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Process parameter optimisation of steel components laser forming using a Taguchi design of experiments approach

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EXTERNAL EXAMINER'S CO

Page	Paragraph	Corrections
4		Title should be "Table c matter e.g Abstract sho Table of Contents Secti should be number as 2.
5		First secion of Chapter corrected to 3.1
6		Appendices should not l continuation of the mai report. Change to A.1, l
7		Correct consitency of th Figures
11		Appendix figures should differently
13		Appendix tables should numbered differently
14		Include list of symbols
15	2	In line 7, Clarify the te clear what that refers t
16	1	Change "Figure 1" to "F
16	2	Change "Figure 1" to "F
18	2	In 3rd line correct "Las

19	2	In 6th line change "stre and "strain'' to "strains
21	1	In line 1 delete "J.D" a change "for" to "on"
21	1	In line 6 change "positi
21		Revise Table 1-2 captio caps e.laser and stainle
22		Change "Figure 1.-1" to
23	1	In line 6, change "spee line 8 delete "a" and ch "angles"
24		Change "Figure 1-2" to
24	1	In line 1 change Figure 4"
24	1	In line 3 insert a full st

25		Change Figure caption f to "Figure 1-5"
26	1	Consider revising first s improve clarity.
28	1	In line 10 "bends" to "b
28		Change section number
29		Change figure caption f 1" to "Figure 1-6". Appl all other figuresin the r
29	2	In last line change"Figu "Figure 1-6"
30		Change section number "1.3.2"
30	1	In line 3 delete "a", ins "d" and change "refer" t
30	2	In line 2 clarify the "0 c
31		Revise last sentence
33		Indicate source of all th show refernce.
34		Change figure caption f to "Figure 1-8"
34		Give references for the

37	1	In line 3, replace "in" w
36		Change the numbering c follow the same style a
38	1	In line 3 change"than70 7000rpm"
38	2	In line 3 change "built"
38	3	In line 5 delete "and"
38	3	In line 6 change "Figure appropriate figure numb
39		Change numbering for "
39	1	In line 3 change "direct "directions are as". Fig
40	1	In line 1 check figure n
40	1	In line 2 remove author

41		Change figure number
41	1	In line 2, change "Howe "However, as too"
42		Change figure number
43	1	In line 1, change "from 100"
43	2	In line 1, delete"resear
43		Change figure numbers
44	1	In line 1, change "High"
44	1	Change "&" to "and"
45		No need for table with parameter. Remove Tab
45		Change Table numbering
46		Change figure numberin
47		Change figure numberin

49	2	In line 3, change "be re "resulted from"
50		Change figure numberin
51	1	In line 2, change "whicl failure" to" which resul
52	2	In line2, change "Furthe Furthermore,"and "throu
52	2	In line 7, replace "cove "presented".

53	1	In line 2, replace "in" w
53	2	In line 2, replace "finis
54		Change section number "2.1"
54	1	Last line, Table 2.3-1 h
55		Caption for Figure "1.1- changed to "Figure 2.1"

55	1	In line 2, change "spaci In line3, change "spacir In line 6, delete "below
56		Change caption for "Fig "Figure2&"
57		Correction figure numbe Figures included in this for actual equipment us reference sources.
58	1	In line 1, delete "A" and "microanalysis" to "Micr

58		Correct figure caption n
58	2	Change "school of mech engineering" to "School Engineering"
59		Correct figures caption
60		Correct figure caption n
60	2	In line 4, delete "is" an "representing" with "rep
60	2	In line 5, replace "repre "presentng".
61		Correct figure caption n

61	1	In line 1, delete "Test" In line 5, change "repre "presents the".
62		Correction figure captio
63	1	In line1, give reference
64		Correct table caption nu
64	3	In line 2, delete "to est

65		Correction table captior
66	1	In 3rd from last line, re clear
67	1	In line 2, remove power
68	2	In line 2, remove power
73	1	In line 2, correction the especially 3.42
74		In Figure 3.4-1, correct key
82	2	Last line, revise senten
88	1	In line3, correct the fig is no Figure 25
95	2	In last line, delete first
104		Mean values of roughne Correct.
124	2	Correct bullet number, at 3.

Correct figure caption n

126 are two different numbe

Clean up references lis

141 name is done in referen

EXAMINER 2

Comments
1. Title is changed to "T
2. Abstract is included i Contents
3. Chapter 2 numbering i be 2.1, 2.2, 2.3, etc.
First secion of Chapter 3 to 3.1 "3.1 1 Laser Beam Laser Beam Forming"
Appendices numbering is A.1, B.1, C1, and D.1 "B Procedure Data"
The numbering of figures consistant, to reflect the section.
The numbering of figures changed tofollow this se B.1 Line Chart of Sample a Function of Position, o Parameters"
This is the new appendix A.1 Experimental Equipm
List of symbolys is included refer to page 13
This was meant to be las sentence is now correcte
Consequently, the laser strains, bending the mat source which is mainly u straightening and curvin components"
Figure 1 in paragrah 1 h to "Figure 1 1 Schemati Beam Forming process [1
"Figure 1" in paragrah 2 to "Figure 1-1"
3rd line in paragrap 2 ha from "Laser" to "The lase diameter B, scan velocity scans N, and the cooling important process param process."

In 6th line changes were
"stress" to "stresses" an
"strains" see " The area
where the laser beam is
introduced, the stresses
tensile"
In line 1 "J.D" has been
has been changed to "on
laser bending of AISI 30
sheet using a high power
continuous wave CO2 las
beam diameter was looke

In line 6 "position" was
micro-hardness of the be
different positions was c
using a Vickers micro-ha
The caption for Table 1-
to have all initial caps "
Process Parameters (She
Power density, Scan spe
passes) Employed in las
304 stainless Steel [7]"
"Figure 1-1" is changed
Variation of angle of ber
speed in laser bent AIS
sheet with a thickness o
(b) 0.9 mm, respectively
numbering sequence bec
was numbered incorrectl

In line 6, change "speed
range of scan speeds us
1.6mm thick sheet withou
effect of surface evapora
500 mm/min 3000 mm/mi
delete "a" and change "a
results are significantly
compared to those achie
angles of a 0.9mm thick
between (3500 mm/min 7
"Figure 1-2" has been c
1.1-2" to follow the same
sequence
In line 1 Figure "1-2" is
1.1-2" to follow the same
sequence
A full stop after P In line 3 is inserted .

Caption on "Figure 1-3"
to "Figure 1.1-3" to follo
numbering sequence
The sentence is revised
reveals that one of the m
factors concerning the w
process is the sheet thic
literature indicates that
important factors concer
process is the sheet/mat
In line 10 "bends" is changed to "bend"
Section number "1" is changed to "1.3.1"

Figure numbering sequen
followed by the subsecti
in this instance, the figu

Figure numbering sequen
followed by the subsecti
in this instance, the figu

Section number "II" is changed to "1.3.2"
In line 3 "a" was deleted
"d" was inserted and "re
to "Refer"

It is assumed that the in
of zone 1, 2 and 3 remain
the introduction of the h
The initial sentence is c
"fin as "expansion value of
"The equation for the fin
"value of zone 1, shortenin
value"

The equations are referenced [22, 23]

Figure numbering sequen
followed by the subsecti
in this instance, the figu
Equations are referenced
temperatures of the top
surfaces of the LBForme
[22, 23]:
"

In line 3, "in" is replace
"Similarly, a significant
enhancement at forming
AZ80 magnesium alloy sh
achieved at a tool rotati
8000rpm [40]."
Table numbering is chan
same style as that of Fig
Heat-assisted SPIF meth
In line 3 change"than700
to "than 7000rpm" see "T
showed that the material
dramatically improved du
rising and dynamic recry
tool rotation speed was
7000rpm."
In line 3 change "built" v
developed" see"With this
increase of material form
observed and formability
developed at the varying
rotational speeds". This
37
"and" n line 5 is deleted
page 37
The numbering of "Figure
with the numbering syste
actually in page 37
The numbering of "Figure
with the numbering syste
actually in page 38
In line 3 "directions as"
"directions are as". Figu
corrected to Figure 1.4-2
page 38
In line 1 figure number i
"Figure 1.4-2". This is a
In line 2 author initials
Previously "In a study do
W. Wu [48], the forming
into the blank sheet, Fz
instantaneously introduc
gradually increased until
reached".now "According
in the literature [48], the
indented into the blank s
instantaneously introduc
gradually increased until
reached."

The numbering of "Figure
with the numbering syste
In line 2, "However, tool
"However, as too". This
40.
figure number is correcte
5".
In line 1, "from 100" is
100". This is actually in
"Mild Steel was preferre
investigation because it
common steels and one o
expensive steels availab
Steel was preferred for t
because it is one of the
steels and one of the lea
steels available"
The numbering system is
chapter number, and sub
the numbering sequence
"i. Reasonable strength-to-weight
High stiffness-to-weight is no
changed to "i. Reasonable streng
weight ratio & high stiffness-to
ratio" This is actually in
"iii. Very cheap, easy to shape, &
weld" is now changed to "iii. Very che
easy to shape, and easy to weld. This
actually in page 42
"Table 21 Physical proper
1008 Carbon Steel [50]"
replaced with " The phys
AISI 1008 carbo steel
(composition 0.06%C, 03
annealed at 925oC is 7.8
or 0.2844 lb/in3."
Table numbers are chang
correct sequence after T
removed.
Figure numbering are fol
sequence, chapter and s
Figure numbering are fol
sequence, chapter and s

"In physical experiments
be resulted due to measu
while in computer experi
noise is a result of the i
convergence of iterative
off errors, or the discret
of continuous physical p
now changed to "In phys
inaccuracy can result frc
measurement errors, whi
experiments, numerical r
the incomplete converge
processes, round-off err
representation of continu
phenomena [54]" This is
48.
figure number is correcte
1" and it is in line with t
equence.

"LBF is a fast forming pr
requires no tooling, but
surface quality which is
in obtaining optimum ber
motivated this research.
is a fast forming process
tooling, but poor materia
which resulted from failu
optimum bending is what
research. " This is actua
"Furthermore the hardne
carried through to deterr
process parameters have
material hardness." is ch
"Furthermore, the hardne
carried through to deterr
process parameters have
material hardness. " This
50
"The RSM is covered in Chapter 5, whi
chapter 6 is the concluding chapter
now changed to "The RSM is presented
Chapter 5, while chapter 6 is th
concluding chapter. This is actual
page 51

"This chapter gives a ge
this research together w
experimental optimisatio
experimental procedures
investigation. " is now c
chapter gives a general
research together with th
optimisation and experim
used in the investigation

"The samples are AISI 1(
this research is focused
process parameters to ac
bending with excellent s
now changed to "The sam
1008 mild steel and this
focused on optimising LB
parameters to achieve m
with excellent surface fi
Section number has been
"1.1 Introduction to "2.1
This is actually in page
"The quantities that are
each level for a specific
LBF process are also pre
1 of section 2.3-1 of this
is presented in page 63.
"Figure 1 1 Figure 4 1 A 4.4
laser system Rofin D
changed to "Figure 2.2 1
kW Nd: YAG laser system
This is actually in p

In line 2, " Each sample
machined by passing a la
parallel spacing, set at 1
the width of the surface
sample" has been change
sample is identically mac
a laser light at equal pa
at 10 mm apart along the
surface area of each sam
In line 3, "The distance
spacing (laser scan tracl
the laser heated zone do
with the next laser scan
changed to "The distance
spacings (laser scan trac
that, the laser heated zo
overlap with the next las
In line 6, "Figure 2.2-2 b
presentation of LBForme
samples that are machin
2 and 3 quantities for th
LBF process parameters.
deleted "Figure 2.2-2 is
LBFormed experimental s
machined using levels 1,
for the five mentioned LB
parameters."
"Figure 2.2A 200 x 50 x 3
steel -AISI 1008 LBF S
changed to "Figure 2.2
mm3 mild steel -AISI 10
This is actually in p
Figure number is corre
2.2B Mahr Dial Indicator,
(cm) Steel Ruler, Square
Clamp" and these are ac
used. This is actually
"A microanalysis was do
samples for further inv
verification of the resul
the LBF process param
changed to "Microanalys
LBFormed samples fo
investigation and verific
generated from the LB
parameters." and the "A"
actually in pge 57

Figure caption number h
to "Figure 2.2 4 A 200 x
steel -AISI 1008 LBF Sa
Sectioned ". This is act

"The NSM V horizontal
from the "school of m
engineering" was used t
x 3 mm3 AISI 1008 mild
samples to 65 x 20 x 3 r
to fit on the stage of th
now chaged to "The NS
milling machine from t
Mechanical Engineering'
the 200 x 50 x 3 mm3 AI
laser formed samples to
that are able to fit on t
microscope. " This is a

Figure caption has bee
"Figure 2.2 5 The NSM-V
machine" This is actul

Figure caption number h
to "Figure 2.2 7 Leica T
microscope."
"Figure 2.2-9 is repres
Tech FM-700 micro-hard
now changed to " Figure
the Future Tech FM-700
tester. "
"Figure 2.2-9 is repres
Tech FM-700 micro-hard
now changed to " Figure
the Future Tech FM-700
tester. "
Figure caption number is
"Figure 2.2 9 Future Tec
hardness tester"

"The following discussion and
equipment and tools that were use
during the MMU, HV Test, the Tagu
DOE, and the RSM mode FRONT Test
analysis of LBF Formed samples."
"The following discussion and
equipment and tools that were use
during the MMU, HV, the Taguchi DO
and the RSM mode FRONT Test
analysis of LBF formed sa
In line 5, representing my
"Figure 2.2-7 presents th
Confocal microscope, Figure 2.2
presents the FEI Quanta FEG-
microscope. The details of the MMU are
Chapter 4 of this report.

Figure caption number
follow the correct numb
"Figure 2.2 9 Future Tec
hardness tester"
Line 1, has been referen
design philosophy, deve
Taguchi in the late 19
The table caption numb
follow the same sequen
system as the figures, c
the sub-section. "Table
Orthogonal Array Sele

"This means by using the
where there are five pa
these parameters and t
establish to establish t
(5x3!)-3 samples will be
than the 729 samples tha
to be assessed for a ful
Table 2.3-2" the repeat
deleted "This means by
Method where there are
under these parameters
to establish the DoE, o
samples will be assesse
729 samples that would
assessed for a full facto
2.3-2"

Table caption number ha
to follow the numbering
2.3 2 Taguchi L27 ortho
used experimental pa
optimisation"
"The ability of this tool
the selection of the best
now changed to "modeFR
deriving the selection of
population from those wh
from the DOE."
power 3, in line 2 is removed
power 3, in line 6 is removed
The figures citations are
follow the numbering seq
Figure 3.4-1, 3.4-2, and
Repeatition is has been
"Figure 3.4 1 Graph of S
Displacement as a Funct
Low/Level 1 LBF Parame

"Consistency in sample b
also observed by non-ov
sample bending results b
parameters i.e. level 1 L
have the least bending w
that are found to be in t
the level 2 sample bendi
increment reading." is n
"Non-overlapping of sam
results i.e. the results d
LBF parameters do no co
derived from samples LB
LBF parameters. "
Figure 25 has been corre
focus knob shown in Figu
to focus the sample."
"Thethe continubouts cansinFigu
4.3-v5 asclickfeodrthemicroscto
captutheallimageisntheabo
selectseedrieasngaesin4.6-2h"ei
now

Mean amplitute verified and is correct.
Bullet numbers are now
starting at 1 "1. Create
Microsoft Excel that has
and the response values
2)."

"Figure 15: Figure 4 1 Scre
show the mode FRONTIER
creation tool; the defini
outputs, algorithm and
surface that is generate
Space" is now changed
Screenshots to show the
response surface crea
definition of the inputs,
and the response surface
in the Design Space" ar
been deleted
First names are now rem
1 and 3.