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Cost Minimization of Turning Machining Process Using Ten Non-Traditional Optimization Methods

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ABSTRACT:

The improvement of product quality,time reduction and cost minimization through the method of machining process done by using Optimization algorithms. The cutting speed and feed can be processed by turning machine. Firework, Lawler's, greedy, bacterial colony, elephant herding , ant lion, spiral, auction and pattern search for these ten nontraditional methods are processed through the method of optimizing. Using ten methods of artificial optimization compared the time and minimizing cost of turning machine. The optimum solution of turning machine process method is concluded.

Keywords: Turning machine process,Ant lion,Bacterial colony,Greedy, Pattern search,ABC algorithm, Elephant herding, Optimization Algorithm, Cost minimization, Fireworks, Auction, Spiral, Greedy and Lawler's algorithm.

1. Introduction:

Power consumption, temperature, cutting, cutting forces, production time, tool life, production cost, number of process for certain outputs, depth of cut, cutting speed and its different ranges are involved in this machine process. The product quality and cost minimization has its certain conditions of cutting. The parameter are cutting speed (Vc), feed (F), and Cutting depth (D).

The conditions of machining process relates the problem of multi turning by parameter selection (2).The various methods for same problems of optimization algorithm are attempted by different authors. Chen proposed simulation algorithm of pattern search are reduce the cost for production by the hybrid technique (4). Genetic algorithm are based on optimization technique. By solving many complex optimization problems which makes many researcher to use pattern search method. The hybrid algorithm and genetic algorithm gives same model.

Solving various optimization approaches is a complex process by of turning machine process is reviewed by above literature (3). The minimization of cost for unit production is obtained by pattern search method which is explained in this paper. The obtained results is highlighted by optimization methods.By studying algorithm the results are compared with other nontraditional optimization models.

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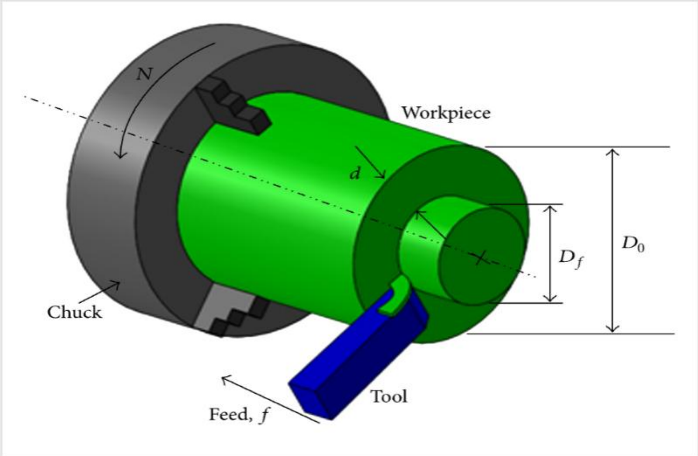
.2. Process optimization

Machining Process

The final size and shape is obtained from the raw materials by cutting through various machining process.

Turning

LATHE is called turning process, which is machining internal or external surface, where the certain parts of the tool is rotated. Surface revolution places is called LATHE. The work piece starts rotating when the feed rate is increased. The rpm of the work piece is based on the speed of cutting. When the single point of the cutting tool is moved towards the axis of rotation, the process or turning occurs. Forging, casting or drawing extrusion in turningmachining are certain other process.



Cutting Tools

Single point cutting tool is said to be a LATHE. The numerous points of teeth at the edges are the drill points or cutting edges. Rather than cutting, lathe is also done if there is motion between work piece and tool. If motion occurs by rotating the tool then it is set as a perfect example. If there is much instance which results in breakage then the movement takes place at the site.

Tool Life

The relationship between cutting speed and tool life is

V Tn = C

Where; C = a constant,

T = tool life in min;

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V = cutting speed in m/min;

Cutting Speed & Feed

The process of work rotation with relative speed, tool cutting feed and metal cutting rates must proceed. The items are manufactured in a particular minimum time for cost effectiveness, according to the specificities of accuracy and quality as this relationship is important.

Cutting Speed

The point of the surface is defined by the optimum cutting speed with all the materials. The work process is thepoint of the total or cutting edge is defined by,

$$N = \frac{CS*100}{\pi d}$$

Where:

Spindle Speed = N

Cutting Speed = CS

Diameter = d

Feed

The distance of the tool moving to the surface is determine by work feed. It is used to determine the fixed of a soft materials up to 0.25mm per/rev. The maximum of materials is reduced to 0.10mm/rev.

3. MATHEMATICAL MODEL

In actual cutting process, optimum machining provides the nearest optimum solution. There is a two types of optimization methods. The mathematical formulation is the first part and finding global optimum solution is the second part.

C-Cost of Machining;T-Tool life,L-Length of turning; tL -Non- productive time; Vc-cuting speed ;D-Work piece diameter,Cr-Labor plus overhead f-feed; Ca-tool cost per cutting edge; ap-depth of a cut;CT, p, q, r-empirical constants Cost of Machining: tm-Machining time,

The Cost of machining is $C = C_r t_L + C_r t_m + \frac{tm}{T}(Cr.td + Ca)$

Machining time in turning process

$$t_m = \frac{\pi.D.L}{1000.Vc.f}$$

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The tool life is,

$T = C_r / v_c^p . f_q . a^r_p$

The Cost of machining is,

$C = C_1 + C_2 . V_c^{-1} . f^{-1} + C_3 . V_c^{p-1} . f^{q-1}$

Where:

$C_1 = C_r . t_L$

$C_2 = \frac{\pi . D . L . Cr}{1000}$

$C_3 = \frac{\pi . D . L . arp (Cr . td + Ca)}{1000 * Cr}$

The Constraints functions is followed;

1. The cutting tool ability: $V_c . f^y \leq \frac{Cv . Kv}{Tm . ap}$

2. Machine tool power force: $V_c . f^{y1} \leq \frac{6120 . Pm . \eta}{Ck1 . kf . ap}$

3. Strength tool: $f^{y1} \leq \frac{Rsd}{Ck1 . C0 . kf . ap}$

4. Stiffness work piece: $f^{y1} \leq \frac{\delta . E . I}{0.8 . Ck1 . l1 . kf . ap}$

5. The minimal spindle speed: $V_c \geq \frac{\pi . D . n \min}{1000}$

6. The maximal spindle speed: $V_c \leq \frac{\pi . D . n \max}{1000}$

7. The minimal feed: $f \geq f_{min}$

8. The maximal feed: $f \leq f_{max}$

The objective function is

$$\text{Min } C = 0.30 + \frac{4.60}{Vc . f} + 1.72 . 10^{-11} . V_c^{4.55} f^{0.67}$$

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Constraint functions:

1. Vc $f^{0.30} \leq 91.57$

2. Vc $f^{0.75} \leq 74.80$

3. $f^{0.75} \leq 6.48$

4. $Vc \geq 5.03$

5. $Vc \leq 502.65$

6. $f \geq 0.04$

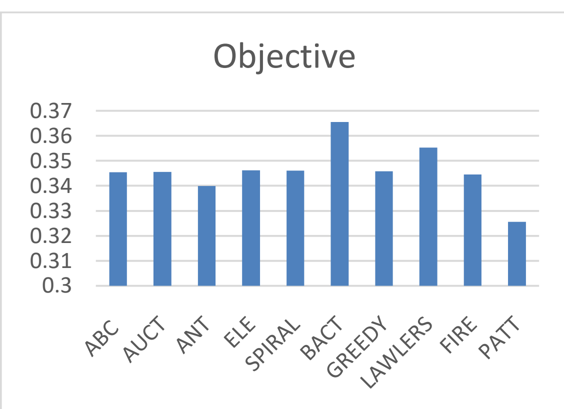
7. $f \leq 9$

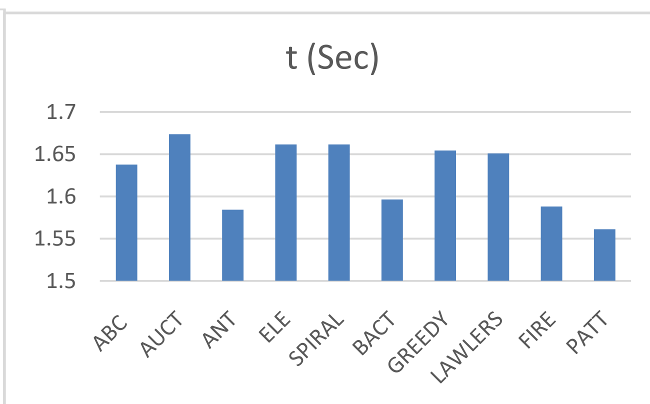
The ten non-traditional optimization methods to be used to solving above problem with run to 20 trials. Finally the average values are taken for comparison.

4. PARAMETERS:

The ten non-traditional optimization methods to be used to solving above problem and the parameters are tabulated.

Trial No.	PATT	ANT	ABC	ELE	AUCT	BACT	GREEDY	LAWLERS	FIRE	SPIRAL
Objective	0.325	0.339	0.345	0.346	0.345	0.365	0.345	0.35	0.34	0.34
t (Sec)	1.561	1.584	1.637	1.661	1.673	1.596	1.65	1.65	1.58	1.66
Feed(mm)	6.124	6.135	6.154	6.314	6.14	6.14	6.13	6.15	6.36	6.13
Vc(mins)	13.99	14.7	14.817	14.89	14.52	14.77	15.02	15.15	14.71	14.88





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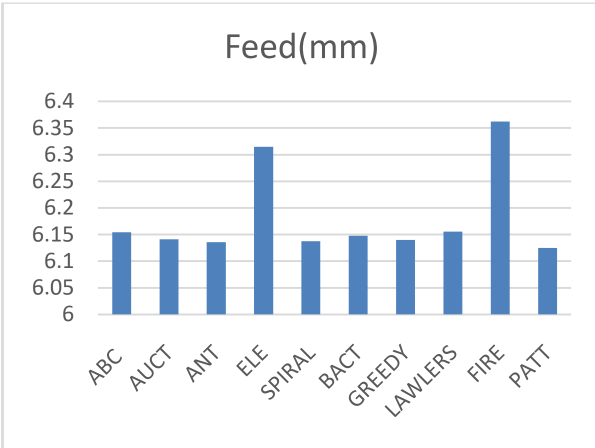

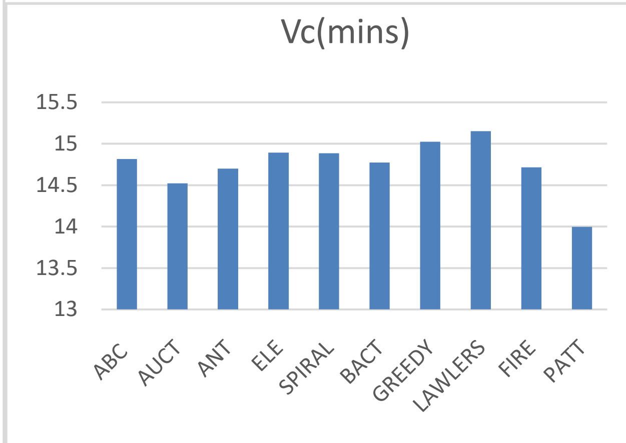

5. RESULTS AND DISCUSSION.

Through ten nontraditional methods in optimization, the turning machine process problem is minimizing using MATLAB and ten algorithms are implemented. The 20 trails are taken to solve this problem. It is understood that pattern search method is taken minimum time, which is followed by ant lion (1.58sec) is obtained from the graph. In this pattern search method (13.995mins) the cutting speed is minimum which is followed by Auction (14.52mins). In this pattern search method the feed is also minimum. We conclude that the pattern search method taken minimum evaluation for turning machine process.

6. CONCLUSION

In this paper we evaluate, solving the engineering problems applied by ten nontraditional algorithms. The ten nontraditional methods are simulated and tested effectively. The results are presented in pattern search method, fireworks, Lawler's, greedy, bacterial colony, elephant herding, spiral, ant lion auction and ABC algorithm. The minimum running time is pattern search (1.561sec) is followed by firework algorithm (1.58sec). Then as the result is obtained that pattern search algorithm is better than other results. Finally, theminimum cost and time are obtained through pattern search method.

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