Rearch will provide vital information on investigation of an effective means for drill wear monitoring. The results have also justified the need of using one of the most advance methods in signal processing technique, vibration signal analysis.
Limitation –This research is applicable to specially in drilling machine operation in mechanical and automotive industry, but there are some limitation about accuracy and surface finish in component design and development.
Impact of Industry – Mechanical industries like will receive the vital information and guidelines for selection of drilling machine for their design of machine elements which will further improve drilling process by reducing the defects.
Originality/value – This paper will put forward the new direction to use of radial drilling machine for manufacturing of the various mechanical components with improved process quality.

Index Terms – **Radial Drilling Machine, condition monitoring, fft analyzer.**

I. INTRODUCTION

Condition monitoring is an important point in manufacturing industry, because it allows an increase in the quality of the products, an optimization of the cost and a good control of the process Drilling is one of the most commonly used machining processes in the manufacturing industry, and many tool condition monitoring methods are applied to drilling. Tool wear in a machining process can be assessed by direct and indirect methods such as measurement of tool wear, vibrations, power consumption, torque and load (thrust) and these methods can be applied to study tool wear in turning, milling, drilling etc. Martin P. Gómez et al (2009) specifies SAE 1040 steel samples were drilled, making holes with 5 mm diameter twist drill bits in continuous feed. The drill bits were modified with "artificial" (produced by spark-erosion) and "real" (obtained by regular mechanical use) failures such as different degrees of wear in the cutting edge and the outer corner. For every drilled hole, torque and AE were simultaneously measured and acquired. In the first Part of this work, the correlation between the AE parameters and torque Torque was measured as a control parameter to follow the dynamic behaviour of the drill bit.

1.1 Energy distribution of staming process using wavelet transformation.

Sheet metal stamping is one of the most commonly used manufacturing operations. Every day, millions of parts are made by stamping, ranging from battery caps, and clock frames, to automobile body panels and aircraft landing gears. Hence, even small improvements could add up to a significant corporate gain. G. C. ZHANG et al (2002) classified a stamping operation called a stroke or a shot, will be completed, with large energy consumption within a fraction of a second. With these characteristics considerable effort has has been invested by industry and academia to meet the ever-increasing demand for quality and productivity.

1.2 Application of acoustic emission techniques for monitoring process

Application of acoustic emission technique (AET) for on-line monitoring of various forming processes such as punch stretching, drawing, blanking, forging, machining and grinding . Computer aided design based procedures are adopted for modeling deformation mechanisms as well as mechanics of flow that occur during the forming processes. Modeling of materials processing becomes important since the process parameters significantly influence the micro structural development in the

component. Modeling of materials flow and proper die design are necessary to obtain reliable products, otherwise, improperly designed die profile leads to incomplete die filling excessive load requirement, die breakage, folding, etc.

T. Jayakumar et al. [2005] summarized AE generated during forming and grinding processes is closely related to the deformation and flow of the workpiece material. Acoustic emission monitoring of forming processes such as drawing, punch stretching, blanking and forging can be carried out for detecting die wear and cracking, friction properties, state of lubrication, galling stick-slip, etc. In the area of sheet metal forming, AE monitoring of punch pressing has been reported by Kim. The AE signals emitted during punch pressing were characterized as indicative of three stages of deformation: initial impact, shear fracture and sudden rupture. Correlations between AE counts and variables such as material hardness, sheet thickness and tool wear also obtained.

1.3 Online monitoring during the punching process

Punching is one of the most common operations in sheet metal working. A wide variety of parts are made through sheet metal punching. Various problems such as broken tool, slug jamming, wear, and tool misalignment may occur in the punching process. These defects can damage the tool or deteriorate the hole quality. As frequent replacement of the tool increases production cost and slows down the production time, a tool monitoring system is developed to efficiently detect the punching faults, monitor the punching process, maintain the hole quality, and protect the tools from damage.

Delima Yanti Sari et al. (2016) studied the punching process, removal of sheet is performed through the shearing process between the punch and die. The sheet will be elastically deformed. Once the yield strength of the sheet is reached, plastic deformation occurs. Pressure at the cutting edge continues to increase and the shearing starts. After the shear strength of the sheet is exceeded, the crack is formed and the sheet will be separated. The resulting sheared edge consists of the rollover zone, burnish zone, fracture zone, and burr.

II. LITERATURE SURVEY

2.1 Condition monitoring of Drilling Machine:-

Le Moal et al. (2012) derived a brief review on the use of acoustic emission in machining, and drilling in particular, has been done and showed a lack of robust methods for monitoring applications. This is essentially due to the classical approaches inability to handle perturbations induced by changing process parameters. W.P. Dong et al. (1994) concerning drilling applications of AE have been implemented, but the results were not always as good as in some other machining processes. Indeed, it has been observed that using AE in drilling is more complex than in other processes such as turning or milling because the chips trapped between the flute and the cylindrical wall of the hole is a significant additional source of AE. Moreover, when AE sensors are mounted on the workpiece, position of the source of AE in drilling is continuously moving from one hole to another and as the drill goes deeper. C.E Everson et al. (1999) derives the application of acoustic emission for precision n drilling process monitoring applicable to mechanical component manufacturing. Barrow, G et al. (2007) Use the process signals for tool wear progression sensing in drilling small deep holes. Based on the knowledge accumulated from conventional cutting tool condition monitoring research, indirect sensing technologies, such as power, cutting force, vibration, and acoustic emission signals are candidates for detecting tool conditions

2.2 Technical feasibility condition monitoring of Machine-

E. Kannatey-Asibu, D. Dornfeld, (1983)describes brief review of the literature concerning the use of AE for machining and drilling monitoring shows that if it is often presented as a promising tool, some theoretical and technical drawbacks are limiting its usage, changing process parameters (including mastered and unmastered changes) in particular. Consequently, in order to exploit AE efficiently for monitoring drilling operations in industrial conditions, robust methodologies aimed at the extraction of useful features in AE signals have to be developed. M T MATHEW (2008) derives effective sensor for tool wear monitoring in face milling, The analysis of the experimental results is carried out and the results obtained with single insert in the cutter is discussed, then a comparison of the results obtained with two and three inserts in the cutter is made with that of results obtained using single insert. The observations are made based on the fact that the surface area of the work piece is less than that of the cutter diameter (100 mm). Ramalingam, S et al (1988), assessed technical feasibility analysis of Acoustic Emission Sensing with an Intelligent Insert and Tool Fracture Detection in Multi-Tooth Milling, which is a major step of design and manufacturing a SPM tools. The proposed feasibility analysis method has been successfully applied to a number of industrial machine components included to automotive parts manufacturing. Results show that feasibility analysis facilitates decision making on utilizing SPM and finding appropriate machine tools applications.

2.3 Vibration Analysis and Diagnostics

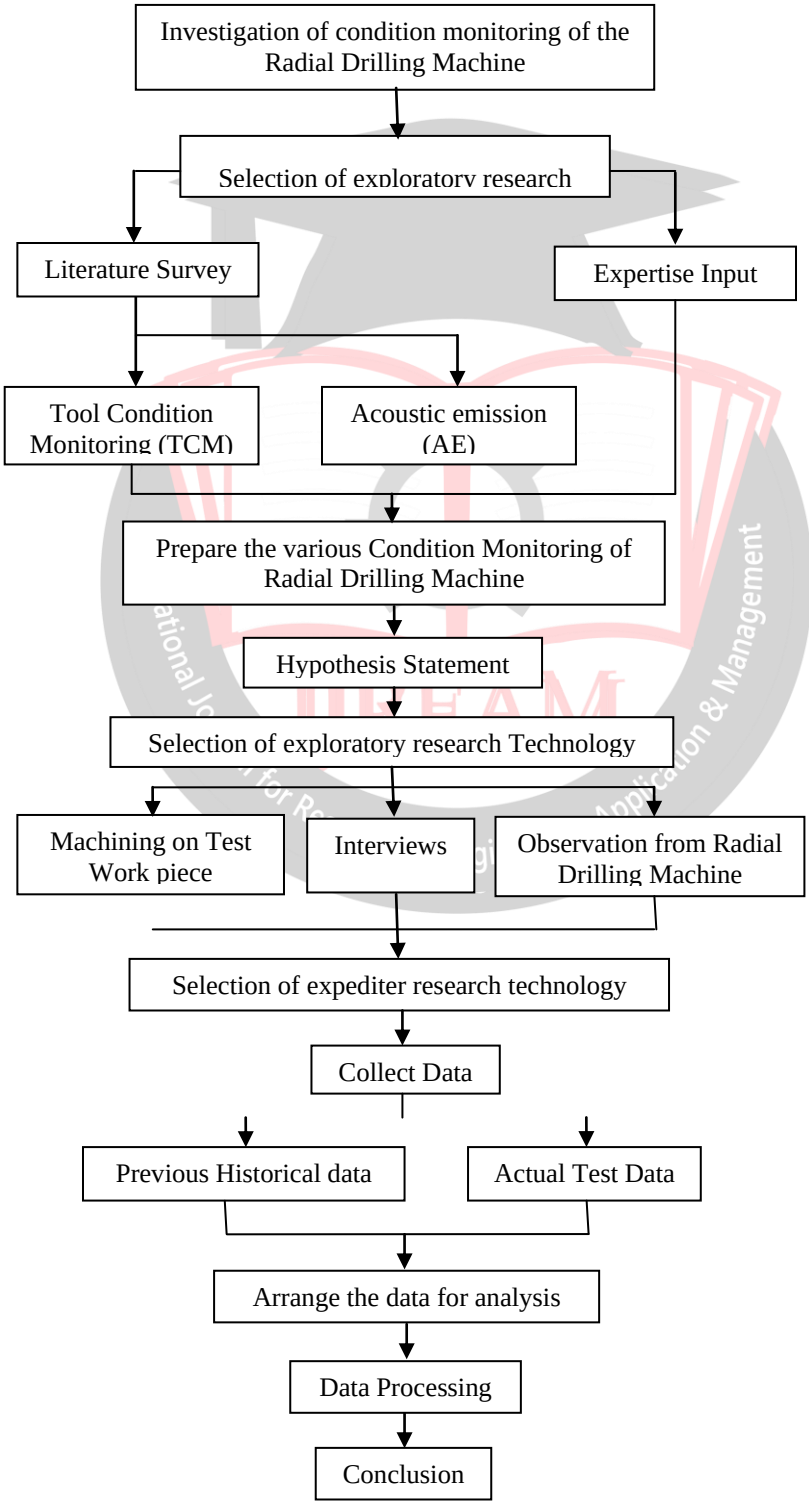
A body is said to vibrate when it describes an oscillating motion about a reference position. The number of times a complete motion cycle takes place during the period of one second is called the Frequency and is measured in hertz (Hz).Vibration transducers produce complex time series waveforms, within which are many specific signatures. It is important to understand these different vibration signatures and how to properly extract them for trending analysis Describes a brief review of acoustic emission method for tool wear monitoring during turning. There are a variety of different types of signal complexities, corresponding to different sound and vibration phenomena as represented as

1. Some signals have a long time duration but narrow bandwidth such as rub & buzz noise.
2. Some signals have short time duration but wide bandwidth such as impacts or transients.

3. Some signals have a short time duration and narrow bandwidth such as decayed resonance.
4. Some signals have a time-varying bandwidth such as an imbalanced shaft generating noise dependent on RPM or machine speed.

Vibration signals are one of the most widely used by many researchers because they provide thorough rinsig ht in metal cutting process. Accelerometer is used as the sensing elements device to measure vibration response. Mechanical vibrations are produced by the cyclic variations in the machine components and due to the dynamic interactions between the cutting tool and the work piece. H. Chelladurai et al (2008) describes Development of a cutting tool condition monitoring system for high speed turning operation by vibration and strain analysis, Tool vibration reduces the performance of machining operations also results in poor surface quality, tool wear and reduced tool life and creates unpleasant noise. Vibration independent of metal cutting which includes forced vibration caused by other machines or machine components, i.e. vibration transmitted through foundations, unbalance of rotating parts, inertia forces of reciprocating parts and kinematic inaccuracies of drives.

III. RESEARCH METHODOLOGY



IV. CENTRAL RESEARCH OBJECTIVE

One of the biggest challenges in recent and advanced manufacturing technique is how to effectively manage the different types of Machine tools in Mechanical and Automotive component without creating a huge higher risk in the condition monitoring of the Radial Drilling Machine.

4.1 Investigation of twist drill tool bit monitoring of the Radial Drilling Machine
4.2 Drilling experiments have been performed at different ranges of cutting speed, feed-rate and drill diameter.
4.3 Investigation to find relationships between acoustic emission (AE) and torque measured during the drilling process, and also with the degree of wear of the tool.
4.4 Tool wear in a machining process can be assessed by direct and indirect methods such as of tool wear, vibrations, power consumption, torque and load (thrust) and acoustic emission.

V. RESOURCES INPUT NEEDED

A. Expertise Required

Following technical expertise will be required for achieving the goals.

1. Domain knowledge for manufacturing technology of materials
2. Focus on special purpose Machine Tools.
3. Expert in Machine and Machine Tool Manufacturing technology.
4. Expert in Machine Acoustic emission (AE), measurement of tool wear, vibrations, power consumption.

B. Applications and Software

Some of the applications will be used as a part of the research, which are as follows:

1. Investigation of monitoring of the Radial Drilling Machine:-, Microphone, FFT Analyzer, Met lab, Acoustic Emission.
2. Statistical Data Processing: - Minitab, MS Excel

VI. TECHNICAL FEASIBILITY CHECK

Following are the points will show that our research would be technically feasible:

1 Data required for the research will be made available through test on Radial Drilling Machine, expert inputs, literature, historical data from ERP and other sources, laboratory test results, Tool wear data will be collected from industries.
2 To derive meaning of the Investigation of condition monitoring of the Radial Drilling Machine will be learned.
3 To develop technical competency, if required for some specific task; training will be taken for the same.
4 The period of further three years will be sufficient to achieve the desired goal.
5 Validation of Design of experts prepared think well.

VII. ECONOMIC VIABILITY CHECK

To undergo these research activities, a capital would be required for conduct surveys, industries visit, attend national and international conferences, purchase material and laboratory test, and attend training programs, travel, and accommodation. All the mentioned activities can be successfully achieved by the research grant that is made available by various sponsoring bodies like TEQIP Ph.D. funding, University Funding, AICTE Funding, Industrial funding research , etc.

VIII. DATA COLLECTION PROCEDURE

Data will be collected from various sources like interviews, Laboratory Result and Analysis, etc.

A. Interviews

Key experts and executives from various industrial sectors like Mechanical, Automobile, Job Order production industry shall be identified. A systematic plan of interview scheduling, preparation of questionnaire getting it reviewed by the research guide, identifying the type of interview and other aspects of an interview will be developed to collect useful data.

B. Laboratory Result and Analysis.

Various typical machining operations done on Radial Drilling Machine for Mechanical industries and Vibration Analysis to be done on for result and analysis**.**

IX. VALIDATION OF RESULTS

Expected result carried out from proposed research is for developed Investigation of Mechanical Properties of the Investigation of condition monitoring of the Radial Drilling Machine will be applicable for Mechanical component manufacturing application

X. PROJECT DELIVERABLES

A. Industry

This research will provide the necessary information for industries to decide the optimum performance of Manufacturing Process to find out the Tool wear and Work after drilling process.

EXPECTED CONCLUSION OF RESEARCH PROPOSAL

This research will provide industries a new framework for Investigation of condition monitoring of the Radial Drilling Machine for Mechanical and Automobile industries for various components manufacturing system for optimum results. Therefore, this research will create a huge improved business opportunity for industries and Venders.

REFERENCES

[1] G Le Moal, P Rabate, George Moraru, Philippe Veron, M Douilly. A Robust Method for Drilling Monitoring using Acoustic Emission. Proceedings of the 9th International Conference on High Speed Machining - HSM, Mar 2012, San Sebastian, Spain. IK4, 6p.

[2] W.P. Dong, Y.H Joe Au, A. Mardapittas, "Characteristics of acoustic emission in drilling", Tribology international, vol. 27, p. 1994, 169-170.

[3] C.E Everson, S.H Cheragi, "The application of acoustic emission for precision drilling process monitoring", International journal of Machine Tools and Manufacture, vol. 39, 1999, p. 371-387.

[4] E. Kannatey-Asibu, D. Dornfeld, "A Study of Tool Wear Using Statistical Analysis of Metal-Cutting Acoustic Emission", Wear, vol. 76, 1983, p. 247-261.

[5] M T MATHEW, P SRINIVASA PAI and L a ROCHA" An effective sensor for tool wear monitoring in face milling: Acoustic emission", Sadhan, Vol. 33, 2008, pp. 227–233.

[6] Ramalingam, S., Shi, T., Frohrib, D. A., and Moser, T., 'Acoustic Emission Sensing with an Intelligent Insert and Tool Fracture Detection in Multi-Tooth Milling,' Proceedings of the 76th NAMRC, 1988,pp. 245 – 255.

[7] Li X. A brief review: acoustic emission method for tool wear monitoring during turning. International Journal of Machine Tools and Manufacture 2002; 42 (2):157–165.

[8] H. Chelladurai. K. Jain&N. S. Vyas "Development of a cutting tool condition monitoring systemfor high speed turning operation by vibrationand strain analysis", 2008, 37:471–485

[9] 254.Hinduja, S.; Barrow, G.; Heinemann, R. Use of process signals for tool wear progression sensing in drilling small deep holes. 2007, 33, pp. 1-6.

[10] Mulc, T, Udiljak, T, Ciglar, D." Tool monitoring system - Modular structure", 2013,20, pp. 871-876.

[11] Stoić, A, Luci, M.; Kopa,J." Dynamic instability of the hard turning process" Journal of Achievements in Materials and Manufacturing Engineering. 2006,17, pp. 373-376.

[12] S. Ai., Y. J. Sun., G. W. He., X. B. Ze., W. Li., &K. Mao. . the milling tool wear monitoring using the acoustic spectrum. Int J Adv Manuf Technol, 61, 2012,457–463

[13] Zheng Xie., Min Wang., &Wei Fan. . Study on Cutting Sound Characteristics of Tool Condition in Milling. Tool Engineering, 7, 2008, 19-21.

[14] Jianglin Hu., Shaowen Zhang., &Liang Li.. Research on tool wear monitoring by acoustic emission technology. Tool Engineering, 3, 2012, 69-71.

[15] S. Bukkapatnam, S. Kumara, A. Lakhtakia, , "Analysis of acoustic emission signals in machining", ASME Journal of Manufacturing Science and Engineering, vol.121,1999, p. 568-575.

[16] A. Velayudham, R. Krishnamurthy, T. Soundarapandian "Acoustic emission based drill condition monitoring during drilling of glass/phenolic polymeric composite using wavelet packet transform", Materials Science & Engineering A, vol. 412, , 2005, p. 141-145.

[17] J. Kopac, S. Sali, "Acoustic emission in drilling carbon steel and nodular gray iron", Journal of Achievements in Materials and Manufacturing Engineering, vol. 19, 2006, p. 91-95.

[18] S.R Ravishankar, C.R.L Murthy, "Characteristics of AE signals obtained during drilling composite laminates", NDT&E International, vol. 33, 2000, p. 341-348.

[19] C.E Everson, S.H Cheragi, "The application of acoustic emission for precision drilling process monitoring", International journal of Machine Tools and Manufacture, vol. 39, 1999, p. 371-387.

[20] C.L. Jiaa, H. Ho-Cheng, C.K.H Dharan, , "Correlation between acoustic emission and delamination in drilling composite laminates", Monitoring and Control for Manufacturing Process, vol.44, ASME,1990,, p. 177-192.

[21] S.R Ravishankar, C.R.L Murphy, "Application of acoustic emission in drilling composite laminates", NDT&E International, vol. 33, 2000, p. 429-435.

[22] I. Marinescu, D. Axinte, "A critical analysis of effectiveness of acoustic emission signals to detect tool and and workpiece malfunctions in milling operations", International Journal of Machine Tool and Manufacture, vol. 48, 2008,p. 1148-1160.

[23] J. Kopac, S. Sali, "Acoustic emission in drilling carbon steel and nodular gray iron", Journal of Achievements in Materials and Manufacturing Engineering, vol. 19, 2006, p. 91-95.

