Arab Republic of Egypt
Ministry of Defence
Military Technical College

10th International Scientific Conference of
The Military Technical College
7 - 9 July, 2020

المؤتمر الدولي العاشر للكلية الفنية العسكرية

Conference Program of
The 19th International Conference on Applied Mechanics
and Mechanical Engineering,
(AMME-19)

برنامج
المؤتمر الدولي التاسع عشر في الميكانيكا التطبيقية والهندسة الميكانيكية

Cairo 2020
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PREFACE

The Military Technical College has the pleasure to organize the 19th International Conference on Applied Mechanics and Mechanical Engineering, (AMME-19) which is sponsored by the Ministry of Defense in the period 7-9 July, 2020.

The main objective of this conference is to bring together scientific researchers and engineers of Egyptian armed forces and their colleagues in the international academic and industrial institutions. This occasion provide a chance to exchange information in the following designated fields of interest:

1- Mechanical Power Engineering (MP)
2- Robotic, Automation and Control (RC)
3- Dynamics and Vibration (DV)
4- Material Science and Processing (MS)
5- Production Technology (PT)
6- Solid Mechanics (SM)
7- Mechanical Design (MD)
8- Automotive Engineering (AE)
9- Mechatronics (MC)
10- Ballistics (BL)
11- Acoustics and Noise Control (AN)

From the 70 manuscripts submitted to the conference secretary, 49 papers have been accepted. These selected papers will be presented during the conference interval 7-9 July 2020 in 11 sessions.

Finally, the conference committee hopes that the conference will achieve its planned mission and would like to acknowledge all contributors, members of scientific committees, chairman and board members of the conference sessions.

Note:
Please remember that you have only 15 min. to present your paper and 5 min. for discussion.

Prof. Dr. Shawky A. Hegazy
AMME-19 Conference Rapporteur
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   - Technical Research and Develop. For Armed Forces
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CONFERENCE PROGRAM
| Time          | Session 1                      | Session 2                          | Session 3                                      | Session 4                           |
|---------------|--------------------------------|------------------------------------|------------------------------------------------|------------------------------------|
| 9:00 - 10:45  | Ballistics I (4)               | Mechanical Power Engineering I (4) | Automotive (2) / Mechanical Design (3)         | Material Science and Processing I (6) |
| 001_AMME-19   | 005_AMME-19                    | 009_AMME-19                        | 014_AMME-19                                    |                                   |
| 002_AMME-19   | 006_AMME-19                    | 010_AMME-19                        | 015_AMME-19                                    |                                   |
| 003_AMME-19   | 007_AMME-19                    | 011_AMME-19                        | 016_AMME-19                                    |                                   |
| 004_AMME-19   | 008_AMME-19                    | 012_AMME-19                        | 017_AMME-19                                    |                                   |

Tuesday 7 July 2020

Ballistics I
Mechanical Power Engineering I
Mechanical Design
Material Science and Processing
Program of the 19th International Conference on Applied Mechanics and Mechanical Engineering (AMME-19)

| Wednesday 8 July 2020 | 9:00 - 10:45 | 11:00 - 12:45 | 13:00 - 14:45 | 15:00 - 16:45 |
|-----------------------|--------------|---------------|---------------|---------------|
| Dynamics and Vibration I (5) | Material Science and Processing II (5) | Ballistics II (4) | Dynamics and Vibration II (4) |
| 020_AMME-19 | 025_AMME-19 | 030_AMME-19 | 034_AMME-19 |
| 021_AMME-19 | 026_AMME-19 | 031_AMME-19 | 035_AMME-19 |
| 022_AMME-19 | 027_AMME-19 | 032_AMME-19 | 036_AMME-19 |
| 023_AMME-19 | 028_AMME-19 | Break | Break |
| 024_AMME-19 | 029_AMME-19 | | |
| Time            | Session                                                                 |
|-----------------|-------------------------------------------------------------------------|
| 9:00 - 10:45    | Mechanical Power Engineering II (4)                                      |
|                 | 037_AMME-19                                                             |
|                 | 038_AMME-19                                                             |
|                 | 039_AMME-19                                                             |
|                 | 040_AMME-19                                                             |
| Break           |                                                                         |
| 11:00 - 12:45   | Mechatronics (1) / Robotic Automation and Control (3)                    |
|                 | 041_AMME-19                                                             |
|                 | 042_AMME-19                                                             |
|                 | 043_AMME-19                                                             |
| Break           |                                                                         |
| 13:00 - 14:45   | Production Technology (5)                                               |
|                 | 045_AMME-19                                                             |
|                 | 046_AMME-19                                                             |
|                 | 047_AMME-19                                                             |
|                 | 048_AMME-19                                                             |
|                 | 049_AMME-19                                                             |

Program of the 19th International Conference on Applied Mechanics and Mechanical Engineering (AMME-19)

Thursday 9 July 2020
SCIENTIFIC SESSIONS
**Session No. 1**  
**Ballistics I**

**Room:** A  
**Date:** Tuesday 7/7/2020  
**Time:** 900 : 1045

**Board:**  
- **Prof. Dr.**  
  Ahmed Mohamed Reyad  
  M. T. C.

- **Assoc. Dr.**  
  Mahmoud Yehia Mohamed  
  M. T. C.

- **Col. Dr.**  
  Moustafa Samir Mohamed  
  M. T. C.

| Session Code | Title | Authors |
|--------------|-------|---------|
| 001_AMME-19  | Experimental investigation of star grains in dual thrust solid propellent motors | M El-Naggar, H Belal and H Abdalla |
| 002_AMME-19  | Mitigation of irregular burning in a small solid propellent rocket motor | M Elkshen, H Belal and M Allam Al-Sanabawy |
| 003_AMME-19  | Validation of a Simplified Model for Liquid Propellant Rocket Engine Combustion Chamber Design | M Hegazy, H Belal, A Maklad and M Allam Al-Sanabawy |
| 004_AMME-19  | Validation of relations for the determination of pyrotechnic igniter mass | A Salama, H Belal and H Abdalla |
Experimental investigation of star grains in dual thrust solid propellant motors

M El-Naggar¹, H Belal¹ and H Abdalla¹

Abstract
One of the great challenges in designing tactical solid missiles is to achieve high acceleration in the boost phase then maintaining constant speed during the sustain phase. This could be achieved by using a dual thrust solid-propellant rocket motor. Many of these tactical motors use a combination of star, tubular or finocyl grains to achieve this profile. The present study uses two tandem star grains with different design parameters and different transition geometry. Previous researches had consistently shown that the main advantage of star grain is the potential higher volumetric loading in addition to high tailorability. The pressure-time curve for the designed grains is calculated using a zero-dimensional internal ballistic module and a small-scale test motor is used to verify the calculated pressure-time curve. Different transition geometries are compared. Tapered transition is shown to give a comparable performance with the sharp transition with the advantage of higher volumetric loading.

¹Egyptian Armed Forces
Mitigation of irregular burning in a small solid propellent rocket motor

M Elkshen1, H Belal1 and M Al-Sanabawy1

Abstract
An irregular burning phenomenon arises in some solid propellant motors (SRM), where the time-averaged pressure differs largely from that dedicated by instantaneous area burning. This phenomenon is generally considered the result of the interaction of pressure disturbances within the motor cavity with solid propellant deflagration. Hence, it is a combustion-dependent acoustic phenomenon. Historically, different suppression devices included the classical resonance rods and paddles, and arrays of acoustic resonators and various baffle arrangements were applied. In this paper, irregular burning which arises in a modification of a shoulder-launched rocket is investigated. Several techniques dealing with the irregular burning problem were attempted. In each case, the signal of pressure was analysed in the time domain through time average and AC pressure signal, and in the frequency domain through Fourier transform and power spectral density. The most successful technique was the drilling of holes through the grain, connecting the perforation to the external burning region of the cylinder. Next was the increasing of blocking factor, both methods lead to stabilizing the modified motor.

1  Egyptian Armed Forces
Validation of a Simplified Model for Liquid Propellant Rocket Engine Combustion Chamber Design

M Hegazy¹, H Belal¹, A Maklad¹ and M Al-Sanabawy¹

Abstract
The combustion phenomena inside the thrust chamber of the liquid propellant rocket engine are very complicated because of different paths for elementary processes. In this paper, the characteristic length (L*) approach for the combustion chamber design will be discussed compared to the effective length (L_eff) approach. First, both methods are introduced then applied for real LPRE. The effective length methodology is introduced starting from the basic model until developing the empirical equations that may be used in the design process. The classical procedure of L* was found to over-estimate the required cylindrical length in addition to the inherent shortcoming of not giving insight where to move to enhance the design. The effective length procedure was found to be accurate within ± 10%.

¹ Egyptian Armed Forces
Validation of relations for the determination of pyrotechnic igniter mass
A Salama¹, H Belal¹ and H Abdalla¹

Abstract
Propellant ignition is an essential process in solid rocket motor operation as it is responsible of starting the combustion and to reliably self-sustain burning of the solid propellant. Despite the importance of igniter design and ignition process, the relations dealing with igniter mass determination are not well studied and not validated against actual motors with a systematic variation of parameters. The main objective of the current research is to validate the available equations in open literature for determination of the mass of igniter pyrotechnic charge. Data from seven real solid propellant rocket motors were used to validate the relations. These motors have different sizes, grain geometries and pyrotechnic compositions. The results show that the equation of Brayan–Lawerene has the smallest root mean square error (RMSE), and so, it is considered more convenient.

¹ Egyptian Armed Forces
Session No. 2

Mechanical Power Engineering I

Room: A
Date: Tuesday 7/7/2020     Time: 1100 : 1245

Board:
Maj.Gen.(r) Prof.     Former
Salman E. El-Shamarka  Command. of
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Maj. Gen.(r) Assoc. Prof.     M. T. C.
Ahmed Mohamed Rashad
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Mohamed Ibrahim Amin

| Paper No. | Title                                                                 | Authors |
|-----------|----------------------------------------------------------------------|--------|
| 005_AMME-19 | Simplified algorithm for determining injection duration to achieve fast response in SI engines | Omer Shawky |
| 006_AMME-19 | The effect of rectangular Gurney flap on Wells turbine performance | A T M Kotba, M A A Nawarb and R M Abd El Maksoud |
| 007_AMME-19 | Numerical Studies of Turbulent Premixed Flame Interaction with Repeated Solid Obstacles | M Elshimy, S Ibrahim and W Malalasekera |
| 008_AMME-19 | Development of rotary heat exchanger model to investigate performance with integrating controller | A M Ghoneim, M H Aly and O E Mahmoud |
Simplified algorithm for determining injection duration to achieve fast response in SI engines

Omer Shawky1

Abstract
For modern SI engines, the injection duration and its timing are one of the most important parameters which influence the mixture homogeneity, emissions, combustion efficiency, and engine response. In the present work, a simplified port fuel injection system with its driver algorithms was designed to control the injection duration and its timing. The Calibrated Dose method is used in this system instead of the stream mixing method. Therefore, the injected fuel mass is accurately computed according to the engine load, engine speed, engine operating condition, and the amount of air drawn into the engine. The system consists of a conventional port fuel injection system equipped with a micro-controller, a Throttle Position Sensor (TPS), a couple of Hall Effect Sensors (HES), load cell with its driver module, injector controller circuit, and a custom-made inlet port. The micro-controller is used to calculate the injection duration each engine cycle according to engine speed, amount of air drawn per cycle and engine load. The two HES are used to detect the injection timing and measure the engine speed. The TPS is used to monitor the throttle position angle so it can calculate the amount of air drawn into the engine at that time with respect to engine speed. The load cell and its driver module are used to measure the engine torque and consequently the brake power. The injector controller circuit is used to initiate the injection process at the perfect timing for the accurate duration.
The effect of rectangular Gurney flap on Wells turbine performance

A T M Kotba¹, M A A Nawarb² and R M Abd El Maksoudc³

Abstract

Wells turbine is very adept at converting pneumatic power from ocean waves into mechanical energy. However, such turbines incur from low performance, limited operating range and low efficiency. The present study introduces a method to enhance the power produced from Wells turbine by implementing rectangular Gurney flap (GF). The Gurney flap is placed on both pressure and suction sides of the trailing edge (TE) and perpendicular to the chord line without change chord length. GF increases the lift coefficient by altering the Kutta condition at the TE. The turbine performance is herein evaluated by solving numerically 3D incompressible Reynolds Averaged Navier–Stokes equations (RANS) by using ANSYS Fluent 19.0. The performance is demonstrated according to the flow coefficient, torque coefficient, total pressure loss coefficient, and the turbine efficiency, as well as the velocity and pressure fields around the turbine blades. The validation of the present work was achieved using previous experimental work and CFD work by using SST $k–\omega$ turbulence model. The present work showed that the Wells turbine augmented with GF increases the torque coefficient by 41.98%. Besides, the stall has been delayed compared with the conventional Wells turbine.

¹ Demonstrator, Mechanical Power Engineering Department, Faculty of Engineering, Mattaria, Helwan University, Egypt.
² Assoc. Prof., Mechanical Power Engineering Department, Faculty of Engineering, Mattaria, Helwan University, Egypt.
³ Assoc. Prof., Mechanical Power Engineering Department, Faculty of Engineering, Mattaria, Helwan University, Egypt.
Numerical Studies of Turbulent Premixed Flame Interaction with Repeated Solid Obstacles

M Elshimy¹, S Ibrahim¹ and W Malalasekera²

Abstract
This paper presents numerical simulations of hydrogen and propane turbulent premixed flames interaction with repeated solid obstructions. The laboratory-scale combustion chamber used in this study is equipped with three solid baffles which promote the generation of turbulence and a square obstacle located downstream from the ignition source. The test cases considered have two different area blockage ratios (ABR) of 24% and 50%, respectively. The large eddy simulation (LES) turbulence modelling technique is used. The numerical simulations are carried out using an in-house computational fluid dynamics (CFD) model. Two different flow configurations are examined, both using three consecutive baffles to identify the subsequent effects and the sensitivity of each fuel to increasing the ABR. These effects are studied using the nature of the flame-obstacles interaction, generated combustion overpressure and resultant flame speed. The modelling capability is confirmed by validating the numerical results against published experimental data. Conclusions are drawn that increasing the ABR increases the combustion overpressure, rate of pressure rise and flame speed. It is also concluded that the larger obstacle has a significant effect on the propagating flame structure and that hydrogen flames are more sensitive to an increased ABR and produce a significantly higher peak overpressure.

¹ Department of Aeronautical and Automotive Engineering, Loughborough University, Loughborough, LE11 3TU, UK
² Wolfson School of Mechanical, Electrical and Manufacturing Engineering, Loughborough University, Loughborough, LE11 3TU, UK
Development of rotary heat exchanger model to investigate performance with integrating controller

A M Ghoneim¹, M H Aly¹ and O E Mahmoud¹

Abstract

The heat wheel considers one of the best heat recovery devices with very high effectiveness, which leads to great savings in energy and operating expenses. This research study a novel dynamic model of a rotary heat exchanger automatically control the temperature of outlet air despite the operating conditions are changed. The model is implemented under MATLAB/SIMULINK environment to investigate the performance of the heat wheel considering the air properties changing during the operation. The transient effect of airflow rate, inlet air temperature and wheel rotational speed on the output temperature and effectiveness are discussed. The optimum rotational speed of a heat wheel was investigated for different operating conditions. The temperature distribution of air and matrix for one Full cycle of heat wheel were investigated. The model was validated based on data found in previously published experimental work. Results reveal that the effectiveness of the device is inversely proportional to the amount of flow, while it is directly proportional to the rotational wheel speed. The effectiveness is slightly affected by the inlet air temperature.

¹ Mechanical Power Engineering Department, Faculty of Engineering at Mataria, Helwan University, Cairo, Egypt
**Session No. 3**

**Automotive Engineering / Mechanical Design**

**Room:** A

**Date:** Tuesday 7/7/2020  
**Time:** 1300 : 14.45

**Board:**

- Prof. Dr. Nabil A. Gadallah  
  Modern Academy
- Maj. Gen. (r) Dr. Moustafa M. Abdel-Wahab  
  M. T. C.
- Prof. Dr. Shawky A. Hegazy  
  M. T. C.

| Paper No.  | Title                                                                 | Authors |
|------------|----------------------------------------------------------------------|---------|
| 009_AMME-19 | Handling Performance of an 8x8 Combat Vehicle                       | M Ahmed, M El-Gindy and H Lang |
| 010_AMME-19 | Evaluating the effect of shape on energy absorbing response of structures used in armored vehicles floors | Hesham kamel |
| 011_AMME-19 | Test rig design for upper-limb socket prosthetics at transradial amputation level | M M Bondok, M A El-Sheikh and M A El-Hadek |
| 012_AMME-19 | Design and manufacturing of a test rig for measuring the torque required in soil drilling operations | M A Abdeldayem, M E Abo-Elnor and M H Mabrouk |
| 013_AMME-19 | Assessment of steel wire's fatigue life using finite elements modelling and experimental testing | H M Lotfy, A B El Shabasy, T Attia and H A Hassan |
Handling Performance of an 8x8 Combat Vehicle

M. Ahmed¹, M. El-Gindy¹ and H. Lang¹

Abstract
In this research paper, the handling stability of an 8x8 combat vehicle will be assessed using two different control systems. The first technique utilizes a Torque Vectoring Controller (TVC) to control the vehicle yaw rate to meet the desired value. The second technique utilizes an Active Rear-axles Steering (ARS) to minimize the vehicle sideslip. TVC will be designed as a Single Input Single Output (SISO) control problem using a Sliding Mode Control (SMC) technique, while an Optimal Linear Quadratic Regulator (LQR) will be utilized to develop the ARS controller. The two controllers will be evaluated against a conventional vehicle with fixed rear axles. TruckSim software is used in corporation with Matlab/Simulink to implement and assess the controllers using Double Lane Change (DLC) over high and low coefficient of friction road surfaces at various speeds. The results give an insight into the driving conditions at which each controller is utilized and introduce a novel method to coordinate the integration between both controllers for integrated chassis applications.

¹ Automotive, Mechanical and Manufacturing Engineering, Faculty of Engineering and Applied Science, University of Ontario Oshawa, Ontario, Canada
Evaluating the effect of shape on energy absorbing response of structures used in armored vehicles floors

Hesham Kamel

Abstract

Improvised explosive devices (IEDs) are a major threat to the lives and wellbeing of soldiers transported in armored vehicles. The blast of an IED under vehicle body can cause severe injuries especially to the lower extremities of vehicle occupants. Blast-mitigating structures are developed to absorb as much energy as possible to protect occupants from the effect of blast. These structures are placed on vehicle floor to soften the impact on occupants’ lower extremities thus minimizing injuries. Shape plays an important role in determining the amount of energy absorbed in these structures. This paper presents a finite element study where nonlinear finite element (FE) models were used to simulate the motion of vehicle floor due to the blast of an IED. A benchmark structure was developed to mimic Skydex that is a trademark structure. Different shapes were then used and compared with Skydex. The study shows the potential of optimizing shape to maximize the performance of blast-mitigating structures.
Test rig design for upper-limb socket prosthetics at transradial amputation level

M M Bondok¹, M A El-Sheikh¹ and M A El-Hadek¹

Abstract

Statistics show that the transradial level is the most common level of upper-limb amputation seen by the prosthetist. Amputee needs an intermediate part to wear and fit the prosthetic device with the residual limb firmly. The socket is the only channel between residual limb and prosthetic components and is the crucial part of the prosthesis influencing the amputee’s acceptance considerably. The purpose of this design is making a test rig that can assess the socket while simulating arm movements that are common during activities of daily living such as: (Abduction, Adduction, Flexion, Extension, Supination and Pronation) in Euler angles: Yaw, Pitch and Roll. This test rig allows to predict when dislocation between the residual limb and the socket will be happened with any weight and at any plane.

¹Production and Mechanical Design Department, Faculty of Engineering, Port-Said University.
Design and manufacturing of a test rig for measuring the torque required in soil drilling operations

M A Abdeldayem¹, M E Abo-Elnor¹ and M H Mabrouk¹

Abstract

Soil drilling operation has become one of the most important interests to researchers due to its many applications in engineering systems. Such as construction industry, soil samples for geological sciences and space sampling. The dominant factor in determining drilling parameters based on drilling operations experience or in some times based on proposed modelling techniques. As a result, soil drilling process using auger drilling is studied to obtain drilling parameters and then optimize these parameters to improve drilling performance which enables proper selection of machine for a required job. One of the main challenges that faces researchers during using modelling techniques to define the soil drilling problem is the complex nonlinear behaviour of the drilled medium itself due to its discontinuity and heterogeneous formation. This paper presents a developed apparatus that has been designed and manufactured to be used in measuring and recording the total torque required during soil drilling operation. A simplified auger drilling machine is built in soil-tool interaction laboratory, Military Technical College, to obtain experimental results that can be used to verify the presented models. Data acquisition measuring system is established to analyse experimental results using a. The Labview® program enables recording and displaying the output data collected mainly from sensors planted in the test rig. Results of both analytical and numerical models are then compared to experimental results to aid in developing the presented parametric study that can be used to define the working parameters during drilling operations in different types of soils.

¹Egyptian Armed Forces
Assessment of steel wire’s fatigue life using finite elements modelling and experimental testing

H M Lotfy¹, A B El Shabasy¹, T Attia¹ and H A Hassan¹

Abstract
Various applications consist of wire rope as one of their most important construction parts. Wire ropes formed of three parts as basis; wires, strands and core, to get a deep understanding of wire ropes and their mechanical properties, it is essential to study their main part; the wire. For this reason, steel wire has been studied in this work to get its fatigue life as the number of cycles to failure using finite element modeling. FEM results have been verified using experiments; Flex tester machine and fatigue apparatus which is created and structured for this study. Outcomes have proved that using of bigger bending diameters resulted in increasing the fatigue life of the steel wire and vice versa. It is noticed that the FEM results have small and reasonable value of deviation comparing to the experimental results. Other mechanical properties of the steel wire have been obtained from FEM such as; equivalent Von-Mises stress, equivalent elastic strain, equivalent plastic strain and equivalent total strain.

¹ Mechanical Design and Production, Faculty of engineering, Ain Shams University, Cairo, Egypt
## Session No. 4

**Material Science and Processing I**

**Room:** A  
**Date:** Tuesday 7/7/2020  
**Time:** 1500 : 1645

**Board:**

| Board Member | Position                  | Institution                  |
|--------------|---------------------------|------------------------------|
| Prof. Dr.    | Mazen Ibrahim Negm        | Al-Azhar Univ.               |
| Prof. Dr.    | Mohamed Tolba Sallam      | M. T. C.                     |
| Brig. Gen. Dr.| Walid Abdel-Hai EL-Thalabawy | M. T. C.                     |

| Paper No. | Title                                                                 | Authors                                                                 |
|-----------|------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 014_AMME-19 | Interactions Between Microorganisms and Composite Material with Marble & Granite Filler | H Ahmed and O Darwesh                                                  |
| 015_AMME-19 | Optical Non-linear Characteristics of particles from Natural Resources | H Ahmed, A Salah, S Hasabelnbi and A Khalil                             |
| 016_AMME-19 | Improving water desalination efficiency by using carbon nanotubes as pre-treatment | A AbdAllah, W El-Sallamy, B Azzam and T Osman                           |
| 017_AMME-19 | Optimization of Friction Stir Welding Parameters Using Response Surface Methodology | I Sabry, N Gadallah and M Abu-Okail                                    |
| 018_AMME-19 | Study of peak temperatures in friction stir spot welding of AA2024-Al/Polycarbonate and AA2024-Al/Polypropylene systems | R K Mohammed, S S Mohammed, and T S Mahmoud                            |
| 019_AMME-19 | The effect of tire rubber particles on the mechanical and physical properties of polyester | K F Abo Elenien, N A Azab, G Bassioni and M H Abdellatif.               |
Interactions Between Microorganisms and Composite Material with Marble & Granite Filler

H Ahmed \(^1\) and O M Darwesh \(^2\)

**Abstract**

It is promising to develop new composite materials which have antimicrobial activity for many applications; this is our goal in this study. All experiments were done to achieve this an important objective by studying the interaction between the new composites and some pathogenic reference microorganisms. The produced composite was manufactured from industrial wastes. Recently, many research groups in all fields have focusing work on removing the wastes and recycling it as useful materials. In this study, the preparing new composite from marble and granite wastes with thermoplastic matrix PMMA was investigated. This composite is considered as new type of micro- nano composite because it has fillers in the nano and micro sizes. Pathogenic microorganisms, used in this study, obtained from the American type culture collection (ATCC; Rockville, MD, USA), yeast and one pathogenic fungus were applied. The evaluation of analysis was done by spectrophotometer SEM and EDX techniques. The suitable applications of new composite material were mentioned based upon the interaction recorded in the study. The study ends with recommendation for future modifications in the new composite materials to improve its resistances to microorganism.

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\(^1\) Dr. Eng. Consultant in materials sciences & materials applications, Egypt  
\(^2\) Agricultural Microbiology Department, National Research Centre, Giza, Egypt
Optical Non-linear Characteristics of particles from Natural Resources
H Ahmed\(^1\), A Salah\(^2\), S Hasabelnbi\(^2\) and A Khalil\(^2\)

Abstract
In these work some nano and micro particles such as granite, zeolite, diopside ferrous and sand glass which considered as waste or byproduct from mining industries. The micro and nano particles from natural resources were prepared by sieving and mixing with acidic solution at certain concentration, the particles are soaked and immerged in the acidic solution for long time to achieve reasonable hemogenity, sterring is done directly before measurements. The non linear characteristics of the prepared solution were measured by z-scan open aperture technique. The results explained in terms of the composition and structure of the micro and nano particles. Granite particles does not introduce any emission due to compact structure, while zeolite, diopside ferrous and sand glass have significant non linear spectrum related to their structure. The research introduces new applications of the ceramics materials micro and nano particles in non linear optical devices. The research ends with conclusions and recommendation for future work in this new field of applications. The new techniques and the new materials selected in the current study have good non linear optical characteristics; these are promising for practical application. It can be used for various optical applications such as optical modulators, sensors and other optical protection applications.

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\(^1\) Consultant in materials sciences & materials applications, EGYPT

\(^2\) National Institute of laser enhanced Science, NILES, EGYPT.
Improving water desalination efficiency by using carbon nanotubes as pre-treatment

A AbdAllah¹, W El-Sallamy², B Azzam³ and T Osman⁴

Abstract
Filters based on carbon nanotubes (CNTs) have been highlighted as an emerging technology for water desalination. In this paper, the weight percentage (wt.%) of CNTs required for desalination is discussed. The idea is based upon addition of CNTs to simple filters that is employed as adsorbent for dissolved solids in water (sodium chloride removal). Different CNTs filters (using CNTs Multi walled tube type) specimens were fabricated. Experimental work was done, through building a test rig, to show the effect of percentage of weight of CNTs on desalination of (Red Sea and Brackish) water. The effect of multiple filtration stages has been also shown. It was shown that the filters containing CNTs would be effective if used at the intake of modern RO (Reverse Osmosis) water desalination plants. Using filters with CNTs as pre-treatment of intake water for the RO units will reduce feeding pressure, specific energy and power consumption.

¹ Production Engineering, Education Development Fund, Cabinet of Ministers, Cairo, Egypt
² Production Engineering and Printing Technology Department, Akhbar Elyom Academy, 4th Industrial Zone, 6th of October City, 12563 Giza, Egypt
³ Mechanical Design and Production Department, Taibah University, Janadah Bin Umayyah Road, Tayba, 42353 Medina, KSA
⁴ Mechanical Designs and Production Department, Cairo University, 1 Gamaa Street, 12613 Giza, Egypt
Optimization of Friction Stir Welding Parameters Using Response Surface Methodology

N Gadallah¹, I Sabry¹ and M Abu-Okail¹

Abstract

The aim of this article is to create a new technique for predicting discontinuity formation, its place and magnitude during aluminium alloy (AA6061) friction stir welding (FSW). The effectiveness of the technique was demonstrated using visual inspection, hardness and tensile test of the friction stir welded joints. The measured current was analysed through power calculations. In each of the FSW stages, the energy consumption is significantly varied, clearly distinguishing the penetration of the tool, its revolution, its traverse movement and its metal removal rate. The findings of tracking the energy consumption indicate that using power consumption means the significance of weld quality. FSW has been carried out based on two factors - two levels. Response surface methodology (RSM) is employed to develop a mathematical model. Analysis of variance (ANOVA) technique checks the adequacy of the developed mathematical model, which is used effectively at 95% confidence level. In contrast, tensile and hardness tests also showed that welds at high power usage failed continuously within the welding area, due to reduced welding temperature and absence of penetration in the welding zone.

¹ Manufacturing Engineering Dept., Modern Academy for Engineering and Technology, Cairo, Egypt.
Study of peak temperatures in friction stir spot welding of AA2024-Al/Polycarbonate and AA2024-Al/Polypropylene systems

R K Mohammed1, S S Mohammed1, and T S Mahmoud1

Abstract

Compared to ordinary fusion welding processes, friction stir spot welding (FSSW) have significant advantages for example: joining of conventionally non-weldable alloys, improved mechanical properties and reduced distortion of weldable alloys joints due to the pure solid-state joining of metals. This welding technique gives the online feedback control and opportunity of automation, allowing automatic adaptation to geometrical and environmental variations of the component. However, several fundamentals of the process such as the temperature inside the stirred zone of the weld and its power on mechanical properties, are not yet fully understood. In the present study, FSSW was adopted to weld AA2024 aluminium alloy sheets with both polycarbonate (PC) and polypropylene sheets using two different tools having two different pin configurations. The two tools have conical pin with 2.5 mm height, however, tool (T1) has draft angle of \( \approx 16.69^\circ \) and the tool (T2) has a draft angle of \( \approx 6^\circ \). The effects of FSSW parameters of the process, typically, the tool rotational speeds and dwell time, on temperature variation in the tool/work piece interface was also recorded, via an infrared camera. The results revealed that, increasing the tool rotational speed and/or the dwell time increase(s) the peak temperature in FSSW of both AA2024Al/polycarbonate and AA2024Al/polypropylene welded joints. For AA2024Al/polycarbonate joints, the peak temperatures recorded for tool T1 are higher than those recorded using tool T2. The peak temperature ranges were found to vary from 54 to 150 °C and from 45 to 136 °C, for joints welded using T1 and T2 tools, respectively. While, for AA2024Al/polypropylene joints, the peak temperatures recorded for tool T2 are higher than those recorded using tool T1. The peak temperature ranges were found to vary from 40 to 115 °C and from 61 to 143 °C, for joints welded using T1 and T2 tools, respectively.
The effect of tire rubber particles on the mechanical and physical properties of polyester

K F Abo Elenien¹, N A Azab², G Bassioni³ and M H Abdellatif⁴

Abstract
In this work, a novel composite of polyester with rubber particles -obtained from recycled wasted car tires -was developed. Worn tires generate a large amount of wastes that do not derogate resulting in environmental problems. This has the advantage of producing useful product that is economical and eco-friendly. The effect of the volume fraction of the rubber particles in the composites on the physical and mechanical properties of the composites was studied. Varying the volume fraction from 0-60% resulted in an increase in the impact properties. The addition of rubber particles had also the effect of reducing the density of the composites which is a desirable property.

¹PhD student, Mechanical Design and Production Engineering Department, Faculty of Engineering, Ain Shams University.
²Associate Professor, Mechanical Design and Production Engineering Department, Faculty of Engineering, Ain Shams University.
³Professor, Chemistry Department, Faculty of Engineering, Ain Shams University.
⁴Professor, Mechanical Design and Production Engineering Department, Faculty of Engineering, Ain Shams University.
Session No. 5

Dynamics and Vibration I

Room: A

Date: Wensday 8/7/2020

Time: 900 : 1045

Board:

| Prof. Dr.                  | Adel Abdel-Razek Ormer       | M. T. C.   |
|----------------------------|-----------------------------|------------|
| prof. Dr.                  | Al Hussain M. Sharaf         | M. T. C.   |
| Assoc. Prof. Dr            | Hesham Mohamed Eltaher       | M. T. C.   |

| 020_AMME-19 | **Effect of Modified Bouc-Wen Model Parameters on Dynamic Hysteresis of Magnetorheological Dampers** | M Abdelhamed, W G Ata, A M Salem, A Z Khafagy |
|-------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------|
| 021_AMME-19 | **Experimental and Computational Dynamic Structural Analysis of Free-flight Rockets**          | M Habaka, S S Farag , M Khalil and M Y Ahmed |
| 022_AMME-19 | **Numerical Investigations of Bistable Piezoelectric Cantilever for Enhanced Energy Harvesting** | M A Abdelnaby, M S Shiba, and S Ali           |
| 023_AMME-19 | **Simulating Ultrasonic Vibration Enhanced FSW Process of AA6082 Using Finite Element Method**  | O M Mabrouk, M S El-Wazery, M A EL-Desouky    |
| 024_AMME-19 | **Passive Vibration Attenuation: A COMPARISON STUDY**                                         | A A Abdelghany, M M Hegazy and A Badawy       |
Effect of Modified Bouc-Wen Model Parameters on Dynamic Hysteresis of Magnetorheological Dampers

M Abdelhamed¹, W G Ata¹, A M Salem¹ and A Z Khafagy¹

Abstract

Magnetorheological (MR) dampers are a semi active control device that becoming a promising actuators in vibration mitigation. The unique properties of MR fluids are used to control the damping force without consuming large power source. Despite MR dampers are fail-safe, efficient, and robustness devices, they poses significant nonlinear characteristics. A well-known Bouc-Wen models and their extension modified Bouc-Wen are the most accurate models that predict the hysteresis of the MR dampers. However, these models suffer from some complexity and limitations and they miss a good fitting to the measured data. In this paper, the existing modified Bouc-Wen (MBW) models are introduced and their dynamic characteristic are simulated using MATLAB Simulink environment. The robustness of the model is judged by a comparison between the experimental tests of the MR damper (on and off state) on the MTS damper test machine in MTC and the simulated characteristics. To better understand the damper nonlinearity, an investigation into the effect of the model parameters on the dynamic characteristics of the damper is studied. A parametric study is proposed to identify the optimal model parameters that best fits the experimental data. The response of the model with the obtained parameters is validated across the measured MR damper characteristics under different sinusoidal excitations and command current. The results show a good agreement between the simulated and measured responses of the MR damper.

¹Egyptian Armed Forces.
Experimental and Computational Dynamic Structural Analysis of Free-flight Rockets

M Habaka¹, S S Farag¹, M Khalil¹ and M Y Ahmed¹

Abstract
Aerospace vehicles’ designers often strive to approach the lightweight structures in order to improve flight performance without compromising vehicles durability. However, this goal may be achieved on the expense of structural rigidity of the vehicle. A missile with high slenderness ratio is a typical vehicle that should be considered as flexible body if precise dynamic behaviour analysis is sought. This analysis is crucial to identify the flight performance of such missile with high accuracy. The present paper discusses the results of a side-by-side experimental and numerical analysis of the vibration characteristics of a full-scale free-flight missile having 70mm caliber. The experimental modal analysis is conducted on the missile with empty motor to represent its unpowered flight regime. Experimental modal analysis setup involved accelerometer sensors while vibration excitation is achieved using an impact hammer. Modal analysis is also conducted numerically using a well-used high-fidelity commercial tool. Results of experimental modal analysis have shown that the first four modes as bending modes with frequencies of 134.4, 400.6, 819.4 and 1173.6 Hz, respectively. The results also demonstrate the close agreement between numerical and experimental approaches.

¹ Egyptian Armed Forces.
Numerical Investigations of Bistable Piezoelectric Cantilever for Enhanced Energy Harvesting

M A Abdelnaby¹, M S Shiba² and S Ali³

Abstract.
Piezoelectric energy harvesting applications have been highly impacted research area recently. Numerical investigations for bistable piezoelectric cantilevers have great importance to understand its dynamic performance. This paper aims to develop comprehensive numerical models to simulate the dynamic response of a unimorph piezoelectric bender under bistability effect for enhanced energy harvesting. To this end, the equivalent stiffness, damping, electromagnetic coupling and capacitance coefficients of a bistable piezoelectric cantilever have been numerically developed. Besides, finite element models are developed to determine the bistability repulsion force between magnets. The resulting simulations are then implemented in an electromechanical model to predict the output voltage and power over a range of load resistance.

¹ Production Engineering and Printing Technology Department, Akhbar El Yom Academy, Egypt
² Higher Technology Institute, 10th of Ramadan City, 6th of October Branch, Egypt
³ Department of Mechatronics, Canadian International College, Fifth Settlement, New Cairo, Egypt
Simulating Ultrasonic Vibration Enhanced FSW Process of AA6082 Using Finite Element Method

O M Mabrouk\textsuperscript{1}, M S El-Wazery\textsuperscript{2,3} and M A EL-Desouky\textsuperscript{4}

Abstract
Several modifications have been made on friction stir welding process to overcome some certain limitations which have been reported. One of these modifications is to use ultrasonic energy as an assistance tool in FSW process. In the present paper, a mathematical model is developed to express the heat generation during ultrasonic vibration enhanced friction stir welding process (UVeFSW). A finite element model is built to perform a transient thermal heat transfer analysis using ANSYS mechanical APDL software package. The temperature contours, temperature distribution and the thermal cycles were predicted using the moving heat source technique. To validate the model, k-type thermocouples were used to measure the temperature and thermal cycles at five locations. The results showed a good agreement between the simulated and experimentally measured results.

\textsuperscript{1,2}Production Engineering & Mechanical Design Department, Faculty of Engineering, Minoufia University, Shebin El-Kom, Egypt
\textsuperscript{3}Current, Mechatronics Engineering Department, High Institute of Engineering and Technology – Elmahala Elkobra
\textsuperscript{4}Civil Engineering Department, Nile High Institute of Engineering and Technology - Mansoura, Egypt
Passive Vibration Attenuation: A COMPARISON STUDY

A A Abdelghany¹, M M Hegazy² and A Badawy³

Abstract
A comparison study between two different approaches for passive vibration attenuation of solar array had been presented. A powerful finite element software “Ansys” was used to perform this study. Finite element models of a cantilever rectangular aluminum plate are created in order to model the satellite solar array. Stiffeners and circular patches (passive masses) are used separately in order to attenuate the vibration of the plate. The output results of the mode shapes and the FRF of the plate are investigated in order to figure out the best and adequate vibration attenuation technique for satellite solar array, the results showed that using stiffeners have a better effect on vibration attenuation more than using circular patches. A further investigation for vibration attenuation using stiffener is conducted to study the effect of changing the aspect ratio of stiffener.

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¹ Egyptian Armed Forces
² Arab Academy for Science, Technology & Maritime Transport
³ October University of Modern Sciences and Arts
### Session No. 6

**Material Science and Processing II**

**Room:** A  
**Date:** Wednesday 8/7/2020  
**Time:** 1100 : 1245

**Board:**
- Prof. Dr. Mohamed Tolba Salam  
- Assoc. Prof. Dr. Abdel-Hamid M. El-Mahallawy  
- Brig. Gen. Dr. Mohamed Elsayed Shamekh

| Paper No. | Title                                                                 | Authors                                                                 |
|-----------|----------------------------------------------------------------------|------------------------------------------------------------------------|
| 025_AMME-19 | Phase stability of mechanically alloyed Ti-Fe-Al alloys               | S A Ibrahim, M M Seleman, H M Ahmed and A E Hannora                     |
| 026_AMME-19 | Fracture Toughness Assessment of Axial Partially Through Cracks in X65 and X70 Steel Pipes | A E Said, H A Hassan, T G Abu-El-Yazied and A M Makady                  |
| 027_AMME-19 | Assessment of St. St. 316L joints welded by laser beam and metal active gas MAG processes | A M Magdy, A B El-Shabasy and H A Hassan                                |
| 028_AMME-19 | Pre-Cracking Techniques of Polymeric Materials: an overview           | A Kamal, A H Elsheikh and E Showaib                                   |
| 029_AMME-19 | Abrasive Water Jet Machining of CFRPs: Single Response Optimization Using Taguchi Method Optimization | I I Edriys, M Fattouh and R Masoud                                    |
Phase stability of mechanically alloyed Ti-Fe-Al alloys

S A Ibrahim\(^1\), M M Seleman\(^1\), A E Hannora\(^2\) and H M Ahmed\(^1\)

Abstract
Iron alloying element addition to pure titanium can be used to enhance strengthening as well as \(\beta\)-phase stabilizer. However, the outcome depends on the processing route to some extent. Mechanical alloy technique is adapted in this work to produce titanium alloys with 7wt% iron content and 1wt% Aluminum. The obtained nano-size particles have two phases \(\alpha\) and \(\beta\) structures and the formation of the second \(\beta\)-phase is mainly enhanced by the milling force. Heating the produced grain compacted powder to a temperature above the beta phase transus temperature followed by quenching to ambient temperature resulted in \(\alpha\)-martensite partial transformation. This result can indicate that the obtained \(\beta\)-phase for the present alloys is not fully stabilized by the iron additions.

1 Metallurgical and Materials Engineering Department, Faculty of Petroleum and Mining Engineering, Suez University, 43521 Suez, Egypt
2 Department of Science and Mathematical Engineering, Faculty of Petroleum and Mining Engineering, Suez University, Suez 43521, Egypt
Fracture Toughness Assessment of Axial Partially Through Cracks in X65 and X70 Steel Pipes

A E Said1, H A Hassan1, T G Abu-El-Yazied1 and A M Makady2

Abstract

This paper presents analysis of fracture assessment methods of axial partially-through crack in X65 and X70 steel pipes with internal pressure. Two analytical methods Folin–Ciocalteu method (FC method) and Gauss–Seidel method (GS method)) are used to make assessment for two steel pipes (steel X65 and X70). Finite Element model of X65 and X70 steel full-scale pipes with axial part-through crack was established. In this work, a comparison is made between results obtained from FC and GS methods and finite element model with previous experimental results. The GS is more conservative assessment method as it provides smaller crack depth (a) corresponding to (Jcr). Finite Element model in case of steel X70 is more conservative than the analytical methods and its results close to the experimental values.

1Design and Production Eng. Dept., Faculty of Engineering, Ain Shams University, EGYPT.
2Department of Manufacturing Technology, College of Technological Studies, PAAET, Kuwait.
Assessment of St. St. 316L joints welded by laser beam and metal active gas MAG processes

A M Magdy¹,³, A B El-Shabasy²,³ and H A Hassan²,³

Abstract

Study the welding of Stainless steel 316L sheet was carried out using two welding techniques, Laser beam and Metal Active Gas MIG. Strips of 1.5 mm thick were cut from the Stainless-steel sheet and then welded using nitrogen gas for shielding. Metallographic examination using optical microscopy and SEM was conducted to study the microstructure of the welded joints. The tensile stress for joints welded by Laser beam and MAG were ranged from 386 to 632 MPa and from 126.5 to 599 MPa respectively according to the parameters of each welding techniques. The average of microhardness values measured at successive distances for joints welded by Laser beam and MAG were 265 HV and 261 HV, respectively. The obtained results were analysed and discussed based on the recent research.

¹ Design and Production Engineering Dept Faculty of Engineering Ain Shams University
Pre-Cracking Techniques of Polymeric Materials: an overview

A Kamal$^1$, A H Elsheikh$^1$ and E Showaib$^1$

Abstract

In fracture toughness tests, a number of notched specimens with identical artificial pre-cracks are essential to obtain accurate fracture parameters. The test results are critically depending on the initiation stage quality. Any slight variance in pre-cracks front shape, length and orientation could significantly affects the test results; therefore, producing identical pre-cracks is a critical issue to obtain accurate results. The pre-cracking technique should be selected carefully to fulfil controllably and repeatability requirements of the standard pre-cracks for a certain material while preserving the induced residual stresses at the crack tip at a minimal value. The notching and pre-cracking standards for metallic material have been well specified in ASTM E399. However, the case is more cumbersome for polymeric materials due their viscoelastic nature. ASTM D5045, ISO 13586:2000 and ASTM D6068 specified different procedures to prepare a sharp pre-crack for polymeric materials. Many pre-cracking techniques have been proposed in literature. The present work introduces an overview of the pre-cracking techniques for polymeric materials.

$^1$ Production Engineering and Mechanical Design Department, Tanta University, Tanta, 31527, Egypt
Abrasive water jet machining of CFRPs: single response optimization using taguchi method optimization

I I Edriys¹, M Fattouh² and R Masoud²¹

Abstract

Taguchi method was applied to assess and optimize machining parameters and their effect on kerf characteristics during abrasive water jet machining (AWJM) of carbon fiber reinforced polymeric composites (CFRPCs). The main responses selected for these analyses are kerf width, kerf taper, metal removal rate, and surface roughness, the consistent machining parameters focussed for this study are abrasive flow rate, pressure, traverse rate, thickness of the workpiece and standoff distance, each parameter has three levels. Twenty-seven experiments were conducted on a typical CFRP composite workpiece materials based on Taguchi L27 design. The response curves and response tables were used to assess the data obtained to control the major significant process factors statistically affecting the kerf characteristics. The optimal settings of process parameters for each response are set up. From the analysis, it was detected that the percentage contribution of the control factors affecting the kerf width is standoff distance, workpiece thickness, abrasive flow rate, traverse rate, and pressure correspondingly. The results exposed that the thickness, feed rate, and standoff distance were the most significant factors affecting the kerf taper, metal removal rate, and surface roughness respectively.

¹ Faculty of Engineering, Tanta University, Tanta, Egypt
² Faculty of Engineering, Minufiya University, ShebinElkom, Egypt
²¹ Kaha for chemical industries (270 army factor), Egypt
### Session No. 7

**Ballistics II**

**Room:** A  
**Date:** Wednesday 8/7/2020  
**Time:** 1300 : 1445

**Board:**
- **Prof. Dr.** Mohamed Saied Abo Elkhair  
- **Assoc. Prof. Dr.** Amr Ibrahim Hassan Fayed  
- **Maj.Gen (r) Dr.** Osama Mohamed Kamal

| Session No | Title                                                                 | Authors                                      |
|------------|----------------------------------------------------------------------|----------------------------------------------|
| 030_AMME-19 | An Experimental Study on Mechanical and Ballistic Characteristics of Different HTPB Composite Propellant Formulations | A F Nour Eldin, W M Adel and Y A Attai       |
| 031_AMME-19 | Penetration of long rods into semi-infinite metallic targets over wide range of impact velocities | M A Abdel-Kader, A M Riad and A Z Ibrahim    |
| 032_AMME-19 | Transient Heat Transfer for GPMG’s Barrel 7.62x51                      | M Ghanem and O Abdelsalam                    |
| 033_AMME-19 | Multi-Fidelity Drag Prediction for Base Bleed Projectile               | M M Aziz, A Z Ibrahim, M Y M Ahmed and A M Riad |
An Experimental Study on Mechanical and Ballistic Characteristics of Different HTPB Composite Propellant Formulations

A F Nour Eldin\textsuperscript{1}, W M Adel\textsuperscript{2} and Y A Attai\textsuperscript{1}

Abstract

The main goal of this paper is to investigate the changing in the tensile behavior and the burning rate characteristics of hydroxyl-terminated polybutadiene (HTPB) propellant under the variations of the crosslinking density, which was predominantly determined by the equivalent ratio of diisocyanate to total hydroxyl (NCO/OH ratio), which known as the curing ratio. Four various batches with different curing ratios (NCO/OH) percentage were produced in which the production processes were fixed. Uniaxial tensile tests were conducted at different temperatures (-40, 20 and 55°C), and different strain rates (0.000656 \text{1/s}, 0.0328 \text{1/s}) using a Zwick universal test machine. In order to measure the burning rate, cured solid propellant strands were tested using the acoustic wave emission method under different pressure ranging from 4 to 10 MPa. The experimental results indicate that the tensile behavior of HTPB propellant is remarkably influenced by curing ratio, strain rate, and temperature. It was observed that a great change on stress-strain curves affected various curing ratios and temperatures on the mechanical behavior of propellant composition. The results showed that high curing ratio leads to increase the ultimate stress and decrease the strain at maximum stress, but higher temperatures lead to decrease the ultimate stress and the strain at maximum stress. The curing ratios (NCO/OH) have an intense impact on mechanical characteristics, but slightly impact on ballistic characteristics for propellant. Furthermore, careful measurements of these parameters are important to control the production quality and to provide a reliable comparison between different propellant batches.

\textsuperscript{1}Mechanical power engineering department, Faculty of Engineering, Helwan University
\textsuperscript{2}Egyptian Armed Forces
Penetration of long rods into semi-infinite metallic targets over wide range of impact velocities

M A Abdel-Kader¹, A M Riad¹ and A Z Ibrahim¹

Abstract

In this paper, the analytical model that describes the penetration process of a long rod into a semi-infinite metallic target over wide range of impact velocities has been presented. In this model, the target strength factor \( R_t \) is not considered as a constant but it is a function of penetration velocity whereas, the rod strength factor \( Y_P \) is represented by Hugoniot Elastic Limit (HEL) of its material. The penetration process of the present model consists mainly of primary phase during which the rod front is subjected to erosion and secondary (after-flow) phase. The main equations of the used model are presented, arranged and compiled into a computer program. The program is capable of predicting the time histories of the parameters associated with the penetration process. Autodyn hydrocode package is used herein to simulate the penetration processes of long rods into targets examined by the present analytical model. The hydrocode is fed with the same data used in the model for rods and targets materials. Both the model predictions and the obtained numerical results of Autodyn hydro code, respectively, are compared with the corresponding experimental measurements of other investigators. Good agreement is generally obtained. In addition, representative samples of the model predictions and their corresponding simulation results of Autodyn hydro code are presented with relevant analyses and discussions. The obtained results prove the predictive capabilities of both the present model and Autodyn hydro code, respectively, where each of them could be used as a quick tool for determining the main parameters associated with the studied penetration process.

¹ Egyptian Armed Forces.
Transient Heat Transfer for GPMG's Barrel 7.62x51

M Ghanem\textsuperscript{1} and O Abdelsalam\textsuperscript{1}

Abstract

In this paper, a modified analytical solution for time-dependent one dimension heat diffusion equation in cylindrical coordinate had been mathematically solved to calculate the temperature distribution through thick-walled weapon barrel subjected to successive shots. The analytical solution has been compared with experimental measurements for the temperature at the outer surface of the barrel at two different positions. The General Purpose Machine Gun (GPMG) 7.62X51 mm was considered as the case of study. The results show a good agreement between the analytical model and the experimental work with a difference less than 3\%. The main difference between them mainly as a result of the very short time of the heating phenomena as it takes about 6 (ms) only, although the used Data Acquisition System was able to take a high sampling rate and a high sensitive thermocouple type k with only 0.5 mm thickness had been used.
Abstract
A computational study is performed to predict the drag reduction for a base bleed projectile. 2-D and 3-D simulations are conducted to describe the flow past a projectile with base bleed. The calculated computational results are compared with measurements of total drag coefficients based on published results for 155mm K307 projectiles with live/dummy base bleed grain. In addition, the mean drag coefficient measurements based on live firing tests for a five K307 projectiles with live BB grain at different Mach numbers are used to validate results obtained from the computational results. Differences between the drag coefficient calculated from computational and published live firing measurements of the drag coefficient for K307 are less than 5.2% and 6.8% for projectile with dummy and live BB, respectively. On the other hand, the maximum deviation between computational results and real measurements from the live firing tests of live BB projectiles is 2.75%.

1 Egyptian Armed Forces
Session No. 8

Dynamics and Vibration II

Room: A

Date: Wednesday 8/7/2020   Time: 1500 : 1645

Board:

Prof. Dr.           Moustafa Adnan Ahmed          M. T. C.
Prof. Dr.           Moataz Mohamed Hegazy         Arab Academy for S.&T.
Assoc. prof. Dr.   Amgad Mohamed Kamel         M. T. C.

|    | Abstract                                                                 |
|----|--------------------------------------------------------------------------|
| 034_AMME-19 | **Experimental Modal Testing of a Honeycomb Sandwich Plate**  
               A Aborehab, M Kamel M Kamel, A F Nemnem and M Kamel |
| 035_AMME-19 | **A New Artificial Neural Network Model Integrated With a Cat Swarm Optimization Algorithm for Predicting the emitted noise during Axial Piston Pump operation**  
               A H Elsheikh, M Abd Elaziz, H A Babikir, D Wu, and Y Liu |
| 036_AMME-19 | **Passive Vibration Damping of a Cantilever Plate**  
               A Mohamed, A Hassan, A A Omer |
Experimental Modal Testing of a Honeycomb Sandwich Plate
A Aborehab\textsuperscript{1}, M Kassem\textsuperscript{1}, A F Nemnem\textsuperscript{1} and M Kamel\textsuperscript{1}

Abstract
Honeycomb structures have been widely used in several applications and industries in the past decades. Such structures have a significant role in aerospace engineering especially in building up the satellite structures. Honeycomb structures provide key benefits represented in high specific strength, high specific stiffness, and superior dimensional stability. Detailed finite element modelling of such structures is a great challenge as it involves high computational expense. Thus, equivalent modelling is mandatory. The detailed and equivalent finite element models of a honeycomb plate are introduced intensively throughout analyzing its dynamic behaviour using the modal analysis module in ANSYS workbench software. The equivalent modelling is carried out via the three-layered sandwich theory and leads to the calculation of the first four natural frequencies and the related mode shapes. An experimental modal testing of the honeycomb sandwich plate is implemented for the sake of validating the computational results. A good agreement is obtained when comparing both experimental and computational results with mean error not exceeding 5%. Finally, a parametric study is performed to relate the modal analysis results with different boundary conditions cases. The results show that the model can be a reliable basis for satellite honeycomb sandwich structures design.

\textsuperscript{1}Egyptian Armed Forces
A New Artificial Neural Network Model Integrated With a Cat Swarm Optimization Algorithm for Predicting the emitted noise during Axial Piston Pump operation

A Elsheikh¹, M Abd Elaziz², H Babikir³, D Wu³ and Y Liu³

Abstract

This study presents a new artificial intelligence based methodology to predict the emitted noise of an Axial Piston Pump (APP). The suggested method depends on augmentation of conventional Artificial Neural Network (ANN) via integration with Cat Swarm Optimization (CSO). CSO is used to obtain the optimal structure of ANN. The training and testing of the approach were accomplished using experimental data sets considering six system operating pressures (0.5, 1.0, 1.5, 2.0, 2.5, and 3.0 MPa) and five speed levels (600, 900, 1200, 1500, and 1800 rpm). Two valve seat materials were investigated: polyetheretherket one (PEEK) and 316L stainless steel. A reasonable agreement was observed between the predicted results obtained by the developed method and the experimental data.

¹ Production Engineering and Mechanical Design Department, Tanta University, Tanta, 31527, Egypt.
² Department of Mathematics, Faculty of Science, Zagazig University, Zagazig, Egypt.
³ The State Key Laboratory of Digital Manufacturing and Equipment Technology, School of Mechanical Science and Engineering, Huazhong University of Science and Technology, Wuhan 430074, China.
Passive Vibration Damping of a Cantilever Plate
A Mohamed 1, A Hassan 1, A A Omer 1

Abstract
Vibration control of mechanical systems divided into two types active and passive, this case study illustrates other approach of passive control of the cantilever plate by using double layers of the viscoelastic material (Dyad 606) one in the upper face of the Al substrate (5051) and the second one in the lower face. This layers are affected by axial uniform distributed force by applying tension load, the damping level depend on the value of this axial force where the vertical component of this force consistently the other way of the vibrating element that reduce vibration amplitude in this direction by about (95%) of the original amplitude without damping layers. Computational analysis using ANSYS program are used firstly to verify that the results from the software are compatible with that obtained from analytical and experimental evaluation by comparing the values of natural frequencies. Then using ANSYS model to calculate the reduction occurs in the lateral vibration with changing of the axial loads on the viscoelastic plates. The benefits of this model are enhancing the reliability and reducing the cost.

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1 Egyptian Armed Forces
# Session No. 9

**Mechanical Power Engineering II**

**Room:** A  
**Date:** Thursday 9/7/2020  
**Time:** 9:00 : 10:45

**Board:**  
Prof. Dr. Ibrahim Saleh Moustafa  
Brig. Gen. Prof. Dr. Ahmed Salah Abo elazam  
Brig. Gen. Dr. Mohamed Safaa Eldin

| Session No. | Title                                                                 | Authors                                                                 |
|-------------|----------------------------------------------------------------------|------------------------------------------------------------------------|
| 037_AMME-19 | Modeling and Experimental Investigation of High Pressure Common Rail Diesel Injection System | W. Niklawy, M. Shahin, M. I. Amin, A Elmaihy                          |
| 038_AMME-19 | Performance of Homogeneous Charge Compression Ignition (HCCI) Engine with Common Rail Fuel Injection | W. Niklawy, M. Shahin, M. I. Amin, A Elmaihy                          |
| 039_AMME-19 | Experimental Investigation and Numerical Simulation of the Thermosyphon Heat Pipe Charged with R134a | SY Zakaria, A G Ibrahim, A M Rashad and S E El-Shamarka                |
| 040_AMME-19 | Aerodynamic performance improvement using a micro-cylinder as a passive flow control around the S809 airfoil. | W. Mostafa, A Abdelsamie, M. Mohamed, D. Thévenin and M Sedrak.       |
Modeling and Experimental Investigation of High Pressure Common Rail Diesel Injection System

W Niklawy¹, M Shahin², M I Amin³ and A Elmaihy³

Abstract
The high-pressure Common Rail (HPCR) injection system was originally introduced for diesel engines to both reduce pollutant emissions and enhancement of performance. HPCR separates fuel pressurization and injection processes from each other. The high injection pressure generated by the common rail system provides better atomisation and evaporation of fuel spray, resulting in improved air inlet and fuel jet mixing, which is advantageous for lowering soot emission. In this paper, a mathematical common rail injection system model has been presented. A Simulink/Matlab code was developed to execute this simulation. This work does not only seek to validate the presented numerical model but to have more insight for understanding the overall common rail injection system diesel engine performance under different operating conditions. Some simulation results are illustrated to highlight modelling capability. The engine used is an HCCI turbocharged diesel engine, 2776 cc, 4-stroke, and 4-cylinder, water-cooled with overhead valve mechanism. The common rail pressure, fuel consumption, start and duration of each injection through one engine cycle are measured at various engine speed and loads. The measured common rail fuel pressure and consumption are used to validate the simulation results. The findings of the simulation show good consistency with the experimental results. At last, some simulation results, which highlight the modelling capability, are illustrated at certain values of engine speed and load.

¹ PhD candidate, Mechanical Power Engineering Dept., Military Technical College
² Mechanical Engineering Department, School of Engineering, Badr University
³ Mechanical Power Engineering Dept, Military Technical College
Performance of Homogeneous Charge Compression Ignition (HCCI) Engine with Common Rail Fuel Injection
W Niklawy¹, M Shahin², M I Amin³ and A Elmaihy³

Abstract
Homogeneous Charge Compression Ignition (HCCI) engine is a newly introduced technology. However, controlling the HCCI timing of ignition and the heat release rate, at all operating regimes, present the biggest challenge due to the complicated and highly coupled combustion problems. The successful implementation of the common rail injection system in diesel engines has made this possible. The main key for this success is the capability to optimize the most important fuel injection parameters, namely timing, rate, and duration. This work experimentally investigates the performance of an HCCI Diesel engine with a Common Rail Direct Injection (DI) fuel system. The engine used is a turbocharged 2776 cc, 4-stroke, 4-cylinder, water-cooled with overhead valve mechanism. The engine performance is evaluated and presented at different loads and speeds. The Apparent Heat Release Rate during combustion is evaluated from the measured cylinder pressure-crank angle data. The pressure in the fuel line is measured at the entry to different fuel injectors to investigate the effect of pressure wave propagation in the fuel line on the fuel injection system.

¹ PhD candidate, Mechanical Power Engineering Dept., Military Technical College
² Mechanical Engineering Department, School of Engineering, Badr University
³ Mechanical Power Engineering Dept, Military Technical College
Experimental Investigation and Numerical Simulation of the Thermosyphon Heat Pipe Charged with R134a

S Y Zakaria1, A G Ibrahim1, A M Rashad1
and S E El-shamarka1

Abstract
This work presents an experimental and numerical study of Two-Phase Closed Thermosyphon (TPCT) heat pipe filled with R134a as a base fluid. For this purpose, a test rig was designed and developed to perform a series of tests on the TPCT heat pipe by applying different heat inputs at the evaporator section. The surface temperature along the TCPT heat pipe and temperature changes of the cooling water across the condenser section were measured. The influence of the TPCT heat pipe operating conditions on its thermal performance was reviewed. The considered parameters were; heat pipe transport capacity, conductance, both heat transfer coefficients of the evaporator and condenser sections and the thermal efficiency. Then, a CFD model was developed to investigate the two-phase flow and heat transfer mechanism during the transient and steady-state operation of the TPCT heat pipe. The results of the experimental work were used to validate the CFD model and acceptable agreements were noticed. The validated CFD model is utilized to predict features of the mass and heat transfer processes, as well as the nucleate pool boiling and the liquid film condensation phenomena during TPCT heat pipe operation.

1 Egyptian Armed Forces.
Aerodynamic performance improvement using a micro-cylinder as a passive flow control around the S809 airfoil.

W Mostafa1,*, A Abdelsamie2,3, MMohamed2,4, D Thévenin3 and M. Sedrak2

Abstract
Aerodynamic performance improvement of airfoils is the first step towards enhancement of the wind turbine performance in electricity generation and energy conversion in renewable energy applications. The flow behavior around wind turbine blades profile can be improved by introducing active and/or passive flow controls. This work numerically describes the impact of adding micro-cylinder, as a passive flow control around S809 airfoil, on aerodynamic performance under various operating conditions. A suitable combination of flow analysis and optimization technique has been used in the current work. The numerical simulation has been performed using ANSYS Fluent 18.2 software. The airfoil was numerically analysed in flow at Reynolds number of 106; aerodynamic coefficients (lift and drag coefficients) at different angle of attacks were validated with the experimental data reported by Somers in NREL. The Response Surface Method (RSM) is applied to obtain the optimum position of micro-cylinder to achieve maximum lift to drag ratio. It has been found that the total aerodynamic forces are sensitive to the location of the micro-cylinder. A significant enhancement of lift to drag ratio can be achieved by adding micro-cylinder in front of S809 airfoil especially at high Reynolds number.
**Session No. 10**

**Mechatronics / Robotic Automation and Control**

**Room:** A  
**Date:** Thursday 9/7/2020  
**Time:** 1100 : 1245

**Board:**

- **Prof. Dr.** Yehia Hendawy Hosam Eldin  
  Future University  
- **Col. Dr.** Amr Ahmed Roshdy  
  M. T. C.  
- **Col. Dr.** Moustafa Shokry Asfoor  
  M. T. C.

| Session Code | Title                                                                                     | Authors                                                                                           |
|--------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 041_AMME-19  | Assistive exoskeleton hand glove using soft pneumatic actuators: design optimization       | M N El-Agroudy, M I Awad, A Rehan and S A Maged                                                   |
| 042_AMME-19  | Design of Gain Scheduled Fuzzy PID Controller for Multi-Link Robot Manipulators           | Maya Emarah                                                                                       |
| 043_AMME-19  | Design of bio-inspired muscle sarcomere structure using a hybrid Hydrogel-IPMC actuator.  | H M Hamdi, S A Abdelwahhab, M I Awad and F A Tolbah                                             |
| 044_AMME-19  | Performance Investigation and control parameters choice for sliding mode control of coupled tanks system | M A Louis, M R Roman, O E Mahmoud and M F Sedrak                                  |
Assistive exoskeleton hand glove using soft pneumatic actuators: design optimization

M N El-Agroudy¹, M I Awad¹, A Rehan and S A Maged ¹

Abstract
An assistive exoskeleton hand glove can be the solution to people who suffer from impairment in hand functionality. Soft pneumatic actuators (SPA) are used to actuate such glove. This paper focus on optimizing the design of the soft actuator. Finite element (FE) model is linked with the design optimization tool to find the optimal dimensions and materials of the SPA that give maximum displacement of the actuator with acceptable stresses on the actuator’s body. Performance analysis shows the relation between different parameters and how each affect the performance of the actuator. Results show the dimensions and materials needed to have maximum actuator displacement without being subjected to high stresses.

¹ Mechatronics Department, Faculty of Engineering, Ain Shams University, Egypt
Design of Gain Scheduled Fuzzy PID Controller for Multi-Link Robot Manipulators

Maya Emarah¹

Abstract
Gain Scheduling (GS) controller is one of the most popular approaches to nonlinear control design. Commonly, Gain Scheduling (GS) controllers have better performance than robust ones. In this paper, the structure of a proposed gain scheduled PID fuzzy controller (GS-PIDF) designed and analyzed. The Fuzzy PID controller gains weighted through gain scheduling designed system to grantee both the stability and the best performance of a multi links robot manipulator system. The overall designed controller system is applied to two links robot manipulator system, which is subject to modelling using Lagrangian dynamics method and simulation via MatLab and Simulink package to minimize the vibration and acquire best performance.

¹ Assistant Professor, the High Institute of Engineering, City of Science and Culture, 6th of October City, Giza, Egypt.
Design of bio-inspired muscle sarcomere structure using a hybrid Hydrogel-IPMC actuator

H M Hamdi¹, S A Abdelwahhab², M I Awad³ and F A Tolbah³

Abstract

Biological muscle is considered a powerful actuator due to its flexibility, lightweight, and efficiency. The building unit of a muscle, sarcomere, and the study of its energy balance cycle is considered in researches due to its importance to mimic the micro-level muscle structure to improve the artificial muscle performance. In this work, a new design of a linear actuator based on the sarcomere behavior is developed. The design is inspired by studying the four steps adenosine triphosphate (ATP) hydrolysis cycle, which is the main source of the required energy for sarcomere contraction. A new developed hybrid hydrogel-polymeric material actuator is designed in this paper using a combination between Ionic Polymeric Metallic Composites (IPMC) and hydrogel to behave like the sarcomere. This new actuator proposes an autonomous cycle using the effect oscillatory Belousov–Zhabotinsky (BZ) reaction. The physical model is proposed, and the mathematical model of the actuator is derived and formulated and identified using MATLAB/Simulink.

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¹ Design and Production Engineering Department, Faculty of Engineering, Ain Shams University, Cairo, Egypt.
² Production Technology Department, Faculty of Industrial Education, Helwan University, Cairo, Egypt.
³ Mechatronics Engineering Department, Faculty of Engineering, Ain Shams University, Cairo, Egypt.
Performance Investigation and control parameters choice for sliding mode control of coupled tanks system

M A Louis¹, M R Roman², O E Mahmoud² and M F Sedrak²

Abstract

In several food processing and chemical industries, liquid is pumped and kept in interrelating coupled tanks. However, automatic regulation of the liquid level and flow control between these tanks is a challenging problem because of the complexity and high non linearity of such system. This paper deals with the liquid level control of two horizontal coupled tanks system. A comprehensive comparative study is made for most popular sliding mode control (SMC) algorithms found in literature, namely Proportional-Derivative Sliding Mode Control (PD-SMC), Proportional-Integral-Derivative SMC (PID-SMC), Fractional Order SMC and finally dynamic SMC. Special emphasis is put on the effect of the sensor noise on the controller performance. Simulated experiments including robustness to variation in plant parameters and step input disturbances are made. Control algorithms parameters are selected to optimize designed performance indices by using MATLAB optimization toolbox. Simulation results reveal that dynamic SMC is superior to other control algorithms in the presence of sensor noise and has a significant reduction in the actuator chattering phenomenon.

¹ Mechatronics department, Faculty of Engineering, Egyptian Russian University, Cairo, Egypt
² Mechanical power engineering department, Faculty of Engineering at Mataria, Helwan University, Cairo, Egypt
| Session No. 11 | Production Technology |
|----------------|-----------------------|
| Room: A        |                       |
| Date: Thursday 9/7/2020 | Time: 1300 - 1445 |
| Board:         |                       |
| Maj. Gen. (r) Dr. | Wael Salah Eldin Hamed M. T. C. |
| Assoc. Prof. Dr. | Amr Mohamed Fekry M. T. C. |
| Col. Dr.       | Ahmed Selem El Mosalamy M. T. C. |

| Paper No. | Title                                                                 | Authors                          |
|-----------|----------------------------------------------------------------------|----------------------------------|
| 045_AMME-19 | Effect of applying Lean Maintenance in Oil and Gas fields          | M. Nasr Hassan, A. F Barakat and A. S Sobh |
| 046_AMME-19 | A New Integrated Process and Product Development model                | A. Ayman, A. B Alhamaki and M. H Abdellatif |
| 047_AMME-19 | Ultrasonic-assisted drilling of Nickel-based superalloy Inconel 601: An experimental study | A. M. Abdelaziz, H. Youssef, M. Al-Makky and H. El-Hofy |
| 048_AMME-19 | Computational fluid Dynamic model for machining using minimum quantity coolant | W. Abdelfattah, H. Hegabb, A. Mohany and H. A. Kishawy |
| 049_AMME-19 | Optimization Ladle-Refining Performance During Treating Special Steel Melts for Aviation Technology | S. A. Elghazaly, K. K Gyula and W. Saied Elghazaly |
Effect of applying Lean Maintenance in Oil and Gas fields

M Nasr Hassan¹, A a Fathalla Barakat² and A Sobh³

Abstract
Oil and Gas Sector are facing a huge increase and delay in Operations & Maintenance tasks for all facilities beside continuous demand from management to improve the productivity of wells and the efficiency of facilities. The top management decides to use Lean Maintenance as a new tool, technique and methodology to improve and modify the current operations, production and maintenance systems as done before by many researchers in the oil and gas sector. This improvement will be done through three real case studies by integrating Building Information Modelling with lean concepts, monitoring Key Performance Indicators within a modern Computerized Maintenance Management Software and finally using some LM tools such as Total Productive Maintenance, Value Stream Mapping and 5S Methodology to increase productivity, efficiency, and quality of the output production and services. The results of implementation since July 2017 till June 2018 show average increase in crude oil production by 6.72% per day in addition to overcome natural decline of oil wells, reduced Technician's total Preventive Maintenance tasks by 52.63% and transfer the less difficult inspections to Operator to be responsible for making checks to all parameters of all equipment and to enable Technicians to perform other maintenance tasks, Saving about $724,770 in Water Injection Pumps Operation's Expense. Last but not least, accelerate the workflow of production and maintenance processes by 28% compared with the previous financial year.

¹Mechanical Dept., Faculty of Engineering, Helwan University, Cairo, Egypt
²Professor Faculty of Engineering, Ahram Canadian University (ACU) & Faculty of Engineering, Helwan University
³Mechanical Dept., Faculty of Engineering, Helwan University, Cairo, Egypt
A New Integrated Process and Product Development model
A. Ayman¹, A. B. Alhamaki² and M. H. Abdellatif³

Abstract
Currently, the demand for more robust, economic, and quality products has increased the complexity in the integrated process development and product design model. In the knowledge economy century, all nations are competing to innovate new technologies to develop a new system that produces goods in less time and cost with compatible quality. Hence, a new IPPD model is needed to offer support and information/technology sharing during the entire product life cycle. The new IPPD model proposed that integrate all domains shall affect the product development. The model has a friendly computerized interface supported with internet enablers that offer support to the user to collect and share data easily. This model contains 6 domains. The Business Environment is the first domain, which analyzing the pre-feasibility of the product creation. The second domain is the market analysis and segmentation taking into consideration customer needs and competition. Managerial readiness of the product developing company is the third domain, including all managerial functions and the necessity of implementing the organizational change techniques if necessary. The fourth domain is Technological creation and deals with product concepts and robust quality design. Production/Launch is the fifth domain which consists of production processes and quality techniques to assure producing with the required quality and price levels. Finally, the sixth domain deals with the vital information of product distribution, maintenance and after-market service. The model is easily adapted to the industry need

¹ Mechanical department, Faculty of engineering, Ain Shams University, Cairo, Egypt.

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Ultrasonic-assisted drilling of Nickel-based superalloy Inconel 601: An experimental study

A M Abdelaziz ¹, H Youssef ¹, M Al-Makky ¹ and H El-Hofy ²

Abstract
In this study, a comparison between ultrasonic-assisted drilling (UAD) and conventional drilling (CD) is presented under different feed rates using thrust force, torque, and hole geometrical errors as output responses. The experiments were done on plates of Inconel 601 (nickel-based superalloy), which is classified as a difficult-to-cut alloy due to its high Nickel content (60%), high hardness (43 HRC), and low thermal conductivity. The experiments were performed using DMG Mori Ultrasonic 20 linear, which is equipped with ultrasonic tool holder oscillating at 20 kHz with 7 μm amplitude. A coated carbide single margin twist drill had been used in the experiments. Full factorial design of experiments approach was employed, and the results had been statistically analyzed to find the most significant factor affecting the process responses. The results showed that the ultrasonic assistance had reduced the thrust force, and torque compared to conventional drilling (CD). Also, a reduction in hole cylindricity error was detected during UAD, which improves the hole quality. In case of UAD, twist drills did not suffer from a physical wear, however notch wear was observed in CD drills. Chip morphology was also studied. Short segmented chips were obtained when using UAD which improved chip evacuation and reduced the chance of chip jamming in the drill flutes.

¹Production Engineering Department, Faculty of Engineering, Alexandria University, Alexandria 21544, Egypt
²Industrial and Manufacturing Engineering Department (IME), School of Innovative Design Engineering (IDE), Egypt-Japan University for Science and Technology (E-JUST), Alexandria 21934, Egypt
Computational fluid Dynamic model for machining using minimum quantity coolant

W Abdelfattah\textsuperscript{1,2}, H Hegabb\textsuperscript{2}, A Mohany\textsuperscript{1} and H A Kishawy\textsuperscript{1}

Abstract
The cooling applications during machining has significant effects on the production costs, surface quality, and the mechanical properties of the final product. In conventional flood cooling, a large amount of continuous cooling fluid is usually used, and that increases the cost of the product as well as the harmful effects on the environment and the machining operator. This study focuses on simulating alternative cooling system, called minimum quantity coolant (MQC), which used an optimal flow rate compared to classical flood cooling. The cooling fluid is directly provided to the cutting edge through the insert holder. In the current work, a computational fluid dynamic (CFD) model has been developed to study the effects of the cooling fluid velocity on the accessibility of coolant to the chip-tool interface area under using various types of cooling fluids. Three types of coolant are used (i.e. water, mineral oil, and nano-fluid). The results of the proposed CFD model have been classified into two phases. The first phase obtains the coolant accessibility percentage into the chip-tool interface (MA\%) with different coolant velocities (i.e., 0.5, 1, 1.5, and 2 m/s) for the three studied coolants. The second phase discusses the heat transfer effectiveness for the employed coolants with different inlet velocities since it is an important aspect, especially when machining hard-to-cut materials. It was found that increasing the coolant velocity would increase the coolant accessibility percentage into the chip-tool interface area. However, no significant effect has been found after 1.5 m/s for all employed coolants.

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\textsuperscript{2}Faculty of Engineering, Cairo University, Giza, Egypt.
Optimization Ladle-Refining Performance During Treating Special Steel Melts for Aviation Technology

S A Elghazaly¹, K K Gyula² and W S Elghazaly¹

Abstract

The ever increasing demands of consumers towards superior quality steel products urged steelmakers to consider the implementation of various relatively new metallurgical technologies into the classical operations. The necessity to produce high quality steels led to the use of two stage steel production processes, one is the primary steelmaking and the other stage is the outside furnace treatment through which many metallurgical functions can be achieved like degassing, stirring and inclusion removal, Inclusion modification, desulphurization, deoxidation, decarburization, heating and alloying. In this research a trial was done to optimize the performance and usage of 30tons-ladle refining system during production of X65-pipeline steel as final product-Aluminium killed steel melts through controlling the mass flow contour using optimized modelling, optimum usage of Al₂O₃ and Sulphide modifiers and enhancing removal of non-metallic inclusions by altering their morphologies and hence floatation speed. Assessment of fine clusters of inclusions in the final steel product has been industrially correlated to the cleanness of melt before refining, to the slag composition and to the parameters of materials flow rates as well as their effects on the mechanical properties of final X65-steel product. Scanning-EM+DX analyzing unit and metallurgical microscopes were used to emphasis qualitatively and quantitatively the characters of non-metallic inclusions.

¹ Steel Technology, Metals Technology, CMRDI, Egypt
² Metallurgy, Miskolc University