**Lit Review**

**[1] SK Thangarsau et al** performed various machining operations like surface roughness, machining force and tool wear in dry turning using workpiece EN8 medium carbon steel with TiN coated carbide insert. Cutting force was impacted by depth of cut (27.72%) while cutting speed was influenced only marginally. The interaction between feed and depth of cut (41.67%), followed by feed, had a significant impact on surface roughness (21.33%). Feed (61.63%) had the greatest influence on tool wear, followed by depth of cut and cutting speed. When tool wear grew, tool–workpiece contact increased, increasing cutting force and resulting in a poor surface finish. Trainlm, trainbfg, traingdm, and traingda were chosen as the best training algorithms in terms of least RMS and calculation time. With the shortest computing time, the trainbfg algorithm produced the lowest MSE. The trainbfg algorithm with five hidden layers was proposed to forecast tool wear. The suggested tool wear monitoring system with ANN has the benefit of being easily implemented in real-time applications such as small manufacturing businesses. **[2] Sanidhya Painuli et al** The authors tried to evaluate the K-star classifier's capacity and usefulness for tool condition monitoring by performing a tool monitoring task for four fault conditions of the tool firstly, tool tip was unused hence marked good(gd). Secondly, tool tip is less blunt (tb1n). Third, tool tip is highly blunt (tb2n) and lastly, tool tip is loose (tps) by 1/12 of revolution. A CNC Lathe machine was setup for the experiment at a cutting speed of 600 rpm and a cutting tool made of carbide (TNMG160408) was used to machine the surface of the workpiece. Single point cutting tool’s vibration signals were recorded, and statistical features were retrieved A satisfactory classification accuracy of 78.69 percent was achieved using the above cutting parameters: feed 0.1 mm/s, depth of cut 0.5 mm, speed 600 rpm, and simulated tool fault conditions. Manual feature selection was shown to be more accurate than the dimensionality reduction technique. This emphasises the importance of improving feature selection algorithms. A 10-fold cross validation of the classifier ensured that the data model was error-free. **[3] Q Zhou et al.** in his research has proposed a pattern recognition-based technique for tool condition monitoring system. The workpiece used was made of ASSAB 760 steel and was 140x 700 mm in dimension. The three components of a dynamic cutting force were measured using a piezoelectric dynamometer (KISTLER, model 9257A). The experimental results show that under a wide variety of cutting conditions, the multiple-feature vector derived from the sensor can monitor tool wear according to this criterion when a sensitive sensor and a reliable signal-processing technique are applied.

**[4] Mustafa Rifat et al.** has described in his research the usage of nanofluid as a coolant and lubricant was studied. According to the research, employing nanofluid in machining has various advantages, including reduced cutting force, cutting temperature, surface roughness, and tool wear. Machining Inconel 600 alloy under MQL with (6 vol. percent Al2O3 particle) nanofluids reduces tool wear significantly compared to dry and MQL. Nanofluids greatly lower the rate of tool wear, according to studies, due to their superior cooling capacities and adequate lubricity. When machining with a nanofluid MQL system rather than dry machining or pure MQL, the quality of the surface roughness improves. At the tool-workpiece interface, nanoparticles form a protective layer. CNC milling of Al6061-T6 alloy is made easier by utilising nanoparticles dispersed in mineral oil and applied at high pressure (4 bars) with a 30 degree nozzle orientation angle. **[5] P Krishnakumar et al.** in this study, Vibration signals were used to construct an experimental set-up for monitoring cutting tool condition in a High-Speed Machining Centre in this work. The 3-axis accelerometer is used to gather vibration information under various tool circumstances. The signal is continually collected until the cutting tool fails. The statistical properties of vibration signals are extracted. Various time periods are used to monitor tool wear and finish. Tool wear is divided into three phases, with vibration data from each step being utilised to reduce and classify features. A decision tree method is used to reduce the number of features. For tool condition classification, we utilised the J48 decision tree and ANN methods. Standard error, median, and kurtosis are important statistical characteristics for accurately identifying the state of the cutting tool. Based on classification efficiency, the J48 algorithm and the Feed Forward Back Propagation Neural Network are evaluated side by side for comparison. J48 and ANN had classification efficiencies of 94.3% and 95.4%, respectively, when anticipating tool conditions. When compared to the J48 algorithm, the ANN's performance is noticeably superior. There were only four false positives in the ANN's classification of the input data out of 87 data points (features). According to the results of the performance evaluation, the statistical feature of the vibrating signal is capable of accurately classifying the tool's state. **[6] N. Gangadhar et al** in his research explores the use of machine learning to diagnose single-point cutting tool faults using vibration signals. The trials were carried out using a lathe powered by an engine. Using this technique, 40 acceleration vibration signal samples were collected for five distinct industrial worn-out situations. The accelerometer's output was sent into the NI-9234 DAQ system, which used NI's LabVIEW software to analyse the data. There were four distinct worn-out insert situations taken into consideration when the vibration signals were collected from single point cutting at a constant speed of 236 m/min under healthy circumstances (fresh). Vibration signals from all fault types were used to extract histogram characteristics. PCA was utilised for feature selection that was of critical importance. The ANN algorithm was utilised to help identify the source of the problem. The accuracy of the classification was determined to be 82.5 percent. To put it another way, MLP classifiers can actually be put to practical use monitoring the wear and tear on tungsten carbide inserts as they are being machined into die steel.

**[7] Chandra Nath et al.** has described in his research that Optical imaging techniques (tools or components) provide the highest precise measurements (around 97 percent) and are reproducible in predicting tool wear. Vibration and AE sensors provide easy and practical signal collection alternatives for industrial environments, although these are less precise. Fuzzy logic systems and neural networks are the two most common AI methods for making decisions. When tested on force signals, the neuro-fuzzy methodology incorporates the advantages of the first two methods while also eliminating all of their drawbacks. There are a variety of signal acquisitions such as vibration, AE and power signals that require comprehensive proof. **[8] Doriana M. D’Addona et al.** The results of this research show that two nature-inspired computing techniques, ANN and DBC, may be utilised in tandem to solve computation issues underlying tool-wear monitoring in material removal operations. The ANN effectively accomplishes its goal of predicting tool wear as a function of machining time. Similarly, the DBC accomplishes its goal of identifying similarities and differences across pictures of the worn-zone of the cutting tool. The DBC may be used to evaluate the similarity (or trustworthiness) of input data before using it to train an artificial neural network. While solving complicated computation issues, it would save time and reduce the amount of data needed. The proposed paradigms may then be used to monitor tool wear in real time. The utility of such an integration between the ANN and the DBC in the future may open the way to more effective solutions to other difficult computational challenges. **[9] Xiaoyu Wang et al.** To model cubic boron nitride (CBN) tool wear in heavy turning, an FFCNN-based generalised optimum estimator is presented. It's simple to build as a generic perceptron-based neural net, and once the total neurons in the hidden layer number are specified, there's no need to define the number of hidden layers or the neuron number for each hidden layer. To improve network resilience, the neuron connections are automatically tuned. The EKF method improves the network training solution quality. Finally, when compared to the other techniques examined, the improved FFCNN tool wear estimator has been shown to be quicker, more accurate, and more resilient, and it will assist to better optimise the cutting conditions for hard turning as well as other machining operations. Although the tool geometry impact is not investigated in this work, the suggested estimator can be used to investigate it. In addition, future research may use a recurrent method to better represent the non-stationary nature of tool wear progression in machining.

**[10] T. Mikołajczyk et al** Image processing is used to assess present tool wear and to anticipate tool wear based on the behaviour of comparable tools in the past. This study presents a two-step technique for the automated prediction of tool wear in turning operations that combines these two research areas. First, for three cutting edges under the identical continuous turning circumstances, the VB parameter of tool wear was determined using standard methods. Second, the data from the first two cutting edges were used to train an ANN model, which was then tested on the third cutting edge. The comparison of projected and actual wear values revealed a good level of accuracy, particularly in the area of high wear levels, which are the most relevant in industrial settings. Third, an image-processing tool with an ANN model was used to train the ANN model to forecast tool life using an automatically calculated VB. Although this fully automated method has a larger error, it falls within the same error range as direct measurement and fulfils industrial standards, particularly because of its extremely accurate forecasts for the highest tool wear values.

**[11] T.S. Ogedengbe** has discussed in his research during machining, the effects of heat production on the cutting tool and the machined workpiece have been examined. The various heat-reduction techniques were also examined. The heat created might minimise the magnitude of cutting forces, resulting in lower power consumption and improved workpiece machinability. Because there is a direct link between the two, heat generated during machine operations has a substantial impact on material surface roughness. Surface roughness values over a certain threshold may cause manufactured components to fail. Increased heat output during machine operations lowers tool life. Coolants are essential for decreasing the rate of heat production during machining. However, if not properly administered, it may still be a difficulty.

**[12] N. Szczotkarz et al.** The goal of this study was to carefully assess three alternative methods for machining 316 stainless steel, all of which employed MQL lubrication. The MQL method's oil mist permitted the creation of a machining liquid layer across the whole workpiece surface as well as on the tool, resulting in reduced friction activity in the cutting zone. When compared to dry machining, the EP/AW additive injected into the active medium of the MQCL technique creates a phosphate ester based tribofilm on the cutting wedge of rake faces, encouraging lower cutting wedge wear. However, breaking it produces adhesion wear and inhibits the process that allows the tribofilm layer to develop from forming. After dry machining, the cutting wedge morphology revealed portions of the machined material sticking and a wide zone with abrasive wear patterns. The MQL technique provided greater lubrication, which reduced adhesion wear and, as a result, the risk of sticking on the cutting wedge surface was reduced. The QCL + EP/AW technique has been shown to be a successful method for preventing the creation of stuck progress. The efficacy is attributed to the tribofilm layer that develops as a protective barrier on the cutting wedge's surfaces.

**[13] S. M. Ali et al** For the assessment of tool wear and surface roughness as a result of cutting parameters, an ANN model was built. In terms of accordance with the results data, the model has been proven effective. By predicting tool wear and surface roughness in turning operations, the suggested model may be utilised to optimise the cutting process for efficient and cost-effective manufacturing. In the constructed feed forward single hidden layer network, the back propagation learning method was utilised. In terms of VB, VM, VS, and Ra, the neural network performed well, with coefficients of determination (R2) between model prediction and experimental values of 0.9915, 0.9906, 0.9761, and 0.9627, respectively. These variables have MAPE values of 0.3633, 0.3812, 1.6331, and 4.8069, respectively. These findings demonstrate that the ANN model can readily be utilised to forecast tool wear and surface roughness while turning medium carbon steel with an SNMG insert in a low-lubrication environment. Even after paying the increased cost of developing and implementing the MQL system, the MQL system can enable substantial improvements in productivity, quality of products, and core functionality efficiency after adopting the Artificial Neural Network (ANN) approach.

**[14] M. Marani et al.** Using an LSTM model network, we present a prediction model for tool flank wear in this study. During the machining process, current signals were employed to monitor tool wear. The machining experiments were executed with various tool conditions; tool flank wear values less than 0.06 mm were classified as an original state, wear between 0.06 and 0.13 mm as a working state, and wear greater than 0.13 mm as a dull state. The findings reveal that the LSTM model with two layers and eight hidden units, which has a test RMSE value of 0.00475, is the most accurate prediction model. When the experiment findings were compared to the predictions, they were found to be quite close. The model learnt the process under all tool circumstances, as evidenced by the training regression value of 0.99593.

**[15] U.M.R. Paturi et al.** This research looks at how machine learning may be used to simulate cutting tool wear in AISI 52100 steel turning in dry, wet, and MQL machining conditions. The Taguchi technique of orthogonal array was used to plan the experiment design. The projected values of the ANN model are compared to the experimental data. The excellent accuracy of the ANN model may be seen in the measure of linear relationship between predicted and targeted values. The results show that the R-value in all three machining circumstances is very high and near to 1, suggesting a remarkable agreement between the ANN model predictions and the experimentally achieved outcomes. The ANN model's low absolute error % and high correlation coefficient factor show that the projected values are too near to the experimental data. As a result, using ANN modelling to solve complex and time-consuming jobs is recommended for your convenience. Furthermore, using a machine learning approach such as this may be viewed as an alternative to completing a series of trials, which would result in a waste of time and money.

**[16] Tiziana Segreto et al** The purpose of this work was to develop a tool wear assessment technique for turning Inconel 718, which is a difficult metal to process. Three types of sensors (cutting force, acoustic emission, and vibration sensor) were used to detect sensorial data created by the cutting process and were installed on the tool holder as close as possible to the tool cutting edge to extract time–frequency domain signal characteristics, the collected sensor signals were pre-processed and analysed using wavelet packet transform (WPT) decomposition. The cutting tool flank wear was evaluated after each two-minute rotating step to assess the tool's condition. In the instance of the 7-7-1 ANN architecture, the best ANN performance was obtained with the 7-element sensor fusion WPT FPV, which was related to all 7 sensor signal types and yielded an average MAPE value of 5.17 percent. The precise tool wear prediction accomplished in this work through the use of wavelet sensor signal analysis and ANN-based machine learning paradigms can lead to the development of an effective intelligent tool condition monitoring system for Inconel 718 turning.

**[17] Zhaopeng He et al**. The experimental findings revealed that the suggested model outperformed traditional ML models in terms of projected results and predictive efficiency. The tool wear process is strongly connected to cutting temperature, which may be utilised as a sensor signal to expand the types of sensors available for TCM study. Cutting parameters impact tool remaining life, according to wear tests conducted under five distinct operating situations. The best cutting circumstances, which included a cutting speed of 100 m/min, a feed rate of 0.1 mm/r, and a depth of cut of 0.5 mm, yielded the greatest number of cutting times and the longest cutting life. The temperature signal's time-domain characteristics are significantly linked with tool wear. With specified features, the BPNN and SVR models were able to forecast tool wear with excellent accuracy. When compared to standard ML models with manual feature extraction, the proposed approach learns deep features from raw temperature data as input to the BPNN model, resulting in superior prediction performance and accuracy.

**[18] Djordje Cica et al**  The results of this study revealed a comparison of four machine learning methods for machining force, cutting power, and cutting pressure prediction in the turning of AISI 1045 using coated carbide tools: polynomial regression, support vector regression, Gaussian process regression, and artificial neural networks. Cutting parameters such as cutting speed, depth of cut, and feed rate are used as input data in the created models. For two distinct machining settings, the prediction of chosen quality parameters was carried out. The research looked at the bare minimum of lubrication as well as high-pressure coolant aided turning. The generated machining force, cutting power, and cutting pressure prediction models have shown to be extremely accurate in both MQL and HPC machining environments. MAPE values for MQL and HPC cutting environments, respectively, range from 0.7–2.7 percent and 0.6–2.1 percent, whereas MaxAPE values vary from 1.2 to 9.5 percent and 1.3 to 6.7 percent, according to the results. When PR is used, the greatest values of these two statistical measures were seen in cutting power modelling in both cutting environments.

**[19] Cunji Zhang et al** A unique TCM and URL prognostics technique based on a wireless triaxial accelerometer is given in this study. During cutting operations, the wireless triaxial accelerometer detects vibrations in three perpendicular directions (x, y, and z). Wavelet analysis is used to pre-process the raw vibration data. To extract and select characteristics, several approaches are used. The NFN is used to forecast tool wear and URL, and in the comparison, the NFN beats the others. This prognostic method is simple to implement, and it lays the groundwork for proactive job shop scheduling by incorporating prognostic data into the production system. However, this research solely looks at TCM and URL prognostics in dry milling processes using a single sensor and NFN. Multiple sensors will be utilised in future work to monitor vibrations at various locations, such as the spindle and the jig. The integration of data from numerous sensors will be used to better precisely forecast tool wear. At the same time, we intend to investigate TCM and deep learning-based URL prognostics.

**[20] Yun Zhang** **et al** In this study, a Gaussian process regression model was constructed to predict three cutting parameters in high-speed turning processes: cutting force (Fc), surface roughness (Ra), and tool lifespan (T) based on cutting speed (vc), feed rate (f), and depth of cut (D) (ap). The models are simple, precise, and stable, making them promise as a rapid, reliable, and low-cost method for estimating parameters. The method might be used to identify statistical connections between process parameters in computer numerically controlled machine machines and final work piece quality in a wide range of machining processes.

**[21] Xiaoping Liao et al** Monitoring tool wear condition during machining efficiently and precisely offers recommendations for machining parameter adjustments to guarantee machining quality stability. Using a cutting force sensor, an automated tool wear condition monitoring method for the milling process is created in this work. Feature extraction, feature selection, and prediction are the three components that make up the system. To get complete information, TD analysis, FD analysis, and wavelet packet decomposition are used to execute feature extraction. To decrease the complexity of the prediction model, feature selection uses GA. The GWO–SVM (i.e., GWO–SVM) SVM model for generalizability is suggested to forecast tool wear status.

**[22] Ibrahem Maher et al** A cutting force-based adaptive neuro-fuzzy method for precise surface roughness prediction during cutting was created in this research study. To begin, the ANFIS model was built using 75 measured surface roughness (Ra) and cutting force (F) values under various cutting circumstances as the training data set. Surface roughness and cutting force were studied in relation to machining parameters (spindle speed, feed rate, and depth of cut). Second, a correlation study was used to see how closely the cutting parameters correlated with cutting force and surface roughness. Finally, the model was validated using 32 data sets, with an average percentage accuracy of 96.65%, demonstrating that surface roughness can be predicted using an indirect cutting force measurement based on the ANFIS model.

**[23] Natalia Szczotkarz et al**