Chapter 2 - Literature Review

This chapter sets the background for up-coming sections. It is basically an assessment of the present state of art of the wide and complex field of evolutionary algorithms and its application. Also this chapter separately reviews what has been done in the past in the area of application of evolutionary algorithms in machining process.

Tarng, Y.S, S.C. Juang and C.H. Chang [1] proposes the use of grey-based Taguchi methods for the optimization of the Submerged Arc Welding (SAW) process parameters in hard facing with considerations of multiple weld qualities. In this new approach, the grey relational analysis is adopted to solve the SAW process with multiple weld qualities. A grey relational grade obtained from the grey relational analysis is used as the performance characteristic in the Taguchi method. They found that a grey relational analysis of the S/N ratios can convert the optimization of the multiple performance characteristics into the optimization of a single performance characteristic called the grey relational grade. As a result, the optimization of the complicated multiple performance characteristics can be greatly simplified through this approach. Their study showed that the performance characteristics of the SAW process such as deposition rate, dilution, and hardness are improved together by using the method proposed.

Vijayan. P and V. P. Arunachalam [2] reported research in their work Taguchi’s off-line quality control method applied for determines the optimal process parameters which maximize the mechanical properties of squeeze cast LM24 aluminum alloy. For this purpose, concepts like orthogonal array, S/N ratio and ANOVA were employed.

Nihat Tosun Cogun and Gul Tosun [3] investigated the effect and optimization of machining parameters on the kerf (cutting width) and material removal rate (MRR) in wire electrical discharge machining (WEDM) operations. The experimental studies were conducted under varying pulse duration, open circuit voltage, wire speed and dielectric flushing pressure. The
settings of machining parameters were determined by using Taguchi experimental design method. The level of importance of the machining parameters on the cutting kerf and MRR was determined by using analysis of variance (ANOVA). The optimum machining parameter combination was obtained by using the analysis of signal-to-noise (S/N) ratio. The variation of kerf and MRR with machining parameters is mathematically modeled by using regression analysis method.

The purpose of optimization of a process is that we need a solution which is as close as possible to the target and as robust as possible, i.e. with minimum variation. Dual response methodology has been successfully used for optimization in various cases [4–7].

The study of Baek et al. [8] presented a surface roughness model for face-milling operations considering the profile and the run out error of each insert in the cutter body. It was stated that because of manufacturing errors in making the cutters, axial (affecting the depth of cut) and radial (affecting the surface roughness) run out errors exist. The feed rate was also taken into account so as to formulate a geometric model. After the model validation with experimental cutting data, the material removal rate was maximized through optimization of the feed rate with the surface roughness as a constraint by means of a bisection optimization algorithm.

Tzeng, Y.-F and N.-H. Chiu [9] presents the application of a Taguchi dynamic experiment in developing a robust high-speed and high-quality electrical-discharge machining (EDM) process. In their study, a two-phase parameter design strategy coupled with a double- signal ideal function methodology is proposed. In the first phase, the ideal function of the EDM process is designed as a linear relationship between the main input signal (machining time) and the first output (material removal rate). This model seeks to develop a robust machining process that leads to a high material removal rate. In the second phase, the ideal function is particularly designed as a linear relationship between the adjustment signal (electrode dimension) and the second output (product dimension). The purpose is to adjust machined product dimension of the
EDM through optimized process parameters obtained in the first phase, to the desired dimension to provide an allowance for subsequent fine-polishing.

For solving an optimization problem need to have estimates of S/N ratio and the average out of roundness error. Lucas [10] has suggested that an equation for predicting S/N ratio can be used for direct minimization of variance. To obtain the estimates of S/N ratio and the average response, analysis was performed on the responses for each run of the experiment.

Kim and Chu [11] stated that the surface roughness could be determined by the maximum height of the effective scallop including the effects of cutter marks and conventional scallops. Through a texture superposition procedure, 3D surface texture, according to the given cutting conditions and cutter types, could be formed. The run out effect (classified as geometric runout caused by the eccentricity of the cutter axis and the irregularity of the cutting edges and as dynamic runout caused by vibration, chatter and the tool deflection) was included to make the predicted surface closer to the actual machined surface.

Jianxin Roger Jiao and Petri T. Helo [12] propose an algorithm for the optimal design of a CUSUM control chart detecting process shifts in the mean value. The algorithm optimizes the sample size, sampling interval, control limit and reference parameter of the CUSUM chart through minimizing the overall mean value of a Taguchi’s loss function over the probability distribution of the random process mean shift.

Hasan Oktem, Tuncay Erzurumlu and Mustafa C [13] developed a Taguchi optimization method for low surface roughness in terms of process parameters when milling the mold surfaces of 7075-T6 aluminum. Considering the process parameters of feed, cutting speed, axial and radial depth of cut, and machining tolerance, they performed a series of milling experiments to measure the roughness data. Regression analysis was performed to identify whether the experimental measurements represent a fitness characteristic for the optimization process. For this purpose, a Taguchi orthogonal array, the S/N ratio, and an ANOVA were used.
A new method was introduced by Ehmann and Hong [14] to represent the surface generation process. Their system basically consisted of two parts, one that modeled the machine tool kinematics and another that modeled the cutting tool geometry. Specific interest for the latter was given in the area of the cutting edge that was described as the intersection of the tool’s face and flank surfaces along with the respective angles.

Palanikumar. K [15] discusses the use of Taguchi and response surface methodologies for minimizing the surface roughness in machining glass fiber reinforced (GFRP) plastics with a polycrystalline diamond (PCD) tool. The experiments were conducted using Taguchi’s experimental design technique. He concluded that for achieving good surface finish on the GFRP work piece, high cutting speed, high depth of cut and lower feeds are preferred.

George. P.M, B.K. Raghunath, L.M. Manocha and Ashish M. Warrier [16] determined the optimal setting of the process parameters on the electro-discharge machining (EDM) machine while machining carbon–carbon composites. The parameters considered were pulse current, gap voltage and pulse-on-time; whereas the responses were electrode wear rate (EWR) and material removal rate (MRR). The optimal setting of the parameters are determined through experiments planned, conducted and analyzed using the Taguchi method. It was found that the electrode wear rate reduces substantially, within the region of experimentation, if the parameters are set at their lowest values, while the parameters set at their highest values increase the MRR drastically.

Mahapatra. S. S and Amar Patnaik [17] attempted to determine the important machining parameters for performance measures like MRR, SF, and kerf separately in the WEDM process. Taguchi’s experimental design method was used to obtain optimum parameter combination for maximization of MRR, SF as well as minimization of kerf. The optimal levels of the factors for all the objectives were shown to differ widely. In order to optimize for all the three objectives, mathematical models were developed using the non-linear regression method.

Beggan. C et al. employed acoustic emission analysis [18] to predict surface quality. Acoustic emission (AE) is defined as the class of phenomena whereby transient elastic waves are
generated by the rapid release of energy from localized sources within a material. In the case of
turning such sources can be found in the primary (due to chip formation), secondary (due to
friction between cutting tool and chip) and tertiary (due to friction between cutting tool flank and
workpiece) cutting zones. Instead of using the RMS value of the AE measured signals; a new
quantity called AERMS20 was introduced in the paper and correlated with surface roughness.

Sahin. Y [19] developed weight loss model of aluminium alloy composites with 10wt.% SiC
particles by molten metal mixing method in terms of abrasive grain size, reinforcement size used
in the composite, applied load and sliding distance using the Taguchi method. The two-body
abrasive wear behavior of the specimen was investigated using pin-on-disc method where the
samples slid against various size of SiC abrasive grits under different conditions. The orthogonal
array, signal-to-noise ratio and analysis of variance were employed to study the optimal testing
parameters on composites with 50µm and 100µm particle sizes. The experimental results
demonstrate that the abrasive grain size was the major parameter on abrasive wear, followed by
reinforcement size.

Implementations of the RSM can be found in the works of M. Alauddin et al. [20] where a
surface roughness model is developed for end milling of 190 BHN steel and Inconel 718. It was
found that first- and second-order models constructed along with contour plots, easily enable the
selection of the proper combination of cutting speed and feed to increase the metal removal rate
without sacrificing surface quality.

Lung Kwang Pana, Che Chung Wangb, Ying Ching Hsiao c and Kye Chyn Ho [21] optimized the
use of an Nd:YAG laser for thin plate magnesium alloy butt welding using the Taguchi
analytical methodology. The welding parameters governing the laser beam in thin plate butt
welding were evaluated by measuring of the ultimate tensile stress. The effectiveness of the
Taguchi method lies in clarifying the factor that dominates complex interactions in laser welding.
The factors can be the shielding gas, laser energy, convey speed of work piece, point at which
the laser is focused, pulse frequency, and pulse shape. Furthermore, 18 combinations of these six
essential welding parameters were set and Taguchi’s method followed exactly. The optimal result was confirmed with a superior ultimate tensile stress of 169 MPa, 2.5 times larger to that from original set for laser welding.

An approach that used a criterion for determining a network’s architecture automatically can be found by W.S. Lin et al [22]. A prediction model was developed prior to the implementation of the actual machining process to determine certain cutting conditions (cutting speed, feed rate and depth of cut) in order to obtain a desired surface roughness value and cutting force value.

Suresh et al. [23] adopted a two stage approach towards optimizing for surface roughness. Experimental results were used to build two mathematical models for surface roughness by a regression method according to RSM. The second-order mathematical model obtained was then taken as an objective function and optimized with a GA to obtain the machining conditions for a desired surface finish.

Suresh Kumar Reddy. N and P. Venkateswara Rao [24] discuss the advantages of dry machining over wet machining by selecting proper cutting tools and tool geometry. The optimization, carried out in their work, gives an opportunity for the user to select the best tool geometry and cutting condition so as to get the required surface quality. Their work emphasizes that proper selection of parameters eliminates the use of cutting fluids during machining and hence makes machining more environmental friendly.

Jeyapaul. R, P. Shahabudeen and K. Krishnaiah [25] presented the use of genetic algorithm and ANOVA for the optimization of the gear hobbing process with multiple performance characteristics. They demonstrated that a multiple response optimization problem can be effectively tackled by using genetic algorithm to generate a single weighted SN ratio (WSN) as a performance indicator.

Rajesh Krishnan and Carla C. Purdy [26] applied both simulated annealing and a genetic algorithm to optimize the output of the TNF α -mediated NF-kB pathway and compared the
results. They found that the algorithms had similar execution time. The genetic algorithm outperforms simulated annealing in both the constrained and the unconstrained experiments. In both cases, the output is maintained at a much higher level than was achieved by the method of Cho et al (2003). Future work includes application of both the algorithms to additional biological pathways such as glycolysis and HIV-1 protease pathways and comparison of the optimizations produced by both the algorithms. They concluded that if the genetic algorithm performs better than simulated annealing in all these cases, we will have good evidence that the genetic algorithm is preferable to simulated annealing for the Box algorithm, and it will then be used as the default optimization algorithm in Box.

Heikki Orsila, Tero Kangas, Erno Salminen and Timo D. Hämäläinen [27] discuss a way to minimize optimization effort and application execution time in mapping an application on Multiprocessor System-on-Chip (MPSoC) using simulated annealing which is a versatile algorithm for hard optimization problems, such as task distribution on MPSoCs. The proposed new method of automatically selecting parameters for a modified simulated annealing algorithm to save optimization effort. The method determines a proper annealing schedule and transition probabilities for simulated annealing, which makes the algorithm scalable with respect to application and platform size. Applications are modeled as static acyclic task graphs which are mapped to an MPSoC.

Vincent A. Cicirello [28], in his work illustrates the ease in which an adaptive simulated annealing algorithm can be designed. He uses the adaptive annealing schedule known as the modified Lam schedule to apply simulated annealing to the weighted tardiness scheduling problem with sequence-dependent setups. The modified Lam annealing schedule adjusts the temperature to track the theoretical optimal rate of accepted moves. Employing the modified Lam schedule allows to avoid the often tedious tuning of the annealing schedule; as the algorithm tunes itself for each instance during problem solving. He discovered that for short searches, the adaptive SA outperforms the current best metaheuristic for this NP-Hard
scheduling problem; while for slightly longer searches, the highly-tuned GA is still better although SA is competitive.

Abido, M. A [29], presents the robust design of multi-machine Power System Stabilizers using Simulated Annealing (SA) optimization technique. This approach employs SA to search for optimal parameter settings of a widely used conventional fixed-structure lead-lag PSS (CPSS). The parameters of the proposed simulated annealing based power system stabilizer are optimized in order to shift the system electromechanical modes at different loading conditions and system configurations simultaneously to the left in the s-plane. Incorporation of SA as a derivative-free optimization technique in PSS design significantly reduces the computational burden. One of the main advantages of this approach is its robustness to the initial parameter settings.

Andreas Efstratiadis and Demetris Koutsoyiannis [30] proposed evolutionary annealing-simplex algorithm (EAS) to try to couple the robustness of SA in rough problems, with the efficiency of the downhill simplex method in simple search spaces. By enhancing the typical Nelder-Mead procedure with new movements such as climbing and mutation, and by introducing to the original movements a stochastic component, it not only makes possible to easily escape from local optima but also to accelerate the searching procedure, especially in high-dimensional applications. After extended analysis, the algorithm was proved at least as effective and efficient as the SCE method, which is now widely used in the region of water resources systems optimisation.

Anshuman Sahu and Rudrajit Tapadar [31] attempts to solve the generalized “Assignment problem” through genetic algorithm and simulated annealing. The generalized assignment problem is basically the “N men- N jobs” problem where a single job can be assigned to only one person in such a way that the overall cost of assignment is minimized. While solving this problem through genetic algorithm (GA), a unique encoding scheme is used together with Partially Matched Crossover (PMX).
Ruhul SARKER and Xin YAO [32], developed a general cost model model for a two-stage batch environment considering both raw materials and finished products which in turn was used to develop a simulated annealing approach to determining an optimal ordering policy for procurement of raw materials and also for the manufacturing batch size to minimize the total cost for meeting customer demands in time. The solutions obtained were compared with those of traditional approaches.

Farhad Kolahan, and Mahdi Abachizadeh [33] developed a simulated annealing algorithm to optimize machining parameters in turning operation on cylindrical workpieces. The computational results clearly showed that the proposed optimization procedure has considerably reduced total operation cost by optimally determining machining parameters and also demonstrated that the proposed solution procedure was quite capable in solving such complicated problems effectively and efficiently.

Janaki Ram. D, T. H. Sreenivas, and K. Ganapathy Subramaniam [34] present two general algorithms for SA in their work. The algorithms have been applied to job shop scheduling problem (JSS) and the traveling salesman problem (TSP) and it has been observed that it is possible to achieve super linear speedups using the algorithm.

William L. Goffe, Gary D. Ferrier and John Rogers [35] tested a simulated annealing, on four econometric problems and compare it to three common conventional algorithms. Not only can simulated annealing find the global optimum, it is also less likely to fail on difficult functions because it is a very robust algorithm. The promise of simulated annealing is demonstrated on the four econometric problems. They found that SA could be used as a diagnostic tool to understand how conventional algorithms fail. They also found that, it could "step around" regions in the parameter space for which the function does not exist. And most importantly, it could optimize functions that conventional algorithms have extreme difficulty with or simply cannot optimize at all.
Yee-Ming Chen & Chun-Ta Lin [36] through their work presents an adaptive particle swarm optimization (APSO) approach to optimize the sequence of component placements on a PCB and the assignment of component types to feeders simultaneously for a pick-and-place machine with multiple heads. APSO proposed in the paper incorporates three heuristics, namely, head assignment algorithm, reel grouping optimization and adaptive particle swarm optimization. Comparing with the results obtained by other research, they concluded that performance of APSO is not worse than the performance of genetic algorithms (GA) in terms of the distance traveled by the placement head. Their results lead to minimize the total assembly time of assignment sequencing time of the placements of component on the PCB board. Considering other applications, they suggest it is easy to modify the APSO approach for the different applications in practice and the other research, for example, a further consideration of component placement for multiple printed circuit boards operation simultaneously and with the time limitation of operation.

The basic PSO algorithm that is described in the works of Venter. G. and Sobieski, J (37). The basic algorithm is first described, followed by a discussion on side and functional constraint handling, and finally, a discrete version of the algorithm is presented.

Hong Zhang, Member IAENG and Masumi Ishikawa [38] proposes a new method to prevent premature convergence and for managing the exploration-exploitation trade-off in PSO search. Particle Swarm Optimization with Diversive Curiosity (PSO/DC). They applied PSO/DC to a 2-dimensional multimodal optimization problem to well demonstrate its effectiveness. The ratio of success in finding the optimal solution to the given optimization problem is significantly improved, which reaches 100% with the estimated appropriate values of parameters in the internal indicator.

Arvind Mohais, Alexander Nikov, Ashok Sahai, and Selahattin Nesil [39] suggested an optimization approach for product design parameters based on emotive responses by combining Kansei techniques and particle swarm optimization algorithm (PSO). The approach involves
designing a Kansei survey for collecting data on customers’ affective responses to various aspects of a product, using several exemplars of the product. After information gathering, the PSO algorithm is employed to build a prediction binary linear model that aggregates the survey data. Subsequently, another binary linear model links product design. Parameters to the outputs of the first model to establish mathematical connections between the subjective impression of a product (Kansei) and its properties.

ZHAO Bo and CAO Yi-jia [40] proposes a multi-objective particle swarm optimization (MOPSO) approach for multi-objective economic load dispatch problem in power system. The proposed MOPSO approach handles the problem as a multi-objective problem with competing and non-commensurable fuel cost, emission and system loss objectives and has a diversity-preserving mechanism using an external memory (call “repository”) and a geographically-based approach to find widely different Pareto-optimal solutions. In addition, fuzzy set theory is employed to extract the best compromise solution. Several optimization runs of the proposed MOPSO approach were carried out on the standard IEEE 30-bus test system. The results revealed the capabilities of the proposed MOPSO approach to generate well-distributed Pareto optimal non-dominated solutions of multi-objective economic load dispatch. They also found that the non-dominated solutions in the obtained Pareto-optimal set are well distributed and have satisfactory diversity characteristics.

Jialin Zhou, Zhengcheng Duan, Yong Li, Jianchun Deng and Daoyuan Yu [41] presented particle swarm optimization (PSO) technique in training a multi-layer feed-forward neural network (MFNN) which is used for a prediction model of diameter error in a boring machining. Experimentally they established that compared to the back propagation (BP) algorithm, the present algorithm achieved better machining precision with a fewer number of iterations. Their work showed that the networks for diameter error prediction trained by the PSO algorithm or by the BP algorithm both improve the precision of the boring machining, but the neural networks trained by the PSO algorithm perform better than those trained by the BP algorithm.
Abido. M. A [42], a novel evolutionary algorithm-based approach to optimal design of multi-machine power-system stabilizers. The designed approach employs a particle-swarm-optimization (PSO) technique to search for optimal settings of PSS parameters. Two Eigen value-based objective functions to enhance system damping of electromechanical modes are considered. The robustness of the proposed approach to the initial guess is demonstrated.

Jong-Bae Park, Ki-Song Lee, Joong-Rin Shin, and Kwang Y. Lee [43] proposed a new approach to economic dispatch (ED) problems with non-smooth cost functions using a particle swarm optimization (PSO) technique. In their work, a modified PSO (MPSO) mechanism is suggested to deal with the equality and inequality constraints in the ED problems. A constraint treatment mechanism is devised in such a way that the dynamic process inherent in the conventional PSO is preserved. Moreover, a dynamic search-space reduction strategy is devised to accelerate the optimization process. To show its efficiency and effectiveness, the proposed MPSO is applied to test ED problems, one with smooth cost functions and others with non-smooth cost functions considering valve-point effects and multi-fuel problems. A position adjustment strategy is incorporated in the PSO framework in order to provide the solutions satisfying the inequality constraints. The equality constraint in the ED problem is resolved by reducing the degree of freedom by one at random. The strategies for handling constraints are devised while preserving the dynamic process of the PSO algorithm. Additionally, the dynamic search-space reduction strategy is applied to accelerate the convergence speed.

Cui-Ru Wang, He-Jin Yuan, Zhi-Qiang Huang, Jiang-Wei zhang and Chen-Jun Sun [44] presented in their work a modified particle swarm optimization algorithm and a new application of it for solving the OPF problem in power system. As a representative method of swarm intelligence, MPSO supplies a novel thought and solution for nonlinear, non-differential and multi-modal problem. For solving the OPF problem, numerical results on the 5-bus system demonstrated the feasibility and effectiveness of the proposed MPSO method, and the comparison showed its validity and superiority over EP and HEP.
Rania Hassan, Babak Cohanim and Olivier de Weck [45] discussed the comparison between the computational effectiveness and efficiency of the GA and PSO using a formal hypothesis testing approach. The motivation was to validate or refute the widely speculated hypothesis that PSO has the same effectiveness as the GA (same rate of success in finding true global optimal solutions) but with better computational efficiency. The results of this test could prove to be significant for the future development of PSO. It appeared that PSO outperformed the GA with a larger differential in computational efficiency when used to solve unconstrained nonlinear problems with continuous design variables and less efficiency differential when applied to constrained nonlinear problems with continuous or discrete design variables.

Jong-Bae Park, Young-Moon Park, Jong-Ryul Won, and Kwang Y. Lee [46] developed an improved genetic algorithm (IGA) for a long-term least-cost generation expansion planning (GEP) problem. The proposed IGA includes several improvements such as the incorporation of an artificial initial population scheme, a stochastic crossover technique, elitism and scaled fitness function. The IGA has been successfully applied to long-term GEP problems. It provided better solutions than the conventional SGA. Moreover, by incorporating all the improvements (IGA3), it was found to be robust in providing quasi-optimums within a reasonable computation time and yield better solutions compared to the TCDP employed in WASP. Contrary to the DP, computation time of the proposed IGA is linearly proportional to the number of stages. The developed IGA method can simultaneously overcome the “curse of dimensionality” and a local optimum trap inherent in GEP problems. The proposed IGA approach can be used as a practical planning tool for a real-system scale long-term generation expansion planning.

Yiğit Karpat and Tuğrul Özel [47] introduces a procedure to formulate and solve optimization problems for multiple and conflicting objectives that may exist in finish hard turning processes using neural network modeling together with dynamic neighborhood particle swarm optimization technique. They indicated through their results that the proposed swarm intelligent approach for solving the multi-objective optimization problem with conflicting objectives is both effective and
efficient, and can provide intelligence in production planning for multi-parameter turning processes.


Hassan R. and Crossley, W.(49,50) defines the problem involving designing the payload and bus subsystems of a commercial communication Geosynchronous satellite with given payload requirements. The design objective is to minimize the spacecraft overall launch mass, which is a surrogate for cost, given design constraints on payload as well as overall system reliability. The problem also involves geometrical constraints imposed by the choice of the launch vehicle. The problem includes six functional constraints and 27 discrete design variables representing the technology choices and redundancy levels of the satellite payload and bus subsystems.

Ramón Quiza Sardiñas, Marcelino Rivas Santana, Eleno Alfonso Brindis [51] suggested that a posteriori multi-objective optimization offers greatest amount of information in order to make a decision on selecting cutting parameters in turning. By means of Pareto frontier graphics, several different situations may be considered, facilitating the choice of right parameters for any condition. They proposed a micro-GA that was shown to obtain several, uniformly distributed points, in order to arrange the Pareto front, at a reasonably low computational cost. Aspects like diversity maintenance and constraints handling have been successfully sorted for their studied problem in turning operation. Cost analysis can complement the Pareto front information, and it helps the decision-making process. The proposed model must be enlarged to include more constraints, such as cutting surface temperature.

Paulo Davim. J and C. A. Conceicao Antonio [52] proposed a methodology aiming at the selection of the optimized values for cutting conditions in machining process, as turning and drilling aluminium matrix composites is proposed. An hybrid technique based on an evolutionary
search over a design space obtained by experimental way is considered. The machining forces, the surface finish and the tool wear are experimentally measured considering the feed and the cutting velocity as predefined parameters. The optimization based on genetic algorithms has proved to be useful dealing with discrete variables defined on a population of cutting condition values obtained from time scale dependent experiments. The obtained results show that machining (turning and drilling) of composite material made of metal matrices with PCD tool is perfectly compatible with the cutting conditions for cutting time of industrial interest and in agreement with the optimal machining parameters (cutting forces, work piece surface finish and tool wear). They cited the importance of optimisation of machining parameters using numerical and experimental models based on genetic algorithms in matters of scientific interest and large industrial applications.

Abdel-Magid. Y. L, M. A. Abido, et.al, [53], demonstrates the use of genetic algorithms for the simultaneous stabilization of multi-machine power systems over a wide range of operating conditions via single-setting power system stabilizers. The power system operating at various conditions is treated as a finite set of plants. The problem of selecting the parameters of power system stabilizers which simultaneously stabilize this set of plants is converted to a simple optimization problem which is solved by a genetic algorithm with an Eigen-value based objective function. Two Objective functions are presented, allowing the selection of the stabilizer parameters to shift some of the closed-loop Eigen values to the left-hand side of a vertical line in the complex s-plane, or to a wedge-shape sector in the complex s-plane.

Mahapatra. S. S & Amar Patnaik [54], in their work, attempted to determine the important machining parameters for performance measures like MRR, SF, and kerf separately in the WEDM process. Factors like discharge current, pulse duration, and dielectric flow rate and their interactions have been found to play a significant role in rough cutting operations for maximizations of MRR, minimization of surface roughness and minimization of cutting width. Taguchi’s experimental design method was used to obtain optimum parameter combination for maximization of MRR, SF as well as minimization of kerf. Interestingly, the
optimal levels of the factors for all the objectives differed widely. In order to optimize for all the three objectives, mathematical models were developed using the non-linear regression method.

Chiuh-Cheng Chyu & Wei-Shung Chang [55] presents a genetic-based algorithm to determine the feeder arrangement and CPS for a chip shooter type machine with the objective of minimizing the cycle time per board. The algorithm has considered several factors in real situations: different machine velocity settings for component types, X–Y table movement time is nonlinear and concave, and feeder duplications. Such a study is very helpful when a manufacturer is requested to produce thousands of PCBs of identical design. The performance of the proposed algorithm, including the effect of feeder duplications, is presented and analyzed in their study. The results indicate that the algorithm produces promising solutions evaluated on the basis of a lower bound on cycle time per board, which is computed by a conservative formula. An estimate of average cycle time per board based.

Kuriakose, S., M.S. Shunmugam [56] suggests use of Non-Dominated Sorting Genetic Algorithm in optimizing the Wire-EDM process parameters to obtain a non-dominated solution set. The sorting procedure employs a fitness assignment scheme which prefers non-dominated solutions and uses a sharing strategy which preserves diversity among the solutions. Also, none of the solution in the Pareto-optimal set is better than any other solution in the set. The process engineer can select optimal combination of parameters from the Pareto optimal solution set, depending on the requirements. They implemented the NSGA algorithm using TurboC and ran on Pentium IV PC.

Several efforts were made by various researchers to design a suitable model for grinding process such as, using parameter optimisations [57,58], analytical and numerical approaches.

Noorul Haq, K. Balasubramanian, Sashidharan & R. B. Karthick [59] solves the problem of parallel line job shop scheduling problem using the genetic algorithm optimization technique. It arrives at the optimal allocation and schedule of given jobs for each of the given processing lines. The C program code is written in LINUX platform and is user friendly. It can be executed
for any number of lines, jobs, and machines per line. It also gives the minimum make span for a
given problem. Their work may be further extended for varying set up times in each line and also
for unequal number of machines in each line. Also the randomization algorithm for the initial
population can be made less complicated without sacrificing its accuracy.

Chao-Lung Chiang [60] presents an improved genetic algorithm with multiplier updating
(IGA_MU) to solve power economic dispatch (PED) problems of units with valve-point effects
and multiple fuels. The proposed IGA_MU integrates the improved genetic algorithm (IGA) and
the multiplier updating (MU). The IGA equipped with an improved evolutionary direction
operator and a migration operation can efficiently search and actively explore solutions, and the
MU is employed to handle the equality and inequality constraints of the PED problem. Few PED
problem-related studies have seldom addressed both valve-point loadings and change fuels.
proposed algorithm is highly promising for the large-scale system of the actual PED operation.

2.1. Motivation

Based on the literature survey performed, venture into this research was amply motivated by the
fact that a little research has been conducted to obtain the optimal levels of machining
parameters that yield the best machining quality in machining of SS 420. Most of the researchers
have investigated influence of a limited number of process parameters on the performance
measures of turning process. In this work, tool nose radius (one of the tool geometry) has been
incorporated to enhance the effectiveness of the machining process, which is one of the most
influential parameter in machining. A suitable optimization technique or algorithm can be
chosen based on the output performance of the optimization technique and the best one can be
selected to maximize the production efficiency. This is possible only by evaluating the
performance of different algorithm. No such performance evaluation is conducted throughout the
literature. Majority of the works are concentrating only on particular method or technique. This
has been rectified by employing different set of algorithms in this work. More over no study has
been performed in turning process using Improved Genetic Algorithm (IGA). The study, it is hoped will lead to theorising efficient monitoring and diagnostics in cutting processes.

The non-linear nature of the machining process has compelled engineers to search for more effective methods to attain optimization. Researchers have found efficient optimized processes in nature itself. Biological systems provide ample insight into their workings; each when applied to mechanical systems help in converging towards the optimum value more accurately.

The studies indicate the importance in analyzing the problem and efforts done to improve the performance of the production or design system even under disturbed conditions. Researchers are responsible to conceive new and improved analytical tools to solve a problem. When a new tool is available the problem should be re-examined to find better and more economical solutions.

In recent years evolutionary algorithms have been gaining more importance and giving promising results in industrial applications. These issues motivate in applying such paradigms for analyzing and improving the performance of machining process system for enhancing quality and economy.

**2.2. Objective of the Thesis**

- To conduct experiments in dry turning process using Taguchi method.

- To perform statistical analysis using S/N and ANOVA technique.

- To develop a mathematical model using Response Surface Methodology.
• To determine the optimum machining parameters using evolutionary algorithms.

• To identify the best optimization method in finding the optimum machining parameters based on the minimum surface roughness.

• Make use of other published work in the literature in order to prove the effectiveness of the proposed algorithms.