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A REWIEW ON APPLICATION OF BIO-GEOGRAPHY BASED ALGORITHM AND OTHER OPTIMIZATION TECHNIQUES

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ABSTRACT

It is well known in this competitive world that cutting condition of the material such as cutting speed, feed rate and depth of cut plays a significant role in the industrial sector for manufacturing process. In this review, a trial has made to identify the issues addressed by the various researchers' works on the machining parameters optimization in multi turning process. This paper highlight the unconventional optimization process like Simulated annealing (SA), Biogeography based optimization (BBO) etc. approach in the turning process and some limitation and advantage are also discussed. Each unconventional optimization process has his own features that perform effectively. The objective of this research is to study the effect of the various cutting parameters like depth of cut, speed and feed rate. In this paper, biogeography based optimization algorithm has been introduced and found that this algorithm is very reliable and effective for optimizing the cutting parameters.

KEYWORDS: Multi-Pass Turning Operation, Cutting Parameters, Bio-Geography Base Optimization

INTRODUCTION

Optimization has become very important in this competitive world. In any field we can observe that optimization has become a key point to success. In our paper, optimization of turning operation is done. Turning process is the most basic machining process for cutting operation. The process of metal removal using turning operation comprise of two stages e.g. rough machining stage and finish machining stage. Several variables such as feed, cutting speed, depth of cut, work material and its properties and characteristics of output variables such as production cost, time, no of iteration, tool life, surface roughness, temperature, cutting force etc. are considered to get the final products that meet the specification. Many traditional mathematical programming techniques have been used to solve optimization problems, but these techniques had so many drawbacks. These techniques couldn't solve the multimodal problems as they gave only local optimal solutions also not solve the problem having so many constraints. Metaheuristic techniques like particle swarm optimization, genetic algorithm, ant colony algorithm, evolutionary algorithm, bio-geography based algorithm are being utilized to solve the optimization problems. In this research, bio-geography based algorithm is being used to optimize the cutting parameters of multipass turning process. Bio-geography based optimization is a nature based algorithm. BBO is the study of geographical distribution of biological organism such as animal, plants with time. The main objective of this process planning is to find the appropriate cutting parameters which can provide max profit to the company and could be available to the customer with appropriate quality and lead time.

Literature Review

Many researchers have been worked to optimize the cutting parameters of the multi-pass turning process. Many attempts have been made by using so many optimization algorithms like Genetic algorithm, Ant colony algorithm, firefly algorithm, simulated algorithm and so on. It has been an attractive field for the Researchers and continuously developing various algorithms in these days to optimize the cutting parameters of multi-pass turning operation.

Many researchers hybridize two or more algorithm to bring some efficient results.

Crookall and Venkataramani

- Introduce the Computer optimization technique. A probabilistic approach has been developed to the determination of the optimum cutting conditions. In this paper, they introduce various non-conventional techniques to solve various optimization problems. Optimization has become very important in various fields. They introduce the mathematical model to solve the optimization problems by using matlab..

Armarego and Brown

- Presented the differential calculus to optimize the machining parameters in turning process considering practical constraints

Then, Shin. Y. C. and Joo Y.S

- Optimize the machining conditions with practical constraints They proposed the mathematical formula to optimize the cutting parameters by dynamic programming approach world academy of science, engineering and technology volume. This is the standard mathematical model that's why many researchers use the same mathematical formulae to optimize the cutting parameters of the machining operation.

Then Onwubolu and Kumalo

- Approaches the Optimization of multi pass turning operations with genetic algorithms. Genetic algorithm is one of the effective algorithms used in the optimization problems. In this paper, they find the optimal value of the cutting parameters of machining process. This algorithm finds the local optimal value. Researchers succeed to find the optimal parameters but the time consumption is higher as compare to other algorithm.

Vijayakumar K, Prabhaharan G, Asokan P, and Saravanan R

- Proposed another optimization method Ant Colony algorithm (ACO) to optimize the cutting parameter and proved their method gives better result with less iteration and within short time. This is one of the effective algorithms. It works on the behavior of ants searching for food. The cutting process divided into two groups that is roughing and finishing stage. The objective of this optimization cutting model is to determine the optimal machining parameters including cutting speed, feed rate, depth of cut and number of rough cuts in order to minimize the unit production cost. They compare their results with other algorithm, and come to a result that Ant colony algorithm is very effective method.

Wang YC

- Optimized the cutting parameters of multi pass turning process and they come with Ant colony algorithm and find that paper of vijaakumar [6] where he did not prove the optimal values they found for the depth of the rough cuts and the finishing cut and the constraint related to the no of cuts. Wang Y C used the same mathematical formulae and obtains the optimal values of the cutting parameter which took less time and even less production cost.

Abderrahim Belloufi

- Intelligent selection of machining parameters in multipass turnings using firefly algorithm**.** In this paper, researcher optimizes the cutting parameters by newly developed firefly optimization technique. The firefly algorithm (FA) is a metaheuristic, nature inspired optimization technique which is based on the social (flashing)

behavior of fireflies. This algorithm based on the swarm behavior such as bird, fish and insects. The algorithm is considered in the continuous constraints optimization problem where the task is to minimize the production cost. The researcher compared with other algorithm such as genetic algorithm, simulated annealing and found that the result obtain near optimal values. It can be used for selection of machining parameters of the complex machining parts.

Jain

- Research on the optimization of ultrasonic machining. In this paper author used Genetic algorithm to optimize the process parameters such as amplitude of vibration, mean diameter of abrasive grain, volumetric concentration of abrasive particles in slurry and static feed rate. Genetic algorithm has been proved better than the traditional optimization techniques. The Genetic algorithm is depending on the population size or the diversity of the solution. If the Genetic algorithm cannot hold its diversity before global optimization reached then the solution is converge to local optimum.

Rao and Pawar

- Used the Artificial Bee Colony (ABC) algorithm for optimization of parameters of a wire electric discharge machining process (WEDM). The author also used response surface methodology (RSM) to correlate the inter-relationships of WEDM parameters such as pulse on time, pulse off time, peak current and servo feed setting on machining speed and surface roughness.

Dubey and Yadava

- Used the hybrid Taguchi method and response surface methodology (TMRSM) for the multi response optimization of cutting parameters of laser beam. The author used the Taguchi method to find the optimal cutting parameters such as gas-pressure, pulse width, pulse frequency and cutting speed. The optimum input parameter values were further used to find the central values to develop second order response model.

Zhang

- Present the paper of optimization of cutting parameters using simulated annealing (SA). In the optimization method, the model layout problem was identified to improve the production of the SCG process and to reduce the cost of the machining. An objective function was developed and compared with conventional linear-weighted objective function. The developed software tool kit can raise the machining operations. STL format can be receive from Pro-E which generate the envelop automatically and update the STL files.

T Sai

- Studied about the relationships between multi pass and single pass machining operation. The author introduced a new concept of break-even point. Break-even point may be define as a point at certain value of depth of cut at which both multi-turning pass and single pass turning are affected. The author analyzed that the break-even point should be minimum all the time. When depth of cut drops below the break-even point, the single pass is more economical than the double pass carbide tools. Author used carbide tool to carry out experiment.

Rao

- Optimize the surface roughness of die sinking electric discharge machining considering effects of the constraints on the cutting parameters. The experiments were carried out on Ti_6Al_4V, HE15, 15cdv6 and M-250. Various

experiments were conducted by varying the peak current and voltage to find the value of surface roughness. Genetic Algorithm was used by the author to optimize the weighting factors of the network.

APPLICATION OF BIOGEOGRAPHY BASED OPTIMIZATION IN VARIOUS FIELD OF MECHANICAL

Bio-Geography Based Optimization for Hydraulic Prosthetic Knee Control

Bio-geography based optimization has been used to design robot and to control the motion of the robot. In the paper, they introduce a cyber-physical system (CPS) which is used as a semi active, above knee prosthetic of a robot.Cyber Physical System is a system featuring a tight combination of, and coordination between, the system's computational and physical elements. To control this cyber physical system above knee-prosthetic, they need to optimize the open loop control system and their simulation. To optimize the open loop control system they use bio-geography based optimization (BBO). They found that BBO is effective to generate near optimum solution to control cyber physical system. This solution provides reasonable knee and thigh angle tracking. In this project ABC is better than BBO for the middle size of the problem but for the large size of the problem BBO has been proved better.

Bio-Geography Based Optimization for Optimal Job Scheduling in Cloud Computational

In this paper, optimization of job scheduling is done using algorithm bio-geography based optimization in cloud computing.Job scheduling is mapping a set of job to effectively utilize the computational capabilities and storage capabilities of parallel system, large scale cluster system, distributed system, grid and cloud. In cloud computing, the resources are dynamic and their performance change with respect to time. Bio-geography based optimization produce the new habitat by immigration and emigration for each non-elite habitat from the several best habitats and optimizes the habitat if the generated habitat is better than the old habitat. It is then compared the results with genetic algorithm, simulated annealing, particles swarm optimization (PSO) and abc and found that the result obtained using abc algorithm is giving better results than bio-geography based optimization for the middle size of the problem. But for the large size problem biogeography based optimization has been proved better.

A Hybrid Grey Based Kohonen Model and Biogeography Based Optimization for Project Portfolio Selection

The problems of selection with best option are the main subject of operational research science in decision making theory. In decision making condition, managers search for the best combination to build up a portfolio among the existing project. In this paper, first researcher employed to build up a portfolio project second each portfolio was evaluated using grey relation analysis (GRA) third scheduled risk of the project was predicted using mamdani fuzzy interference method and then finally bio inspired optimization utilized for drawing risk and rank pereto analysis. Grey relation analysis (GRA) used for analyzing uncertainty system in which the part of the information is unknown.

NON-TRADITIONAL OPTIMIZATION ALGORITHMS

These algorithms are stochastic in nature, with probabilistic transition rules. These algorithms are comparatively new and gaining popularity due to certain properties, which the deterministic algorithms do not have. These methods are mainly based on biological, molecular, or neurological phenomenon that mimics the metaphor of natural biological evolution and/or the social behavior of species. To mimic the efficient behavior of these species, various researchers have developed computational systems that seek fast and robust solutions to complex optimization problems. Examples of these algorithms include simulated annealing (SA), genetic algorithm (GA) and particle swarm optimization (PSO).

Particle Swarm Optimization (PSO)

Particle swarm optimization is an algorithm based on group or social behavior of the animals like birds, fish etc., certain species of which move in group. In this algorithm the swarming intelligence is used to solve the optimization problem. The various parameters that affect the performance of the algorithms are inertial, social and cognitive parameters. The individuals moving the group try to move towards the individuals in better positions. This behavior is used in optimization to move the solution set with poor fitness towards the solution set having better fitness. In particle swarm optimization the particles change their position while taking into account the best position of all the individuals as well as their own personal best position. This behavior is simulated using social and cognitive parameters respectively. The inertial parameters decide the direction of the moving of the individual solution. in this algorithm the particles or individual in multi- dimensional search space such that they find the global optimal solution. The velocity can be calculated and added to the previous value of the particle swarm optimization in order to find new values. The velocity of the particle is given by

$V_{i+1}= w*V_i + C_1*(Gbest – X)*rand_1+ C_2* rand_2*(Pbest-X)$

Where Gbest is the global best value, Pbest is the best value of the individual, X is the current

C_1 is the social parameter while C_2 is the cognitive parameter, $rand_1$ and $rand_2$ are the random numbers in the range [0,1]. The value of the weight is given by the equation

$$w = wmax - \left(\frac{wmax-wmin}{itermax}\right) * iter$$

Where, wmax and wmin are the maximum and minimum value of the weight, iter is the current iteration number and itermax is the maximum it

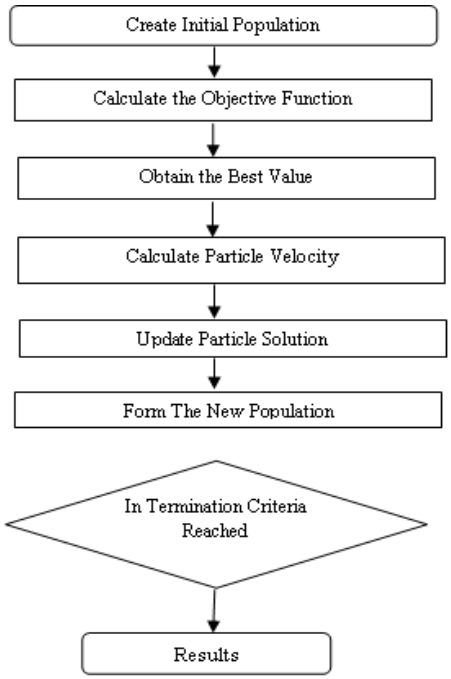

Figure 1: Flow Chart of PSO

Simulated Annealing

Simulated annealing (SA) is one of the earliest methods of optimization. Annealing is the metallurgical process of heating a metal to a certain temperature and then cooled slowly at room temperature until it crystallizes. Atoms present in the material have high energy. This provides the atoms a good deal of freedom to restructure themselves. If the temperature is reduced the energy of the atoms also decreases until the source of energy is achieved. The simulated annealing starts at a high temperature where the input parameters are allowed to assume as a great range of vibration. While operating the algorithm the temperature is allowed to decrease. This restricts the input of algorithm to vary. This made the algorithm to give good solution. Simulated annealing has the ability to avoid of being trapped in local minima. So, it search on global minima

METHODOLOGY

Simulated annealing implementation

- Application of the simulated algorithm requires definition of:
- Initial population
- Initial temperature
- Perturbation mechanism
- Objective function
- Cooling schedule
- Terminating criterion

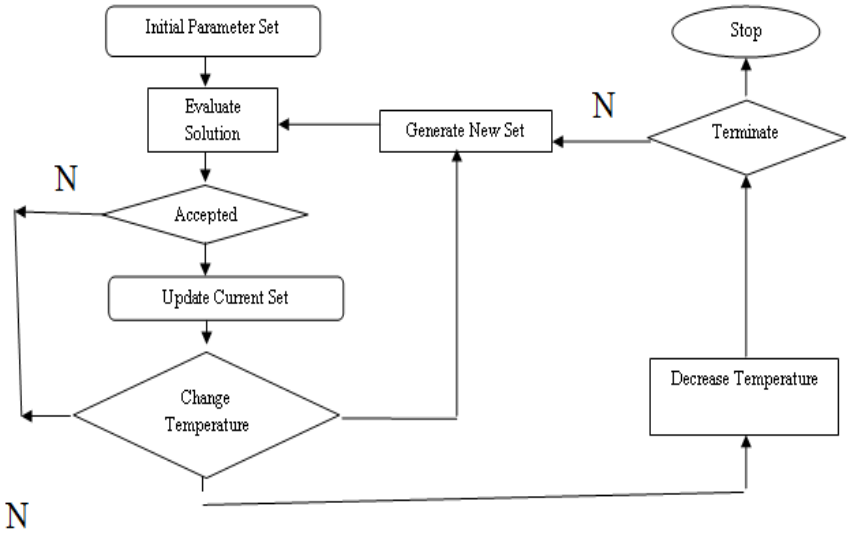

Figure 2: Flow Chart of Simulated Annealing

Genetic Algorithm

Genetic algorithm is an optimization technique based on the mechanics of natural genetic and natural selection. The genetic algorithm operates on the principal of survival of fittest. In this process the weak individuals died before reproducing, while the stronger one survives and produces some more children. The children produce have high ability than the earlier parents.

Genetic algorithm operates through the following states:

Creation of a population of chromosomes

- Evaluation of each chromosome
- Selection of best chromosome
- Genetic manipulation to create the new population of chromosomes

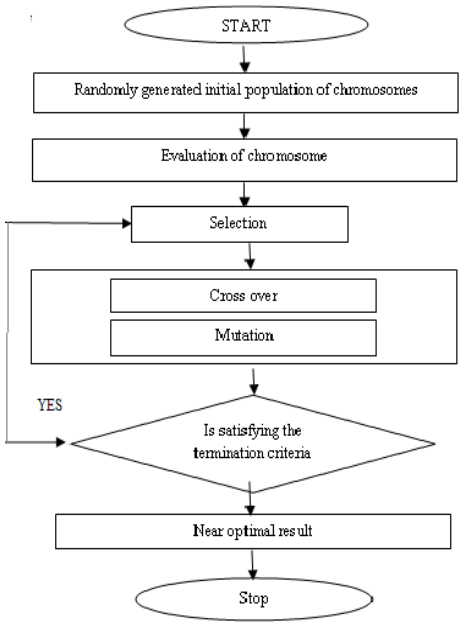

Figure 3: Flow Chart of Genetic Algorithm

Differential Evolution

The differential evolution is a basically a exploration based algorithm. It functions mainly with the help of the mutation. The other parameter of the differential evolution is the crossover. This algorithm has better exploration capability as compared to other algorithms. In this algorithm the mutation is provided by the following equation

$$\upsilon_{i,G+1} = x_i,G + K\,(x_{r1},G - x_i,G) + F\_\,(x_{r2},G - x_{r3},G)$$

Where, i, r_1, r_2, $r_3 \in \{1,2,\ldots,NP\}$ are randomly chosen and must be different from each other. F is the scaling factor which has an effect on the difference vector $(x_{r2};G - x_{r3},G)$, K is the combination factor..

Then the crossover is done between the mutated variable and the randomly chosen solution set from the given population. The crossover equation is given below

$$uji;G+1 = \begin{Bmatrix} vji;\, G+1 \text{ if } rndj(\,CR) \text{or } j = rni \\ vji;\, G+1 \text{ if } rndj(\,CR) \text{or } j = rni \end{Bmatrix}$$

If the fitness of the new individual is more than the previous one then the new individual is replaced with the older one. This process is continued till the optimal value is reached.

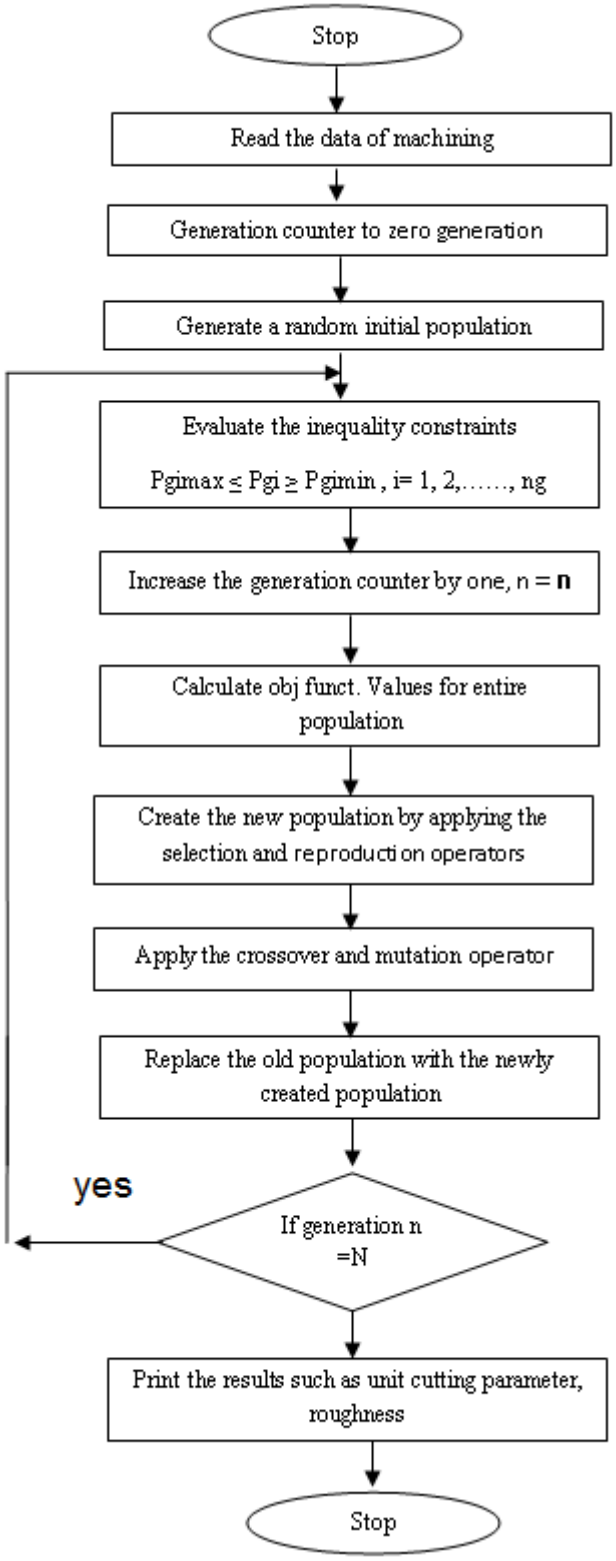

Figure 4: Flow Chart of Differential Evolution

CONCLUSIONS

A review of literature shows that various traditional and nonconventional techniques have been successfully applied in the past to optimize the cutting parameters of the machining operation. From the reviews, we can say Bio-geography based optimization is the most widely used optimization technique being utilized in various field of

mechanical engineering. Bio-geography based optimization is very reliable and effective optimization technique has potential for saving time, production cost and improves the quality of the product.

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