Optimization of Process Parameters of CNC Turning Machine using Mild Steel

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Abstract

In today's life, the realization of a fine surface finish is the main objective of the metal cutting industry during the turning processes. This work consists of an analysis of the work carried out by the researchers in the field of filming process parameters, to Examine the impact of speed, cutting speed (feed), and depth of cut in a computer numeric control machine. This study will provide insight into current trends research in the area of Taguchi, Grey Relational Analysis, Response Surface Method, ANOVA & CNC Turning.

Keywords:CNC Machine, Taguchi, ANOVA, GRA

1. Introduction

CNC turning is the broad machine used for manufacture of diametrically shaped parts in less time, featuring a better surface finish and high material removal rate exact dimensions as well. It is very much desired that the result of having a good surface finish and high material removal rate be made in a shorttime .The quality of the surface finish of a product is generally determined as a function of the surface roughness measured. Surface roughness typically hangs on such cutting parameters as speed, feed,and depth of cut.

Choosing the right management factors for the experience is very important to provide the parts with better surface end and high material removal rate in a brief time. Over the past couple of decades, a lot of work has been done to raise the standard of the commodity and power in machining. The still diverse aspects of this paper constitute a unit to be explored.

2.LiteratureReview

Year&Author	Aimof Research Work	Material	Input Parameters	Output Parameter	Technique Used	ResultObserved
R.Viswanathanetal.(2020)	Optimizationof turning parametersfor magnesiumalloy	Mgalloy AZ91D	Cuttingspeed, Feed,&Depthof cut	Flankwear, Surfaceroughness, Cuttingforce&Material removal rate	Taguchi,GRA, PCA	Themostdominatingparameteron themultipleperformanceswas foundtobethedepthof cut.

S.Dhanalakshmi &T. Rameshbabu(2020)	Optimizationof ProcessParametersin CNCTurningof LM 25AlloyUsingthe Taguchi-Grey Approach	LM25 Aluminum Alloy	Cuttingspeed, Feed,Depthof cut &Cuttingfluid flowrate	Surfaceroughness, Materialremoval rate&Total machiningcost	Taguchi,GRA, ANOVA	Depthof cutispredominating variableforMRR, andfeed& cuttingspeedpredominating variableforSRandTMC
S.P.Palaniappanetal.(2020)	processparameters optimizationon Aluminum6082alloy	Aluminum 6082	Spindlespeed, Feed&DOC	Surfaceroughness &Material removalrate	Taguchi, ANOVA	significantparameterforMRR wasspeed& feedwasthe most significantparamet
NingLiet al. (2019)	MultiResponse optimization	Ti-6Al-4V	InsertType,Feed &DOC	Radialthrustforce, Cuttingpower&Coefficientof friction	GRA,KPCA	Feedrate hasthemostdominant effectonthrustforce& edepthof cutisthemost thesignificantfactorfor cutting
A.Saravanakumaret al.(2018)	Optimizationof CNC TurningParameters	Aluminum 6063	Speed,feed& DOC	Surfaceroughness	Taguchi	Thefeedisthe majorinfluencing parametersamongthethree controllablefactors
SuneelKumarRathoreet al. (2018)	Determinationof optimumparametersin CNCturning	Aluminum 6463	Spindlespeed, feed,DOC& Coolant	Surfaceroughness	GRA,PCA	Quantitativeinvolvementsof the differentfactorsare15.33%of SS,3.06%of FR,0.40%ofDoc, and30.87%of
VijayKumaretal.(2018)	Optimizationof MachiningParameters inCNCTurning	SS(EN19)	Lubrication,feed, DOC&spindle speed	SR&MRR	Taguchi	MRRincreasewiththeincreasein feed&SRdecreasewithincrease inDOC&speed
BikramJitSinghetal.(2017)	Parametric optimizationof CNC turning	Al7020	Cuttingspeed, feed&DOC	SR&MRR	RSM	Bestturningparameters foundfor maximumMRRandminimumSR are:-cuttingspeed=167m/min, feed=0.1 mm/revanddepthofcut=2.0 mm
M.Nataraj&K. Balasubramanian(2017)	Parametric optimizationof CNC turningprocess	LM6aluminum alloy	Cuttingspeed, feed&DOC	Work-tool interface temperature,SR& Vibration	ANOVA	Feedwasthe majorcontributorfor vibration&Docandcuttingspeed werethe majorcontributorsto surfaceroughness.
FrankoPuhetal.(2016)	OPTIMIZATIONOF MACHINING PARAMETERSFOR TURNING OPERATION	Carbonsteel Ck45	Cuttingspeed, feed&DOC	SR&MRR	GRA	Surfaceroughnessandmaterial removalatcuttingspeedof V= 400m/min,feedrateof f=0,1 mm/revanddepthof cutd=1,2

RRudrapatiet al.(2016)	Optimizationof processparametersin CNCturning	Aluminu m Allo y	Spindlespeed, feedrate&DOC	SR	RSM&TLBO	Optimalparametriccon dition spindlespeed=700rpm ,feedrate =25 mm/minanddepthof cut= 0.2 mmand
SinghMKetal. (2015)	Optimizationof ProcessParameterson CNClathe	Al-6082T-6	Feed,speed& DOC	SR	Taguchi	Depthof Cuthadminimumimpac t onSurfaceRoughnessc ontributing
MuratSarıkayaetal.(2015)	Multi-response optimizationof MQL parameters	Haynes25	Cuttingfluid,flow rate&cutting speed	TWR,SR	GRA	MQLparameterslike cutting speed,cuttingfluid,an dfloware thesignificantfactors affecting toolwearandsurfacer oughness
MuratSarıkayaetal.(2014)	Analysisofmachining parametersinCNC turning	AISI1050	Cuttingspeed, feed&DOC	SR	Taguchi& RSM	Feedrate andthecoolingconditio n havethehighestinfluenc eon machinedsurfacerough
K.Chandrasekaranet al. (2013)	PredictionModelfor CNCTurning	AISI316	Cuttingspeed, feed&DOC	SR&TWR	RSM	Theresponsesurfacemo delforSR andTWaredevelopedfr omthe observeddatathepredict edand measuredvaluesarefairl yclose.
IlhanAsiltürk&SüleymanNe seli (2012)	Multiresponse optimizationof CNC turningparameters	AISI304	Cuttingspeed, feed&DOC	SR	Taguchi& RSM	BothTaguchiand responsesurface statisticalanalysesindic atedthat themaineffectof
S.Ranganathan &T. Senthilvelan(20 11)	Multi-response optimizationof machiningparameters inhotturning	stainlesssteel (type316)	Cuttingspeed, feed,DOC &workpiece temperature	SR,MRR& Tool life	GRA	cuttingspeedat 113.1 m/min,feed rateat 0.381mm/rev,and workpiecetemperaturea t 400°C willgivetheoptimumres
AmanAggarwaletal.(2008)	Optimizingpower consumptionforCNC turnedparts	AISIP-20	Cuttingspeed, feed,DOC, Environment&N oseRadius	Power Consumption	Taguchi& RSM	Taguchi'stechniquere vealedthat cryogenicenvironment isthe most significantfactor&RS Malso revealedthatcryogenic

3. Experimentation

3.1 Material Selection

Table 1 Chemical Composition

Constituent	C	Si	Mn	P	S
%Composition	0.16-0.18%%	0.25%	0.30%	0.040%Max	0.040%Max

Table 2 PhysicalProperties

Sr.No	Properties	Metric
1	Density	7.85g/cc
2	MeltingPoint	2600˚c

Table 3Mechanical Properties

1	MaxStress	400-560n/mm^2
2	YieldStress	300-440n/mm^2Min0.2%
3	ProofStress	280-420n/mm^2Min
4	Elongation	10-14%Min

3.2 Methods

Experimental design methods are too complex and are not easy to use. A large number of experiments have to be carried out when the 86 number of process parameters increase. To solve this problem, the Taguchi method uses a special design of orthogonal arrays to study the entire parameter space with only a small number of experiments.

Table 4: TaguchiL9runsofexperimental design

Run	Speed (mm/min)	Feed (mm/rev)	DepthOfCut (m/min)
1	500	0.1	0.2
2	500	.02	0.4
3	500	0.3	0.6
4	1000	0.1	0.4
5	1000	0.2	0.6
6	1000	0.3	0.2
7	1500	0.1	0.6
8	1500	0.2	0.2
9	1500	0.3	0.4

After completion of experimentation, surface roughness of 9 specimens measured. Their results are given in table:

Table 5: TaguchiL9runsofexperimental design

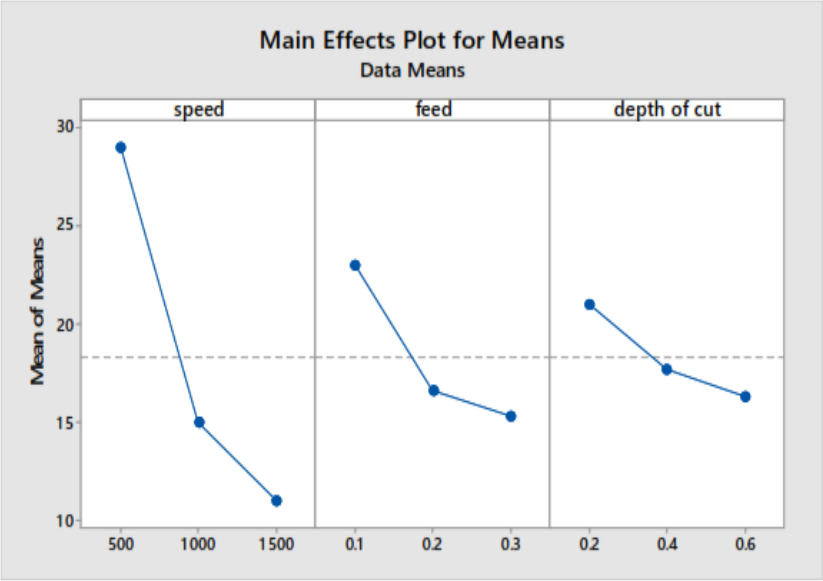
Exp. No.	Speed (mm/ min)	Feed (mm/rev)	DepthOfCut (m/min)	Surfaceroughness (Ra)	Time (Seconds)
1	5	0.1	0.2	5.021	39
2	5	0.2	0.4	5.937	25
3	5	0.3	0.6	6.431	23
4	1	0.1	0.4	5.579	18
5	1	0.2	0.6	5.675	14
6	1	0.3	0.2	5.024	13
7	1	0.1	0.6	5.606	12
8	1	0.2	0.2	5.41	11
9	1	0.3	0.4	5.619	10

Three super plastic forming parameters are considered as controlling factors. They are Pressure,Temperature and Time.Each parameter has three levels–namely low, medium and high, denoted by 1, 2 and 3 respectively. According to theTaguchi method, if three parameters and 3 levels for each parameter L9 orthogonal array should be employed for the experimentation. Orthogonal Arrays(often referred to Taguchi Methods) are often employed in industrial experiments to study the effect of several control factors.

MethodologyforAnalysisof changingParameter

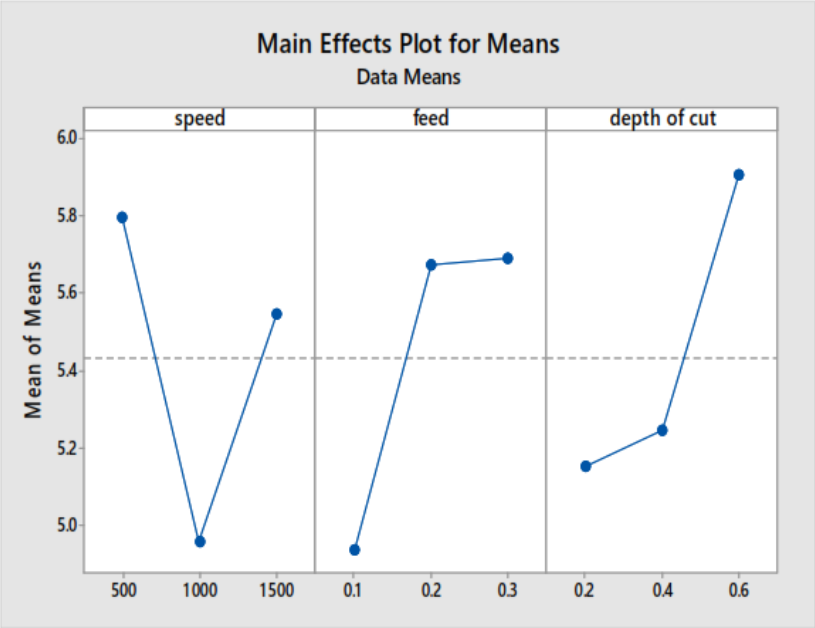
*Surface Roughness:*A digital Surface Roughness Tester is used for measuring the roughness of the work pieces after machining.Roughness is a measure of the texture of a surface. It is quantified by the vertical deviations of a real surface from its idealform. If these deviations are large,the surface is rough; if small, the surface is smooth. Surface roughness is denoted by S Rinth is report.

1) MainEffectsPlot forMeansforTIME



Main effects plot for means for Time

2) MainEffectsPlot forMeansforSurfaceRoughness



4. Conclusion

The optimum levels of parameters for minimizing the surface roughness were determined from the response table for Signal-to- Noise ratios.The best combination was obtained with:

1) Cuttingspeed
2) Feedrate
3) Depth of cut toconfirm the effectiveness of our optimization, we followed two ways:
a) Confirmation experiment,
b) Development of regression model with interactions between parameters.

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