بسم اللّه الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

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Cairo University

OPTIMIZATION OF SYNCHRONIZATION PARAMETERS FOR HYDROFORMING T-TUBE PROCESS

By

Moataz AbdelGawad Mohammed AbdelGawad

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
in
MECHANICAL DESIGN AND PRODUCTION ENGINEERING

FACULTY OF ENGINEERING, CAIROUNIVERSITY
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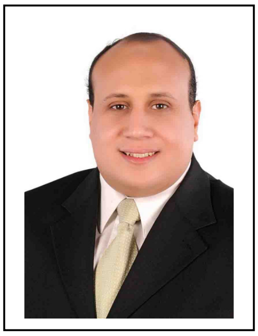

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Title of Thesis:

OPTIMIZATION OF SYNCHRONIZATION PARAMETERS FOR HYDROFORMING T-TUBE PROCESS

Key Words: Tube hydroforming; Machine learning; Multiple ridge regression; Loading path; Wrinkling

Summary:
An adaptive, heuristic, nonlinear mathematical model (AHNM) was proposed to optimize the loading path of a hydroforming process as a result of adaptive minimization of the internal pressure and axial load of the process. FEA was used to analyse the process, also this research examined several Machine Learning algorithms such as; Multiple Ridge Regression and Random Forest to learn the relations between the features. The linearity between the features was assumed to create simple AHNM model, where the Multiple Ridge Regression was found to give the highest accuracy. AHNM model was implemented, solved, and optimized using several steps of tee protrusion height. A new Test Rig was developed to experiment the validity of the obtained loading paths for different thicknesses of tube. This research applied the machine learning in this process for the first time, and confirmed that creation of the (AHNM) modelling was successful application.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

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All praise to Allah, the almighty who made me accomplished this research

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Nomenclature

Symbol	Description
AL_t	Axial load at time t
AS_t	Maximum axial stress within the area of the non-circular protrusion at time *t*
DT	Decision Tree algorithm
FEA	Finite Element Analysis
FEM	Finite Element Modeling
HS_t	Maximum hoop stress within the area of the non-circular protrusion at time *t*
IE_t	Average internal energy of the whole deformed part at time *t*
IP_t	Internal pressure inside the tube at time *t*
KE_t	Average kinetic energy of the whole deformed part at time *t*
MAS	The maximum allowable deformation stress
MAT	The maximum allowable thickness
$MaxT_t$	Maximum thickness at the area of the non-circular protrusion at time t
MD_t	Maximum vertical displacement within the area of the non-circular protrusion at time *t*
$MIAS$	The minimum allowable deformation stress, and the
$MIAT$	The minimum allowable thickness
ML	Machine Learining
$MinT_t$	Minimum thickness at the area of the non-circular protrusion at time t
MS_t	Maximum principal strain within the area of the non-circular protrusion at time *t*
MT_t	Minimum thickness at the area of the non-circular protrusion at time *t*
N	Total number of periods
n	Material hardening exponent
PP_t	Punch pressure at time *t*
RF	Random Forest algorithm
T-Tube	Tube with lateral protrusion
T- protrusion	Lateral protrusion of Tube
t	Time period
$\varepsilon_{critical}$	The critical strain at which instability occurs
σ_{axial}	The axial stress within the tube
σ_{hoop}	The circumferential stress within the tube