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Review Article

A Review on Cutting Tool Optimization Approaches

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Keywords

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Wear,
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Abstract

Tool wear is a global issue in manufacturing as well automotive industry. The speed of the machines and the forces applied exposes the cutting tool and the work to different stresses which deteriorates the tool life. This causes a significant down time to pull out a tool either to reconfigure or change the tool. This consumes more time as every member in the production line remains idle. In addition, the worn tool will have a serious effect on the quality and surface integrity of the machined part. As the aim of automotive manufacturing industries is to produce high volumes and qualitative products in a brief period, the machine's cutting tool remains the key component which affects the overall performances of work. This paper reviews the latest researches on improvement of tool life.

1. Introduction

The history of manufacturing is dated back to the history of human being of the Stone Age. The early humans use different primitive methods to prepare their basic needs food, cloth and shelter. They used stone as cutting tool to cut and prepare hide, wood, and other materials at least 3 million years ago. With time they improved the cutting tool to a single point cutting method by using bones, ivory etc. [1]. Before the Industrial Revolution of the 18th century, metal hand tools were used to cut and shape materials for the manufacturing of goods such as cooking utensils, wagons, ships, furniture, and other products. The 20th century has witnessed the introduction of numerous refinements of machine tools in manufacturing, such as multiple-point cutters for milling machines, the development of automated operations governed by electronic and fluid-control systems, and nonconventional techniques, such as electrochemical and ultrasonic machining. [2]. The later (mechanical manufacturing system) is the most popular cutting processes these days. The rest are used for the special purpose jobs due to their constraints (application requirements, cost-effectiveness, production capabilities and customer needs) [3]. Researchers and manufacturers are continuously working on tool optimization by preventing, maintaining on break down or an early predicting the tool wear effect. Their aim is to gain high quality, in term of work piece dimensional accuracy, surface finishing, very high production rate, less wear on the cutting tools and in the term of economy of the cost saving [3,4]. Some of the most common coatings used these days are: Titanium Nitride (TiN), Titanium Carbo-Nitride (TiCN), Titanium Aluminum Nitride (TiAlN or AlTiN), Chromium Nitride (CrN) and Diamond [4]. To enhance the turning productivity in terms of tool life, surface finish, and surface integrity, variation in tool geometry is one of the major parameter to be considered. Tool geometry has been practiced by the researchers to study the machining performance in the past. The various geometries of the tool are: Rake angle, tool nose radius, approaching angle, groove on rake face, wiper (chamfer) honed edges and side cutting edge angle [5]. The researches for cutting tool parameters such as depth of cut, feed rate, cutting speed and force are done either by directly or indirectly controlling these parameters [6].

2. Review of Related Works

Chelladurai et al. attempted to creat the artificial flank wear using the electrical discharge machining (EDM) process to emulate the actual or real flank wear. The tests were conducted using coated carbide inserts, with and without wear on EN-8 steel. The acquired data were used to develop artificial neural networks model. Empirical models

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were developed using analysis of variance (ANOVA). Vibration and strain data during the cutting process were recorded using two accelerometers and one strain gauge bridge. Power spectral analysis was carried out to test the level of significance through regression analysis. Experimental results were analyzed with respect to various depths of cut, feed rates and cutting speeds [7]. Also, Palanisamy et al. studied the flank wear prediction of a tool by focusing on two different models, namely, regression mathematical and artificial neural network (ANN) models. The Design of Experiments (DOE) technique was developed for three factors at five levels to conduct experiments. Experiments were conducted for measuring tool wear based on the DOE (Design of experiments) technique in a universal milling machine on AISI 1020 steel using a carbide cutter. The predictive neural network model was found to be capable of better predictions of tool flank wear within the trained range [8].

Singh and Khamba, studied stationary ultrasonic machining of titanium and its alloys by using the outcome of the Taguchi model and developed a mathematical model for tool wear rate using Buckingham's π-theorem. Six input parameters, tool material, power rating, slurry type, slurry temperature, slurry concentration, and slurry grit size were selected to give output in form of tool wear rate [9]. Kumar et al. investigated the application of ultrasonic machining, an impact machining process for the cost-effective machining of commercially pure titanium (ASTM Grade-I) and evaluation of tool-wear rate under the effect of different process parameters. The outcome of the Taguchi model was used for developing a micro-model for tool-wear rate (TWR); using Buckingham's pie theorem. A comparison of the experimental resulted obtained assisted in the validation of the model [10]. Yuefeng et al. studied statistical relationships between the initial wear and uniform wear periods. Large amount of literature review of tool wear and questionaries' of manufacturers, 873 tool wear curves were taken as samples. Finally, statistical analysis was carried out to select the most suitable tool from all the tool materials suggested by the tool manufacturers [11]. Furthermore, Jayabal and Natarajan, studied the effect of optimal cutting parameters on thrust force, torque, and tool wear in drilling of coir fiber-reinforced composites. They determined the optimal cutting parameters' settings through experiments, and analyzed using the Box–Behnken design, Nelder–Mead, and genetic algorithm methods [12]. Singh and Rao developed an analytical tool wear model for the mixed ceramic inserts during the hard turning of bearing steel incorporating abrasion, adhesion, and diffusion wear mechanisms. The new model developed reliably used to assess the wear of the mixed ceramic tools within the domain of the parameters. It was observed that tool wear was increasing with the increased cutting speed, feed, and effective rake angle. However, it was found to be slightly decreased with the increased in nose radius. The proposed model was validated by conducted experiments [13]. Also, Li and Guo, investigated experimentally the condition of the tool wear by studying signals acquired from vibration and force sensors. They explored the use of Frequency Band Energy (FBE) analysis and Fuzzy Clustering (FC) techniques for tool wear status recognition in metal cutting. Their results proved that superiority and effectiveness of this method over other method for tool wear status recognition [14]. Moreover, Fang et al. conducted an experiment on the effect of tool edge wear and the cutting forces. The experiment showed that the tool edge wear increased as the tool edge radius increases [15]. Gonzalo et al. investigated the use of PVD (Physical Vapor Deposition) of two different coatings (ZrCN and TiN) . Different turning inserts were coated with four different bias voltages (30, 120, 210 and 400 V). The results showed that the tool wear was directly related to the residual stresses of the coatings, and these were controlled by the bias voltage [16]. In another work, Fang et al. investigated experimentally and theoretically the sharp and round-edge tools in orthogonal machining with BUE (built up edge) formation. The experiment showed a round-edge tool produces higher vibration magnitudes than does a sharp tool. The developed neural network model had proven valid using a separate set of cutting experiments under different cutting conditions from those used for network training and testing [17]. Saglam, studied feed rate, the cutting speed, the engagement length and material hardness in order to monitor tool wear effect on line. An old multi point band saw machine was used for the experiments. Tool wear monitoring models using artificial neural network were developed to predict the tool wear during cutting off the raw materials. The analysis also showed that cutting length, hardness and cutting speed had significant effect on tooth wear, respectively, while feed rate showed less effect [18]. Also, Zhang et al. proposed an innovative approach based on shape mapping to acquire tool wear, to establish an off-line tool wear predicting model for assessing the degree of wear and remaining useful life. These mapped holes on the metal material were analyzed according to all types of milling cutters in order to establish the relationship between the characteristic parameters of these mapped holes and tool wear. Experiments showed that the shape mapping strategy of tool wear allowed for an effective assessment of tool wear and indicated good correlation with the expected wear characteristics and easily conducted tool wear experiments [19]. Furthermore, Albertelli et al. experimentally studied the effects of Spindle Speed Variation (SSV) technique on tool wear in steel turning. The cutting speed and the cutting speed modulation were the main investigated factors. The flank wear width was the main considered process response and it was monitored continuously during wear tests up to the end of the tool life. The effects of the factors were analyzed through the analysis of Variance approach [20]. Chen et al. analyzed the relationship between cutting tool vibration and surface roughness. In this experiment the spindle speed, feed rate, and cutting depth were chosen as the numerical factor; the cutting feed direction and holder type were regarded as the categorical factor. The final results showed that the effects of feed rate and cutting depth provide the reinforcement on the overall vibration to cause the unstable cutting process and exhibit the result of the worst machined surface [21]. Also, Pejryd et al. investigated the tool wear by studying the changes in forces and dynamics of an individual multi tooth milling cutter using internal encoders and signal analyses [22]. Moreover, Peng et al. investigated the effects of vibration by studying the fundamental principles and mechanism of ultrasonic machining together with experimental results of scratching of polysilicon with parallel and vertical ultrasonic vibration assistance. A new approach was proposed by an elliptic ultrasonic vibrating workpiece. It presented with the elliptic ultrasonic vibration assistance, the brittle material was more ductilely removed than in conventional condition, and tool wear decreased in scratching of brittle materials [23]. Hsieh et al. discussed the effects of the sensor installations, selected features, and the bandwidth size of the features on the classification rate. Results showed that proper feature extraction for classification provided a better solution than applying all spectral features into the classifier [24]. Also, Jaffery and Mativenga, studied development of a wear map for Ti-6Al-4V alloy, to identify the wear mechanisms associated with tool deterioration across different regions of the wear map. The characterization of wear mechanisms with respect to machining conditions and tool wear rate ultimately helped in the development of suitable tool coatings for machining titanium-based alloys [25]. Furthermore, Zangera and Schulzea, experimentally analyzed tool wear rate against change in temperature and sliding velocity (feed). Lath machine, Ti-6Al-4V (Titanium) alloy as work piece and tungsten carbide as cutting tool were used for experiment [26].

Xu et al. studied tool wear analysis on the uncoated and multi-layer (Al2O3/TiCN) coated carbide tools was performed in high-speed turning operation with the aid of cutting temperature and tool Von Mises stress simulations. The main wear mechanisms of the uncoated tool were crater wear, oxidation wear, adhesive wear, and abrasive wear, whereas for the multi-layer coated tool, they were crater wear, adhesive wear, and abrasive wear [27]. Also, Magdum and Naik, studied the stresses acting on tool tip at the onset of machining, and on the work piece to develop an online monitoring system to estimate tool wear effect. They proved that the cutting forces, stresses and deformation at the tool increased and the tool wear increased [28]. Also, Hu and Huang, investigated the machining of hardened steel H13. The finite element modeling (FEM) approaches with lagrangian increment method for 3D metal turning approach was used. The ceramic tool and ultrafine-grained tool are applied. For final rsult they used simulation of DEFORM-3D software. The obtained results provided the fundamental and practical guidelines of tool material choice for hard turning [29]. Attanasio et al. studied experimentaly tool wear's effect on surface integrity and developed predcitive model. Analytical models of the tool wear and a comparison between response surface methodology (RSM) and artificial neural networks (ANNs) fitting techniques for tool wear forecasting was performed [30].

Salvatore and Saad, studied a new approach to predict tool wear progression during cutting operation. In particular, an energy approach, linking the tool wear volume with the energy dissipated by friction. In addition, the interaction between residual stresses induced by cutting and the variation of tool geometry due to wear's mechanisms was investigated. It presented the experimental measurements of the wear of the tool, in particular the lost volume during the cut. Numerical simulation of orthogonal cutting operation using the commercial FEM code ABAQUS/Explicit was employed [31]. Moreover, D'Addona et al. experimentally investigated the tool wear advancement by studying the parameters by using optical monitoring processes. They used different computing methods to investigate images and finally proposed an approach for the early identifiaction of tool wear deflection [32]. Wojciechowski and Twardowski, experimentally studied cutting tool's vibrations generated during ball end milling process, including the influence of progressing tool wear. The research revealed that vibrations generated in a stable milling process were strongly affected by the tool wear width on the flank face [33]. Ding et al. studied the tool wear behavior during ultrasonic vibration-assisted grinding (UAG), whose grain motion trajectory differs from that in conventional grinding (CG). This way they evaluated the grinding wheel performance inorder to investigate the effects of ultrasonic vibration on the tool wear through tracking observation of grains. As a result, UAG obtained lower and more stable grinding forces while slightly rougher ground surface in comparison with CG [34].

MihoKlaic et al. conducted experiments on stone drilling with a small diameter twist drill to predict tool wear by means of a machine learning decision tree algorithm. Signal features extracted from both the time and frequency domain were used as input parameters for construction of a decision tree which classifies the tool state into sharp or worn. The best model achieved 90% accuracy in classification and relied only on features of the current signals, which simplified its implementation in a CNC system for industrial applications [35]. D'Addona and Teti, investigated tool wear development during machining processes. In order to monitor the tool wear, the interface chosen between the working procedure and the computer was a digital image of the cutting tool detected by an optical sensor. They designed and optimized artificial neural networks for automatic tool wear recognition using standard images of cutting tool is proposed [36]. Abainia and Ouelaa, studied experimentally the optimal cutting tool geometry by studying the effects of tool back rake angle, the tool cutting edge angle of the major cutting edge, edge inclination and their relationship with cutting forces, tool vibrations and machined surface roughness. Different cutting tool geometries were designed according to the main tool angles and manufactured with a high speed steel material (HSS) type-T15 with a high tungsten alloy grade. Finally, they classified the good optimized cutting tool geometries [37].

Ducobua et al. investigated the right time when to change the tool before it got worn during machining, to keep the required surface integrity (microstructure) of the part. Titanium as work piece was used, and Finite Element Model was used for evaluation. Tool geometry with machining parameters was studied and compared for five different tools. They proved that as the tool flanks wear increased also, the temperature and the contact forces (friction and strain) increased, and damaged the surface integrity of the machined part. So, to overcome this problem, they proposed that clearance angle of the tool must be adjusted for proper chip formation to give required finished (machined) surface [38]. Aghdam et al. investigated comprehensively the correlation between vibrational features of tool/holder assembly and tool major flank wear in a turning process. This analysis provided a reliable algorithm for tool wear estimation since it directly originated from tool/holder system natural modes/frequencies and interpreted the physical behaviour of the system about the tool wear [39]. Wagner et al. devoted to understanding the relationship between the chip formation, the cutting process, and the tool wear for the Ti-5553 near-beta titanium alloy. They studied the evolution of tool wear through the cutting process and the chip formation. An analytical model was used to quantify stresses, temperatures, and friction inside the workpiece material and at the tool/chip interface [40]. Zhuang et al. investigated the performance of ceramic cutting inserts in turning of Inconel 718 by two different assisted machining conditions, plasma preheating- and cryogenic cooling-assisted technologies. By comparing these two assisted cutting techniques with opposite effects on the cutting tool and workpiece, they found the surface roughness was reduced by 50 %, the micro-hardness was smaller, and the tool life was extended up to more than 40 % over conventional machining [41].

Zhaoju et al. investigated the surface finish by analyzing the chip formed during machining. Chip morphology and cutting vibration characteristics under different tool wear stages were examined using optical microscope, and vibration test system. Tool wear progression enlarged the cutting vibration which causes the friction force on tool/chip interfaces to increase, and this aggravated chip edge wear accordingly. On the contrary, the increase of chip segment degree induced the progression of cutting vibration and tool wear. In this research their relationship was investigated sophistically, to improve the cutting efficiency and guaranteeing machining quality [42]. Baghlani et al. investigated the effects of vibrational amplitude, spindle speed, and number of steps to drill each hole on machining force and surface roughness. The setup conducted drilling tests was Inconel 738LC with depth-to-diameter ratios from 2 to 10 by conventional drilling (CD), ultrasonic assisted drilling (UAD), and electro discharge drilling (EDD). The final results demonstrated significant improvement in tool life by applying ultrasonic vibration to the drilling process but also a 40 % reduction in thrust force compared to CD [43]. Stavropoulos et al. studied the limitations of tool wear prediction on the milling of CGI 450 plates, through the simultaneous detection of acceleration and spindle drive current sensor signals. Finally tool wear prediction was accomplished, by utilizing the experimental results that derived from third degree regression models and pattern recognition systems. These results indicated that predictability is affected by the mean signal energy, acquired from the vibration acceleration signals [44]. Antonialli et al. studied tool life, tool wear, and resulting surface roughness of Inconel 625 were evaluated for taper turning in comparison with straight turning. In taper turning, double feed was tested to compensate metal removal rate reduction (since in this operation, the feed length was doubled), and in order to avoid roughness increased caused by the higher feed, a wiper tool was used. Results showed that taper turning was not successful in terms of tool life, although the furrowing mechanism of the tool coated caused by the hard burr formed, that led to notch wear, was avoided.[45]. Ordas et al. investigated efficiently the adequate time for the tool replacement of the insert wear using image processing and classification for decision making. A dataset composed of 577 regions with various levels of wear was created. Two different classification processes were carried out: the first one, using three different classes (Low, Medium and High wear -L, M and H, respectively-) and the second one with just two classes: Low (L) and High (H) [46]. Shen and Wang, showed the effects of cutting force and cutting parameters (cutting speed, depth of the cut and feed rate) on tool flank wear. This was done by simulation and experimental analysis. Finally, the difference between ideal and actual analysis showed very little deviation which was practical, showed the consistency of this research. They concluded that as the more the tool was worn the more friction occurred, so the tool had to reconfigure (Sharpen) again and the cutting parameters must be adjusted. This means that the tool wear could be controlled indirectly by controlling the cutting tool parameters [47]. Selmokar and Kumar, studied the effects of machining parameters of spindle speed, feed rate and depth of cut on tool wear using milling machine to cut the mild steel with high speed steel end mill cutter and developed statistical model method to optimize the tool wear by applying Taguchi method, which was used to measure the quality characteristic deviated from desired value [48].

Karpat and Oliaei, studied tool wear patterns (flank wear, edge rounding) of micro end mills and their relationship to machining parameters. The result was used in process parameter selection in pocket micro milling operations and tool condition monitoring systems [49]. Wang and Gao, studıed the stochastic joint-state-and-parameter model with machining setting as a parameter, that affects the state evolution or tool wear propagation. The model was embedded in a particle filter for recursive wear state prediction. Effectiveness of this method was verified through experimental data measured on a CNC milling machine [50]. Menezes et al. studied experimentally the flank wear width, cutting force, temperature, and surface finish with increasing tool wear in titanium (Ti6Al4V) as work piece. Based on the experimentally measured force data, cutting force coefficients were determined using a nonlinear optimization algorithm as the tool wears and these coefficients were combined with the structural dynamics to predict the process stability. The achieved chatter-free material removal rate was then computed for both the new and worn tool conditions [51]. Rao et al. presesnted a technique to measure the vibration of a rotating workpiece to use it as a parameter to replace a cutting tool at an appropriate time. Experiments were conducted on CNC lathe to obtain data of surface roughness and RMS of workpiece vibration velocity in boring of AISI 1040 [52].

Dongxi ,studied the potential effects of the ultrasonic on the tool wear involved in rotary ultrasonic machining (RUM) of glass BK7 process. Comparative examinations of the profile deviations and abrasive morphologies of the two diamond tools produced with and without ultrasonic were conducted with optical microscopy, 3-D optical profiler, and scanning electron microscopy (SEM), and their resultant effects on the dimension accuracy and the surface quality of the machined component were also explored. The dynamic mechanical properties of glass BK7 increased its Young’s modulus, which reduced the crack nucleation depth in the abrasive, leading the conversion of the splitting appearances [53]. To et al. studied theoretically and experimentally tool wear characteristics in ultra-precision fly cutting UPFC and their relationship to cutting forces, cutting chip morphologies, and machined surface. Results showed that the cutting-edge fractures led to the formation of ridges on both the cutting chips and machined surface [54]. Diniz et al. contibuted an understanding by studying the mechanisim that cause tools to wear. They presented a review of the literature describing the wear mechanisms that are present in metal cutting processes for machining of steels and stainless steel. Finally, they concluded that: attrition was a very important wear mechanism in the machining of ductile materials such as steels and stainless steels; When a steel alloy with high ductility and work hardening rate was machined, a hard burr occured in the end of the depth of cut and the burr-furrowing effect on the tool coating stimulated the attrition mechanism; Other wear mechanisms like abrasion and diffusion also appeared in the machining of steels and stainless steels [55]. Ahmed et al. investigated the wear mechanisms and tribological performance of uncoated and coated carbide tools during the turning of stainless steel. Tribo-film formation on the worn rake surface of the tool was analyzed. In addition, tribological performance was evaluated by studying chip characteristics such as thickness, compression ratio, shear angle, and undersurface morphology [56].

D'Addona et al. investigated two major aspects of machinability, the tool wear and surface roughness. Inconel 718 (Nickel based Heat Resistance Super Alloy (HRSA) widely used in many aerospace applications, due to its superior property is used as specimen. They presented High Speed Machining (HSM) of Inconel 718. Turning trials were conducted at various speeds ranging from low to high (60 m/min, 90 m/min, 190 m/min, and 255 m/min) [57]. Lenz and kaemper, studied the tool usage data (the cutting path, cutting circumstances, tool type and material type) and cutting conditions (feed rate per tooth, cutting width, cutting speed, and number of revolutions) in order to predict the remaining life of the tool precisely. A model was developed, and algorithm was explained for each tool life that makes the prediction more accurate [58]. Xavior et al. experimentally investigated the parameters (feed rate, cutting speed and depth of cut) that cause the machining characteristics, the flank wear. The experiment was done for Inconel – 718 material. Scanning Electron Microscope (SEM) observations were made to understand the wear pattern encountered by different tool materials. Analysis of Variance (ANOVA) was performed to understand the percentage influence of all the cutting parameters on the flank wear [59]. Nor and Sharifah, conducted experiment by milling of Carbon fibre reinforced plastic (CFRP), stronger than steel and stiffer than titanium, while retaining its lighter weight. The experiments were designed by using Central Composite Design (CCD) with range of 160- 200 m/min (cutting speeds), 0.125- 0.25 mm/tooth (feed rate) and 0.5- 1.0 mm (depth of cut). Less tool wear was observed under chilled air machining conditions than dry machining [60]. Kamenik et al. experimentally investigated monitoring of tool wear intensity during high precision in miniature machining to identify tool wear intensity in interaction with given materials. They studied wedge deformation in long term cutting processes that lead to rapid wear and destruction of the tool [61]. Tan et al. examined the influence of cutter path orientation on cutting forces, tool life, tool wear, and surface integrity. The results indicated that horizontal downward orientation produced the highest cutting forces. The best surface finish was achieved using an upward orientation, in particular, the vertical upward orientation [62]. Zahoor et al. Studied the effects of three levels of vertical milling spindle attributed forced vibrations along with feed rate and axial depth of cut, on surface roughness, dimensional accuracy, and tool wear under constant conditions of radial depth of cut and cutting speed. AISI P20 and solid carbide cutter were used as workpiece material and tool, respectively [63]. Lu et al. experimentally studied tool flank wear effect during micro-milling of nickel-based superalloy with coated carbide micro-milling tools. A 3D thermal-mechanical coupled simulation model for micro-milling nickel-based superalloy was developed to obtain the tool wear conditions and the distribution of stress. The results showed the modified force analytical model could predicted micro-milling cutting forces more accurately [64].

Kong et al. studied the methods and techniques of on-line tool wear monitoring through static and dynamic cutting force sensitive signals. The obtained result showed that the prediction accuracy of the proposed tool wear model was proved effective beyond expectation. Besides, the proposed model still was better generalization ability even in small sample size [65]. Suyama et al. specifically studied the tool performance in internal turning of long holes in hardened AISI 4340 steel in finishing conditions against vibration. They tested different machining conditions, two different tool holders (steel and carbide), and several tool overhangs. The results showed that vibration and the material of the tool holder played a secondary role in the surface finish for stable turning, but the use of carbide tool holders made the process stable for longer tool overhangs. Moreover, when the cutting became unstable, surface roughness was increased severely [66]. Pimenov et al. adequately assessed and designed mathematical models of elastic displacements of the technological system under face milling processes (workpiece material, cutting speed, cutting depth, the main cutting-edge angle, the cutter overhang to its diameter ratio, feed per tooth) for different values of tool flank wear on the flank surface. They used GF2171S5 milling machine's compliances of the Angular compliances of the spindle assembly technological system [67].

Zhang and To, studied tool wear level in ultra-precision raster fly cutting (UPRFC) process by determining cutting force composition and the relation between cutting force amplitude and tool wear level.. The width of flank wear land and the first order workpiece modal vibration has a linear relationship, which could be used to predict tool wear in UPRFC and even other intermittent cutting process [68]. Aghdam and Cigeroglu, studied inverse problem of tool wear estimation using vibration signals via non-stationary functional series time-dependent autoregressive moving average model. Two wear sensitive features were used. First, the models were clustered considering autoregressive (AR) distance as a feature and then, damping ratios of tool-holder bending modes were used as another feature for correlating tool wear with the vibrations. The AR metric provided a parsimonious parametric way for comparison of the structures generating the time series. The obtained wear-AR distance curves possesed extremums at critical wear stage [69]. Pattnaik et al. presented a study on machining of rolled aluminum at cutting speeds of 336, 426, and 540 m/min, the feeds of 0.045, 0.06, and 0.09 mm/rev, and a constant depth of cut of 0,2 mm in dry condition to minimize the formation of built-up edge (BUE) on the surface. 5 cutting tools were presented for the experiments. The surface roughness produced, total flank wear, and cut chip thicknesses were measured. The characterization of the tool was carried out by a scanning electron microscope (SEM) equipped with energy-dispersive X-ray spectroscopy (EDS) and X-ray diffraction (XRD) pattern. The chip underface was analyzed for the study of chip deformation produced after machining [70, 71]. Zhang et al. investigated diamond tool wear (DTW) in ultra-precision machining (UPM). The challenges and opportunities for DTW, which may be of interest for future studies, were discussed with several conclusions [72]. Shi et al. investigated tool wear in face milling of alloy cast iron under constant material removal volume (MRV) condition. First, the relationship between tool flank wear (VB) and MRV was determined. Secondly, the wear morphology and mechanism were analyzed and a predicted model between cutting parameters and tool wear was proposed. Finally, the optimization was taken, and three groups of optimal parameters were obtained. For the result a model between VB and the cutting parameters under the constant MRV condition during milling HTCuCrSn-250 was proposed [73].

In a series of publications by Ranjbar et al., the concept of multidisciplinary engineering design optimization of various automotive structures was investigated and reported. They showed the effect of optimization in the quality of results. Furthermore, they presented very innovative techniques for improving the optimization results for real industrial automotive applications by using topology optimization [74-105].

3. Conclusions

In this paper, the review of diffrent methods for the tool optimization is investigated. It is observed that these days in manufacturing industries everything is almost standard or absolute. What is produced (manufactured) is according to the properly computed designs with models, parameters and highly accurate machines equipped a cutting-edge technology. The people working in these areas are also well trained and have full knowledge of the machines and the parts to be produced. So, what goes wrong in the manufacturing industries is not inadequacy in the knowledge of the operation, selection of materials for the part or choosing kind of the cutting tool but the real problem occurs when manufacturing industries components' starts the action or operation. Here before the action (operation) starts, everything is 100% accurate as it is designed, by expecting the possible accident which may happen. So, by taking this into consideration and from the above reviewed researches most effective issue is the cutting tool parameters. The coatings and reconfiguring of the tool geometry have less impact on tool optimizations. As a direction for future study, we will deal with some methods such as but not limited to [106-119]

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