PROGRAM AND ABSTRACTS

of the 6th International Conference on Engineering Mechanics and Automation (ICEMA6)

Sponsored by

The Asia Research Center, VNU

Organised by

University of Engineering and Technology

and

Institute of Mechanics

Hanoi, November 13÷14, 2021

CONFERENCE INFORMATION

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PROGRAM

Program at a Glance

November 13, 2021

Time	***Link***
14:00-17:00	**System Testing (authors can log in to test the connection before the official presentation on the conference date)**

November 14, 2021

Time	***Link***		
08:00-08:10	**Opening Ceremony**		
08:10-08:50	**Keynote Speakers** *Chairmen. Prof. Chu Duc Trinh and Prof. Nguyen Tien Khiem*		
	Nguyen Dong Anh, Nguyen Ngoc Linh, Nguyen Nhu Hieu, Dang Van Hieu. Some Dual Techniques in the study of Nonlinear Dynamic Systems (Invited Speaker)		
	Nguyen Dinh Duc, Viet-Hung Truong. Prediction Of Steel Structures' Responses Using Machine Learning: Prospects And Challenges (Invited Speaker)		
	Parallel Sessions		
Room	304G2	303G2	301G2
Zoom link	Link	Link	Link
09:00-10:00	**Mechatronics and Automation**	**Solid Mechanics**	**Fluid Mechanics**

Chairmen	*Assoc. Prof. Pham Manh Thang and Dr. Do Tran Thang*	*Prof. Nguyen Dong Anh and Assoc. Prof. Nguyen Viet Khoa*	*Assoc. Prof. Dang The Ba and Assoc. Prof. Nguyen The Duc*
Scientific Secretary	*MSc. Hoang Van Manh*	*Dr. Bui Hong Son*	*MSc. Do Huy Diep*
10:00-11:50	***Session break***		
Chairmen	*Assoc. Prof. Pham Manh Thang and Dr. Do Tran Thang*	*Prof. Nguyen Dinh Duc and Prof. Nguyen Tien Khiem*	*Assoc. Prof. Dang The Ba and Assoc. Prof. TranThu Ha*
Scientific Secretary	*MSc. Hoang Van Manh*	*ME. Pham Dinh Nguyen*	*MSc. Do Huy Diep*
12:00-13:30	***Lunch break***		
	Parallel Sessions		
Room	304G2	303G2	301G2
Zoom link	Link	Link	Link
13:00-14:40	**Mechatronics and Automation**	**Solid Mechanics**	**Mechatronics and Automation**
Chairmen	*Assoc. Prof. Pham Manh Thang and Dr. Tran Anh Quan*	*Assoc. Prof. Nguyen Manh Cuong and Dr Nguyen Trương Giang*	*Dr. Do Tran Thang and Dr. Vu Bao Lam*
Scientific Secretary	*MSc. Hoang Van Manh*	*MSc. Dao Thi Bích Thao*	*Dr. Dinh Tran Hiep*
14:40-14:50	***Session break***		
Room	304G2		
Zoom link	Link		
14:50-16:50	**Mechatronics and Automation**		

Chairmen	*Assoc. Prof. Pham Manh Thang and Dr. Tran Anh Quan*		
	MSc. Hoang Van Manh		
16:50-17:00	**Closing Session**		

PROGRAM IN DETAILS

November 14, 2021

Room 212 Building

Zoom link: link

08:00-08:10 Opening Ceremony

Opening speech of Professor Nguyen Viet Ha, Rector of the University of Engineering and Technology

Welcome speech of the Director of the Institute of Mechanics

08:10-08:50 Keynote speakers

Chairmen. Prof. Chu Duc Trinh and Prof. Nguyen Tien Khiem

08:10-08:30 *Nguyen Dong Anh, Nguyen Ngoc Linh, Nguyen Nhu Hieu, Dang Van Hieu.* Some Dual Techniques in the study of Nonlinear Dynamic Systems (Invited Speaker)

08:30-08:50 *Nguyen Dinh Duc, Viet-Hung Truong.* Prediction Of Steel Structures' Responses Using Machine Learning: Prospects And Challenges (Invited Speaker)

1. Mechatronics and Automation

Session 1: Room 304-G2 Building

Zoom link: link

Chairmen: Assoc. Prof. Pham Manh Thang and Dr. Do Tran Thang

Scientific Secretary: MS. Hoang Van Manh

09:00-09:20 *Cuong Nguyen Nhu, Luan Le Van, Lam Bao Dang, Van Thanh Dau, Tung Thanh Bui, Trinh Chu Duc.* 3D Printed Micro nozzle-based Mixer with Integrated Capacitive Sensor toward High Precision Mixing Applications

09:20-09:40 *Quang Manh Doan, Van Duy Nguyen, Cong Hieu Le, Ngoc Khang Nguyen, Tran Hiep Dinh*. A Post-processing Approach Using Clustering for Vision-based Crack Detection Algorithms

09:40-10:00 *Tran Van Viet, Do Tran Thang, Nguyen Van Khuong.* A proposed design of vacuum gripper system integration for one specific robotic arm

10:00-10:10 Break

10:10-10:30 *Chi Tran Nhu, Phu Nguyen Dang, Van Nguyen Thi Thanh, Ha Tran Thi Thuy, Van Dau Thanh, Tung Bui Thanh.* Fabrication and Investigation of Flexible Strain Sensor for Sign Language Recognition System

10:30-10:50 *Hanh Nguyen Thi Hong, Hung Truong Xuan, Phuong Phung Kim.* Multi Mobile Robot System Application on Transportation in the Warehouse: an Introduction

10:50-10:10 *Van-Tinh Nguyen.* Adjusting Material Amount of Proportional Technique for Bilinear Topology Optimization

10:10-10:30 *Cong-Hoang Quach, Truong-Son Nguyen, Minh-Trung Vu and Minh-Trien Pham.* Design and implement a UAV for low-altitude data collection in precision agriculture

10:30-10:50 *Nguyen Quang Hoang, Than Van Ngoc.* Design of PD Controller for Flexible Manipulators by Particle Swarm Optimization

12:00-13:30 Lunch break

Zoom link: link

Chairmen: Assoc. Prof. Pham Manh Thang and Dr. Tran Anh Quan

Scientific Secretary: MS. Hoang Van Manh

13:00-13:20 *Duc-Anh Dao, Truong-Son Nguyen, Cong-Hoang Quach and Minh-Trien Pham.* Design of UAV system and workflow for weed image segmentation by using deep learning in Precision Agriculture

13:20-13:40 *Duc Tien Nguyen, Thanh Tung Bui, Van Nguyen Thi Thanh.* Design, Simulation, Fabircation and Characterization of a Pneumatic Soft Gripper

13:40-14:00 *Tran Thanh Tung.* Development of a gripper for a fruit harvesting machine

14:00-14:20 *Hang Tran Thanh, Duong Nguyen Dinh, Vinh Nguyen Phuc, Hoang Tong Tran, An Nguyen Ngoc, Loc Do Quang.* Development of a Low-delivery-rate Syringe Infusion Pump towards Remote Monitoring of Biomedical Applications using Accessible IoT Technology

14:20-14:40 *Van-Tinh Nguyen, Kim-Thuan Nguyen, Ngoc-Kien Nguyen.* A Study of Wall Cleaning Robot with Zigzag Motion Trajectory

14:40-14:50 Break

14:50-15:10 *Linh Phuong Ta, Hung Xuan Truong, Duong Nam Bui, Huy Xuan Le, Phuong Viet Vu, Minh Duc Nguyen*. Research and Fabrication of a Carbon Fiber Parabolic Reflector Antenna for Satellite Ground Station at S-band

15:10-15:30 *Hiep Dam Dinh, Huy Khuat Duy, Linh Nguyen Ngoc.* Design and Integrate Control System for 3R2S2S typed Delta Robot

15:30-15:50 *Pham Manh Thang, Bui Thanh Lam, Hoang Van Manh, Ngo Anh Tuan, Dang Anh Viet, Kim, Jong-Wook.* Fruit Picking Robotic Arm for Agricultural Applications

15:50-16:10 *Bui Thanh Lam, Hoang Van Manh, Pham Manh Thang, Ngo Anh Tuan, Dang Anh Viet, Pham Manh Tuan.* Image processing algorithms for an agricultural harvesting robot in natural lighting conditions

16:10-16:30 *Cuong Nguyen Nhu, Hang Nguyen Thu, Thao Pham Ngoc.* Improvement in Mixing Efficiency of Passive Micromixer with Integrated Grooves

16:30-16:50

Session 2: Room 301-G2 Building

Zoom link: link

Chairmen: Dr. Do Tran Thang and Dr. Vu Bao Lam

Scientific Secretary: Dr. Dinh Tran Hiep

13:00-13:20 *Duong Vu, Anh Hoang Vo, Trung Duy Dao, Quy Thu Le.* Solution for robot cleaning the photovoltaic panels in Vietnam

13:20-13:40 *Cuong Hung Tran, Ngoc Linh Nguyen.* Analysis and design of a photovoltaic water pumping system

13:40-14:00 *Tran Vu Minh*. Model Predictive Control for Piezoelectric Actuated System with Hysteresis

14:00-14:20 *Cong Hieu Le, Tran Hiep Dinh.* Fitting Models to Crack Coordinate Data Using Change Detection

14:20-14:40 *Nguyen Van Khang, Dinh Cong Dat, Nguyen Van Quyen.* Dynamic stability control and calculating inverse dynamics of a single-link flexible manipulator

16:50 Closing Session

2. Fluid Mechanics

Room 301-G2 Building

Zoom link: link

Chairmen: Assoc. Prof. Dang The Ba and Assoc. Prof. Nguyen The Duc

Scientific Secretary: MS. Do Huy Diep

09:00-09:20 *Thu Ha Tran, Hong Son Hoang, Hong Phong Nguyen.* A sensitivity method studying regional response to external sources of pollution and its application to 1D water pollution problem

09:20-09:40 *Nguyen Tuan Anh, Nguyen Chinh Kien, Duong Thi Thanh Huong.* Evaluation of salinity intrusion on Kone – Ha Thanh river system

09:40-10:00 *Huy Diep Do, The Ba Dang.* Study on the influence of period and wave amplitude on the output power of linear generator by numerical methods

10:00-10:10 Break

Chairmen: Assoc. Prof. Dang The Ba and Assoc. Prof. Tran Thu Ha

Scientific Secretary: MS. Do Huy Diep

10:10-10:30 *Tran Thi Thanh Huyen, Nguyen Chinh Kien.* Application of GIS tool and hydrologic modelling for flow simulation of Cau river basin

10:30-10:50 *Tam Hoang Van, Anh Dinh Le.* Effect of the Mesh Types on the Prediction of Flow Aerodynamic around Airfoil

10:50-11:10 *Nguyen Hoang Quan, Tran Dang Huy, Duong Viet Dung*. Determination of Aerodynamic Coefficients of Drone Propeller by 3D Scanning Technology and Blade Element Momentum Method

11:10-11:30 *Nguyen Van Đuc, Đang Tha Ba, Do Huy Diep*. Motion analysis of wave energy conversion dual buoys using ANSYS-AQWA

Closing Session

3. Solid Mechanics

Room 303-G2 Building

Zoom link: link

Chairmen: Prof. Nguyen Dong Anh and Assoc. Prof. Nguyen Viet Khoa

Scientific Secretary: Dr. Bui Hong Son

09:00-09:20 *Nguyen Dang Bich, Nguyen Hoang Tung, Le Xuan Tung.* Research for static stability of the conical shells including foundation effects

09:20-09:40 *N. D. Anh, Nguyen Ngoc Linh, Nguyen Van Manh, Anh Tay Nguyen.* Nonlinear vibration in Dufing system subjected to narrow-bad colored noise excitation

09:40-10:00 *Nguyen Dong Anh, Manukid Parnichkun, Phan Thi Tra My, Nguyen Cao Thang, Le Thi Hong Gam, Pham Ngoc Chung, Nguyen Nhu Hieu*. Force Control of an Upper Limb Exoskeleton for Perceiving Reality and Supporting Human Movement Using Feed-forward Model

10:00-10:10 Break

Chairmen: Prof. Nguyen Dinh Duc and Prof. Nguyen Tien Khiem

Scientific Secretary: ME. Pham Dinh Nguyen

10:10-10:30 *Pham Dinh Nguyen, George Papazafeiropoulos, Quang-Viet Vu, Nguyen Dinh Duc*. Optimum buckling analysis of laminated composite plates reinforced by multiple stiffeners

10:30-10:50 *Doan Hong Duc, Do Van Thom, Phung Van Minh, Nguyen Dinh Duc.* Finite element modeling for free vibration behaviors of piezoelectric cracked nanoplates with flexoelectric effects

10:50-11:10 *Mai Van Trung, Vu Dinh Giang, Nguyen Dinh Duc, Vu Thi Thuy Anh.* Simulation of crack propagation in FG-GPLRC structures and its application in dataset generation

11:10-11:30 *Ngo Dinh Dat, Nguyen Dinh Duc, Vu Dinh Giang, Vu Thi Thuy Anh.* Investigation of a sandwich plate with two MEE face sheets and FGM core layer from the nonlinear dynamic buckling point of view

11:30-11:50 *Le Thi Ha.* Free vibration of multi-span bi-directional functionally graded beams

12:00-13:30 Lunch Time

Zoom link: link

Chairmen: Assoc. Prof. Nguyen Manh Cuong and Dr Nguyen Trương Giang
Scientific Secretary: MS Dao Thi Bich Thao

13:00-13:20 *Khoa Viet Nguyen, Thao Thi Bich Dao, Long Do Vu, Quang Van Nguyen.* Exact receptance function of the axially load cracked beam carrying concentrated mass

13:20-13:40 *Cong Vinh Pham, Manh Cuong Nguyen, Tuan Hai Nguyen.* Vibration analysis of FGM ring-stiffened conical shells by Continuous Element Method

13:40-14:00 *Tuan Hai Nguyen, Manh Cuong Nguyen, Quoc Hung Nguyen*. Parameters analysis on the vibration of composite ring-stiffened cylindrical shells in interaction with elastic foundation

14:00-14:20 *Pham Ngoc Chung, Nguyen Nhu Hieu.* Hopf bifurcation of a mass-spring system with LuGre friction model

14:20-14:40 *Hoang Ngoc Quy, Nguyen Truong Giang*. Simulation superelastic behavior of shape memory alloy and applications reduce oscillations

14:40-14:50 Break

14:50-15:10 *Dinh Van Duy, Vu Duc Quang, Nguyen Dac Trung*. Influence of Technological Parameters on the Quality of Hydroforming Product from Tube Billet

15:10-15:30 *Van-Tinh Nguyen.* Effect of Structure Properties on Biped Locomotion

15:30-15:50 *Xuan-Quang Ma, Van-Tinh Nguyen.* Self-Supervised Depth Estimation with Vision Transformer

Closing Session

PLENARY SESSION

Some Dual Techniques in the study of Nonlinear Dynamic Systems

Nguyen Dong Anh
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Abstract

Most phenomena in our world are essentially nonlinear and described by nonlinear equations. Thus, the study of nonlinear problems is of crucial importance not only in all areas of physics but also in engineering. The analysis of vibration based on nonlinear mathematical models requires appropriate methods. Therefore, new methods for analysis of nonlinear oscillations always cause concern of scientists and technicians.

Natural phenomena and human activities exhibit often dual characters which reflect two side processes or/and the relative balance of two opposite sides. For illustration we may say attack – defense in a football match, one way and return in an excursion, day and night. When a problem is considered it is quite often that one its side is given too much attention while another side is almost or completely forgotten. This usual approach doesn't reflect the real essence of the problem in question and hence doesn't yield an expected solution in many cases.

Recently, a dual approach has been proposed to study the response of nonlinear systems and some dual techniques have been developed, e.g. [1–7], based on the concept of duality. The main issue of a dual approach to a scientific problem is to always consider two different (dual) aspects of the problem. This allows the study to become more harmonious and reflects the essence of the problem. In the dual approach a dual technique is one

that can introduce two dual perspectives for the same problem in consideration. Let one needs to investigate a problem. The use of the dual approach to this problem means that one should introduce a dual technique that can reflect the essence of the problem. This presentation reviews key ideas of researches on the dual approach to the vibration analysis. Three types of dual techniques, namely, regulated dual linearization, forward - return dual technique, weighted averaging dual technique, for the problem of equivalent replacement are summarized. Different implements and realizations of dual techniques to nonlinear vibration analysis and design of dynamic absorbers are reviewed. A number of possibilities for developing dual techniques are proposed.

Prediction Of Steel Structures' Responses Using Machine Learning: Prospects And Challenges

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Abstract

Along with the rapid development of computer science, artificial intelligence (AI) techniques such as machine learning (ML) have been attracting a significant interest of researchers in various fields. A preliminary statistic shows that the total number of published papers in Elsevier journals has increased more than 30 times from 2012 to 2021. Following that general trend, the application of ML algorithms in structural design has been widely studied in recent years. In this work, we will introduce some promising results of using ML algorithms to predict the load-carrying capacity of several types of steel structures, including trusses, frames, and concrete-filled steel tubular (CFST) columns. To build databases of the ML models, advanced analyses were used to calculate the load-carrying capacity of truss and frame structures, while over 1,000 tests on circular CFST columns were collected from the open literature. Several well-known ML algorithms were considered, such as random forest (RF), support vector machines (SVM), decision tree (DT) and deep learning (DL), etc. The numerical results proved that ML algorithms could highly predict the load-carrying capacity of steel structures. Therefore, the application of ML algorithms in steel structure design is quite promising. Besides that, we discussed several questions raised about the practicality of this approach.

Keywords: Artificial Intelligence; Machine learning; Steel structure; CFST; truss; frame

MECHATRONICS AND AUTOMATION

3D Printed Micro nozzle-based Mixer with Integrated Capacitive Sensor toward High Precision Mixing Applications

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Abstract

Fluid delivery and mixing process are both indispensable parts in many Micro Total Analysis Systems - μTAS. In this work, we presented a micropump/mixer actuated by the PZT diaphragm with capacitive sensing electrodes integrated into the device. It can be fabricated by a low-cost 3D additive manufacturing process and is capable of both pumping and mixing simultaneously. Both the device is first studied using the finite element method and by experiments with prototypes. Both studies demonstrate the working principles of the devices. Experiments with the sensing electrodes show that they are able to detect the change in pumping liquid by measuring the change in capacitance.

Keywords: micropump, micromixer, capacitive sensing

A Post-processing Approach Using Clustering for Vision-based Crack Detection Algorithms

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Abstract:

With the advance of technology in recent years, infrastructure has been well developed, leading to an essential requirement in its monitoring and maintenance. Instead of using human labor, automatic systems such as mobile robots and unmanned aerial vehicles have been gradually employed to reduce workplace injuries and increase the efficiency of the process. Besides, vision-based methods have been developed to detect and recognize infrastructure degradation, such as surface cracks. Although the results of recent methods are promising, their dependency on the quality of the input image, which is impacted by some barriers such as lighting conditions or surface material, still remains. This study represents a new classification method to reduce noise and increases the quality of segmentations resulted from some recent crack detection techniques. With the employment of machine learning and image properties such as intensity, area, and shape, the proposed approach has improved the effectiveness of two recently analyzed techniques by almost 1%.

Keywords— crack detection, segmentation, noise cancellation, classification, clustering

A proposed design of vacuum gripper system integration for one specific robotic arm

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Abstract

Robotic arms have been widely used in many applications such as production lines, research and development, the military, medicine, space exploration, and so on. Ordinarily, conventional robotic arms consist of an arm and a gripper (a kind of tool). Today, there are plenty of robotic grippers developed with high flexibility, stability, and accuracy. This paper approaches a type of vacuum grippers used commonly thanks to its simplicity but flexibility enough, that works based on Bernoulli's principle - a high-pressured flow sucks the air in enclosed space between the clamp plate and a given object creating a tight grasp. The research issues of the paper will help to understand deeply vacuum gripper systems including both their advantages, disadvantages, and applicability. In the beginning, the paper focuses on the fundamentals of robotic grippers used for manipulating objects, calculation on the bearing load in some cases, and then designing a specific prototype integrated with one robotic arm for simulation and control purposes. Finally, some results will be shown for illustration and discussion.

Key Words—Robot arms, vacuum grippers, robotic grippers, industrial robots

A Sign Language Recognition System Using Ionic Liquid Strain Sensor

A Study of Wall Cleaning Robot with Zigzag Motion Trajectory

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Abstract

This paper presents a mechanical design and motion-control system of a Wall-Climbing Robot (WCR) which can move on the flat and curve surface for cleaning purposes. One of the most challenges with this type of robot that the researchers confront is how to keep the robot moving steadily on various types of surfaces with the most optimal approach. In this study, a new mechanical design of the Wall-Climbing robot using the Vacuum Principle and Wireless Control technology were proposed. This version of the robot enhances the ability of its movement on the various types of surfaces and optimizes control system. In detail, the Minimum Required Adhesion Force (FMRA) is calculated to be balanced with gravity and its torque. Moreover, a Wireless Control System (WCS) is designed to drive the Robot remotely. The optimal control trajectory and velocities are given based on theory calculations and comparisons**.**

Keywords— Wall-Climbing Robot, Cleaning Robot, Vacuum principle, Wireless control

Adjusting Material Amount of Proportional Technique for Bilinear Topology Optimization

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Abstract

Topology optimization is a process which distributes material into necessary position of design area under the action of external force. The main purpose of this process is to decrease the mass of structure but still ensures its strength. In this field, proportional topology optimization (PTO) is a popular non-sensitivity technique. This method updates material density through the relationship between maximum stress at each iteration and allowable stress of material. Besides, the target of material amount is added or removed by certain ratio of total number of elements. It makes the optimization process take a long time to reach the convergence. This paper supposes that the ratio of moving material at each iteration has significant effect on the convergence of the optimization process. Thus, this paper proposes adaptive moving material using Sigmoid function for proportional technique. A cantilever with nonlinear characteristic material is used to verify the effectiveness of this approach.

Keywords— Topology optimization, bilinear material, cantilever, material amount, convergence speed

Design and implement a UAV for low-altitude data collection in precision agriculture

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Abstract

In recent years, along with the development of precision agriculture, Unmanned Aerial Vehicles (UAVs) in crop data collection is becoming more popular because of the advantages of collecting data in a large area. However, many crops and special growing conditions require low-flying UAVs to collect data such as orchards. This challenge with the safety control algorithm of the UAVs. The research aims to develop UAVs capable of autopilot and sampling at low altitudes. The safety control problem of UAV is solved by the Visual Inertial Odometry (VIO) algorithm using a stereo camera synchronized with an inertial measurement unit (IMU). Besides that, the UAV is equipped with a high-resolution RBG camera for data sampling. The system has been tested under various conditions of low-ceiling performance with altitude hold and obstacle avoidance requirements, and the collected data is satisfactory for use.

Keywords—UAV, precision agriculture, Visual Inertial Odometry, low-ceiling

Design of PD Controller for Flexible Manipulators by Particle Swarm Optimization

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Abstract

The robotic manipulators consisting of flexible links are widely used in industries such as construction, mining, medical, aerospace, and automation. With lightweight and slender links, flexible manipulators have some advantages comparison to rigid one such as material and energy saving. However, control of flexible manipulator has some challenges due to the flexibility of the link. This paper presents the dynamic modeling and control of a flexible manipulator of two links with translational and rotational joints. The finite element method and Lagrange equation are used to build dynamic model. An optimal PD controller based on Particle Swarm Optimization algorithm is designed to bring the endpoint to the desired position. The numerical simulations are carried to illustrate the proposed algorithm.

Keywords — Flexible manipulator, Modeling, Finite element method, PD controller, PSO

Design of UAV system and workflow for weed image segmentation by using deep learning in Precision Agriculture

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Abstract

Collecting and analyzing weed data is crucial, but it is a real challenge to cover a large area of fields or farms while minimizing the loss of plant and weed information. In this regard, Unmanned Aerial Vehicles (UAVs) provide excellent survey capabilities to obtain images of the entire agricultural field with a very high spatial resolution and at a low cost. This paper addresses the practical problem of the weed segmentation task using a multispectral camera mounted on a UAV. We propose the method to find the ideal workflow and system parameters for UAVs to maximize field crop coverage while providing data for reliable and accurate weed segmentation. Around the segmentation task, we examine several Convolutional Neural Networks (CNNs) architectures with different states (fine-tune) to find the most effective one. Besides that, our experiment using Near-infrared (NIR) and Normalized Difference Vegetation Index (NDVI) -the foremost spectroscopies - as an indicator of the vegetation density, health, and greenness. We implemented and evaluated our system on two farms, sugar beet and papaya, to conclude based on each stage of crop growth.

Keywords— UAV, weed segmentation, deep learning, spectroscopy

Design, Simulation, Fabircation and Characterization of a Pneumatic Soft Gripper

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Abstract

Studies on improvement of the end-effector of robot arms have been widely implemented. End-effectors made by hard robot technology from rigid materials face with several problems when utilising to grasp and hold complete-shaped or fragile objects. Recently, soft robot technology which dealing with constructing robots from highly compliant materials has been developed to improve the performance of the gripper. In this paper, we present the design and implementation of a soft pneumatic gripper for using in robot arm. The gripper consists of four pneumatic soft finger-liked actuators, which can fold in a designated direction by inflation of air from an external compressor. The soft actuator is composed of silicone (Ecoflex 00-30) with a chamber-based structure, which is fabricated using a 3D printed mold. By using finite element analysis (FEA) to adjusting the length and wall thickness in the air chamber, the proposed actuator can act like a finger instead of fully curled like an octopus' tentacle. We conduct a series of experiments to evaluate the performance of the pneumatic actuator as well as the constructed gripper. Specifically, the relation between bending angle and pressure are analysed from the results of the experiments and compared with simulation results to understand the entire operation mechanism of the gripper. Besides, we demonstrate the grasping of objects with diverse shapes and materials, from hard to fragile objects as glass cups, eggs, round fruits, and objects with many surfaces. The obtained results show that the prototype of proposed pneumatic gripper can grasp and hold of objects less than 80mm in diameter and 200g in weight,

indicating the feasibility of using the gripper as an end-effector for robot arm in pick-and-place operations.

Keywords—Soft robot, Slow pneumatic net, Soft gripper, Grasping

Development of a gripper for a fruit harvesting machine

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Abstract

The paper proposes the conceptual design of a gripper be used with a harvesting machine. After reviewing some of the challenges posed by the robotic harvesting of tree fruit, the design objectives for the system are specified. The mechanical design and kinematic assessment of the system were also reviewed. The proposed gripper was able to perform an adaptive gripping that adapts to variable fruit geometries. Then an experimental gripper was built and tested in the lab. Finally, the experimental results and simulation calculations are processed, discussed, and analyzed to evaluate the reasonableness of the product

Keywords—harvesting machine, gripper, mechanical design, prototype

Development of a Low-delivery-rate Syringe Infusion Pump towards Remote Monitoring of Biomedical Applications using Accessible IoT Technology

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Abstract

Intravenous administration of drugs and fluids is a widespread technique in modern medical treatments. Administering medicines or fluids directly into a patient's bloodstream results in predictable and quick absorption of the drug or fluid supplied, which may be critical in the treatment of some acute illnesses that need fast action by pharmaceuticals or fluids. Syringe pumps are extremely important for delivering a precise amount of a chemical at certain times. Advances in wireless technology and the Internet of things (IoT) make it possible to utilize medical equipment wirelessly over great distances for remote monitoring. In this study, a framework for a low-cost medical syringe pump with variable and low delivery rates based on the accessible IoT technology for the administration of tiny amounts is proposed to improve rural health care.

Keywords—automatic syringe injection pump, continuous and low dose drug treatment, monitoring system, wireless device

Dynamic stability control and calculating inverse dynamics of a single-link flexible manipulator

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Abstract

When a robot manipulator operates at high speeds, the elastic vibration of its links is inevitable. To study this vibration phenomenon, the present paper deals with problem of modelling, the dynamic stability control and calculating inverse dynamics of a single-link flexible manipulator. An algorithm to study dynamic stability and calculating inverse dynamics of flexible manipulators is proposed. The proposed algorithm is demonstrated and verified by the model of a flexible single-link manipulator.

Keywords: Flexible manipulator, linearization, Taguchi method, dynamic stability, periodic system

Fitting Models to Crack Coordinate Data Using Change Detection

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Abstract

This paper deals with the curve fitting problem and its application in crack detection. Due to the variety of real-world crack, modeling the propagation path is a challenging issue. To take this problem, a modeling method based on simulated crack and model fitting is proposed. First, a dataset of simulated crack is generated based on fracture mechanics and interfacing Abaqus and MATLAB. For each simulated crack, available regression models in Python are employed to approximate the development path. The resulting models are then utilized to approximate segments of real-world crack obtained from some reputable datasets. A similarity-based approach is proposed to predict the crack segments. Experimental results have shown a high correlation between the simulated crack and the real one.

Keywords—crack detection, machine learning, change detection, image processing

Improvement in Mixing Efficiency of Passive Micromixer with Integrated Grooves

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Abstract

Micro-scale fluidic devices have attracted increasing attention in numerous fields of chemical reactions, biomedical diagnostics, food safety control, environmental protection. Micromixer is an important part of a microfluidic system and considerably influences the efficiency and sensitivity of these devices. Here, our paper presents the improved designs of passive micromixers with the emphasis on the concave grooves that imposed on the serpentine channels to significantly induce molecular diffusion and chaotic mixing phenomena of fluid transport. Improved microfluidic passive mixer devices were designed, analyzed of simulation with and without using the grooves on U-folded channel, and then compared to the conventional Y structure. Simulation results demonstrate that the serpentine micromixer with obstacles increased the mixing performance by 2.35 times compared to the conventional Y-shaped mixers and 1.47 times compared to the ones without obstacles. The incorporation of grooves greatly enhances mixing in the flow path due to strong laminar perturbations. Also, according to the theoretical/numerical calculations, the effect of the geometry of the integrated obstacles and their arrangement pattern in the microchannel was studied extensively. The incorporation of numerous grooves in the microchannels resulted in enhanced performance of the micromixer in terms of reduction in mixing time. It was found, that the mixing efficiency of the passive micromixers can be improved to an excellent value by the positions and more densely distributed concave

grooves. This achievement is a great step toward the next generation of high-efficiency passive micromixers at a lower cost in the future.

Keywords— passive mixer; serpentine channel; grooves; mixing simulation

Model Predictive Control for Piezoelectric Actuated System with Hysteresis

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Abstract

In this paper, a discrete second order linear model is used to describe the piezoelectric actuated stage. To suppressing the hysteresis phenomenal of the piezoelectric actuated stage, this paper proposes a tracking control with model predictive technique. The proposed controller is successful in mitigate the nonlinearity of piezoelectric actuator at low frequency. The experimental results verify the feasibility of the proposed method.

Keywords—model predictive control, hysteresis, piezo electric actuator

Multi Mobile Robot System Application on Transportation in the Warehouse: an Introduction

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Abstract

Firstly introduced in the 1980s, multi mobile robot systems (MMRS) have been rapidly developed in research activities and practical usage. Based on a swarm of mobile robots with the ability to plan, coordinate tasks and organize operations, a MMRS has many advantages compared to a single robot, such as space coverage as well as operational efficiency. They can successfully handle complex tasks that a single mobile robot lacks the ability to perform. In this article, we introduce a specific application of MMRS in the items distribution system of the warehouse or the fulfillment center. For this use case, the "collective" feature of the MMRS is exceptionally well-suited to the requirements of warehouse management systems, being able to simultaneously handle multiple tasks with fast delivery speed, reduction of inventory time, flexible quick adaptation with the warehouse reconfiguration and the goods arrangement. This application is speedily growing with many applicable solutions and proposed models in recent years. State of art solutions were combinations of the mobile robot and the human staff, the mobile robots moving in 2D or 3D space carrying a package of goods or the whole storage pod. The number of robots can be hundreds to thousands to cover different area types: from mini-mart storage to huge fulfillment centers. The MMRS herein can be integrated with new technologies: cloud computing, IoT, artificial intelligence and high-end sensors, actuators, embedded computers to improve not only the functions of each robot but also the features of the whole system. We also surveyed this MMRS application in Vietnam in order to realize its prospects.

Keywords— multi robot system, multi mobile robot system, mobile robot, distribution system of warehouse, fulfillment center

Research and Fabrication of a Carbon Fiber Parabolic Reflector Antenna for Satellite Ground Station at S-band

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Abstract

The applications of carbon fiber material are growing strongly in recent days and it obtains a lot of interest in research and development in satellite technology. Its significant advantages over conventional metal materials (such as steel, aluminum, copper…) are lightness, higher durability and the flexibility in constructing complex structures. In this paper, the possibility of using Carbon Fiber Reinforced Polymer (CFRP) is studied for the design and manufacture of a commonly used satellite ground station antenna topology - the parabolic reflector. The proposed antenna system consists of the reflector and an axial-mode helical radiating element working as the feed antenna, which allows transmitting and receiving circular polarization waves for satellite communication. The feed antenna and the simplified model of the CFRP reflector are constructed and simulated by electromagnetic simulation software for analyzing the electromagnetic properties in 3D wave propagation environment. Furthermore, to evaluate the effects of the CFRP material to the electrical properties of the antenna, an experimental sample has been created and its directional conductivity values are measured using the four-probe method. In order to mimic the

isotropic conductivity of the metal material, the four laminae topology of CFRP is designed, in which, the directions of the carbon fibers in each laminate are 0°, 45°, 90° and 135°, respectively. The laminae have been bonded together by epoxy resin, then being molded to form the parabolic reflector. The simulation and measurement results of the important antenna parameters such as input reflection coefficient (S11) and impedance matching, gain, radiation pattern and axial ratio are presented. The results showed an identical match between simulation and measurement to prove the availability of Carbon Fiber Parabolic Reflector of the antenna. The chosen operation frequency range lies within S-band, which is the frequency band suitable for telecommunicate between ground station and satellite.

Keywords—component, formatting, style, styling, insert

Simulation of crack propagation in FG-GPLRC structures and its application in dataset generation

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Abstract:

The major challenge in Artificial Intelligence applications is the difficulty in dataset collection, especially in the case of advanced materials. The reason for this matter is not only the availability of these materials but also the constraints in human resources, time, and space for the collection. This report aims to develop a method to generate data for the application of AI through the investigation of crack propagation in the structure made of advanced materials: Functionally Graded Graphene Nano-platelet Reinforced composite (FG-GPLRC). The combined knowledge of eXtended Finite Element Method (XFEM) and MATLAB is used to simulate crack propagation in structure, as well as create a dataset with the desired number of data about the crack of FG-GPLRC structure will be a novel, interdisciplinary approach of this study, which is expected to have many useful points for an area of research where data collection is still difficult. In addition, a method for improvement of the simulation results has been proposed in this study too, where meshing is carried out to achieve the convergence between simulation and analytical results.

Keywords: Advanced materials, FG-GPLRC, Crack propagation, XFEM, MATLAB, Dataset.

Solution for robot cleaning the photovoltaic panels in Vietnam

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Abstract

According to the Vietnam Renewable Energy Development Project to 2030 with an outlook to 2050, the strategic goal was set forth: the share of solar power in total electricity production shall account for 0.5% in 2020; 1.6% in 2025, and 3.3% in 2050. And accordingly, the total solar power production shall increase from a negligible level at present up to 12,000 MW in 2050. To reach this goal, huge capital investment to grow the solar energy capacity is needed. But from the other side, the continuous maximum effective energy extracted from the sun (namely the photovoltaic panel-PV, as the main component in the supply system) reduces the installation and production costs and makes it easier to meet the demanded peak electrical power. The accumulation of dust decreases the net output power and reduces the system efficiency significantly. Therefore, it is notably important to keep the solar panels clean from physical conditions such as dust, muddy rain, bird dropping, and other harmful substance on the surface of the PV. There are many types of solar panel cleaning systems based on the principle of operation. It is found that manual cleaning economically is not viable for solar photovoltaic panel (SPV) plants. It is costly as it requires professionally trained technicians. Utilizing robotic cleaning is the most recent trend in recent years. But the question remains for discussion is: with water or dry cleaning? The other aspect is the water supply for cleaning is required. The lifetime of the PV depends on the scratching effect on the surface of the PV. The size and

configuration of the robot are also the problems concerning the allowable pressure on the surface of the PV to keep it from bending too far. From this analysis, this work aims to review all cleaning methods for solar panel and design a promotive, cost-effective robot for PV cleaning. This study presents a preliminary design and fabrication of a semi-automatic robot for cleaning the PV suitably in the local conditions of Vietnam.

Keywords - Photovoltaic panel; Robot cleaning; Vietnam climate environment; Light intensity;Dust accumulation

Design and Integrate Control System for 3R2S2S typed Delta Robot

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Abstract

In the paper, a mechanical design and an integrated control system has been studied in order to create a 3R2S2S typed delta robot can perform some desired tasks. Firstly, geometric structure of a 3R2S2S Delta robot was defined. Alike parallel robots, it includes two platforms, one fixed and joined to a moveable platform by three parallel chains. Next, the kinematic equations of robot are considered to solve the forward and inverse kinematic model. Mechanical design of robot was implemented with the support of Inventor software. The control system was integrated with the use of DMC 2163 driver card. A control algorithm was installed to provide some desired motion tasks. A complete model of 3R2S2S typed delta robot with control and monitoring software has been successfully developed. Validation of proposed robot system was done by simulation and experimental results.

Keywords—delta parallel robot, 3R2S2S, DMC

Analysis and design of a photovoltaic water pumping system

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Abstract

Solar energy is considered to be one of the most promising renewable energies in the world. Water pumping systems using solar photovoltaic energy have been used increasingly widely in recent decades as one of the most popular solar energy applications. This paper aims to analyze and design a simple standalone photovoltaic (PV) water pumping system used for agriculture applications. Initially, solar pumping systems with direct couplings with the pump were utilized; however, their limited performance caused the system to not operate at the maximum output of the PV generator. In the last decade, these systems have been improving their performance due to the addition of the maximum power point tracker (MPPT) and control systems.

Keywords—Photovoltaic pumping system, MPPT controller, Perturb and Observe (P&O)

Fruit Picking Robotic Arm for Agricultural Applications

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Abstract:

Robotic arms are popular and highly applicable robots in many fields nowadays. Following the development trend, they are increasingly improved to become an important technology in production. In this work, a 4-degree-of-freedom robotic arm is studied and designed for application of fruit picking in agriculture. The position of the robot is controlled by coordinates sent from the image processing system through an inverse kinematic model. The robot can operate stably in flexible working positions. The control system consists of an Arduino Mega microcontroller and a servo motor. Through experiments, the average errors of the position in the x, y, z directions are 5.5%, 3.21%, and 9.84%, respectively. The average travel time to the set coordinates is 7.8 seconds. The results after various test cases show that the robot performs well with the accuracy and response time satisfying the specifications in the design.

Keywords: Robotic Arm, Fruit picking, Position control, Kinematics

Image processing algorithms for an agricultural harvesting robot in natural lighting conditions

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Abstract:

The process of automation and modernization is having a strong impact on the agricultural sector recently. In this process, robots play an important role as they are the key driving smart and automotive agriculture. In order for a robotic system to work efficiently, vision processing module is crucial. This study presents an automatic classification and detection system of fruit objects to be harvested for a fruit picking robot. The method is based on the object analysis algorithm by color and image segmentation. The color features are extracted in the HSV color space and then used as input to the OpenCV library-based processing algorithm which will automatically calculate the values for the classification threshold. Different fruits were used to evaluate the automatic sorting method. The resulting objects extracted by this method are presented in binary images. Various experimental results show that the automatic system can extract mature fruit from complex agricultural background and the extraction accuracy is more than 95%. This method is very effective for computer vision systems

to detect and select fruits. Along with this is the strong applicability in practice.

Keywords: Machine vision, OpenCV library, Harvesting robot, Image processing

FLUID MECHANICS

A sensitivity method studying regional response to external sources of pollution and its application to 1D water pollution problem

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Abstract

Prediction of current water pollution is a very important task for life safety of human and life species. To this end, it is imperative to be able to define uncertainty in the model prediction. That is the task of sensitivity analysis whose role is to identify what uncertainty in the model outputs is attributable to the model inputs (parameters in this case). Traditionally this is achieved by running the model for many different random samples of the parameter space to determine their impact on the model outputs. It provides information on how much of the output variance is controlled by each parameter of the inputs. In this paper, we follow the adjoint approach for computing sensitivity of the response function to changes in the input source. This approach allows us to compute the gradient of the response function with respect to the measurement values. One finds that the sensitivity is strongest in the pollution source area. That is one of few methods that is capable of finding the pollution source location for the situation when there is insufficient information on the initial system state and measurements. The method is applied to study the 1D Bugger equation of water pollution.

Keywords— Output sensitivity, response function, source pollution, 1D Bugger equation of pollution.

Application of GIS tool and hydrologic modelling for flow simulation of Cau river basin

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Abstract

The Cau river is one of the major basins in Thai Binh river system and located in the northeastern region of Vietnam. This area has a special geographical position, diversified and substantial water resources. It plays a very important role in social and economical development of provinces within its catchment, such as Bac Kan, Thai Nguyen, Bac Giang and Bac Ninh province. In the recent years, the climate change has caused the extreme weather patterns, like flood inundation, becoming more and more serious. As a result, the study of simulation and forecast of discharge of the Cau river basin is necessary to serve the planning and management the river system in sustainable development.

This paper presents the research and application of hydrologic modeling combined with geographic information systems (GIS) to calculate and simulate the runoff in Cau river basin. The calibration and verification results showed the high reliability of this model, it would be very useful in flood controlling and mitigating for whole area.

Keywords— Cau river, GIS, hydrologic modelling, simulation, NSE index.

Evaluation of salinity intrusion on Kone – Ha Thanh river system

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Abstract

Kone - Ha Thanh River Basin is the largest river basin in Binh Dinh province, with its area of about 3809 km2. This is an economic, cultural, social and political center of the whole province. In dry season, the amount water from upstream decreases, salt water from the sea go into the river, causing river water to be contaminated with salt which seriously affects people's lives, living and production. Therefore, the calculation of salnility intrusion scenarios on the river is essential to minimize the damages.

In this study, a model of calculation combining hydrological, hydraulic and water quality was established, adjusted and tested for good results. Some scenarios are calculated, giving the characteristics of salinity intrusion on the Kone-Ha Thanh river system. This result helps to effectively use of irrigation dams on the Kone-Ha Thanh river system thereby minimizing the damage caused by salinity intrusion.

Keywords: Salnility intrusion, Kone – Ha Thanh River.

Study on the influence of period and wave amplitude on the output power of linear generator by numerical methods

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Abstract

Wave energy conversion is a very important and interesting research field in Vietnam. In the early research work, an experimental permanent magnet linear generator was developed and researched. In this article, we used a method that combines Ansys numerical simulation with the MatlabSimulink program to study the power output of a linear generator using multiple dual Halbach magnet arrays. The results show that the simulation method helps to find the appropriate structure and design parameters to obtain the maximum system power output and efficiency. With the help of the MatlabSimulink program, we can study the influence of wave period and amplitude on power output, therefor we can choose suitable working conditions for the wave energy system.

Keywords—wave energy conversion, linear generator, Halbach arrays, Matlab-simulink

Effect of the Mesh Types on the Prediction of Flow Aerodynamic around Airfoil

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Abstract

Recently, several mesh types have been developed for numerical application in industry such as the structured mesh, the triangle mesh, the Chimera mesh, and the polyhedral mesh. Each of the mesh types has its advantages in handling complex geometries, computation time, convergence property, and numerical accuracy. This study aims to investigate the effect of those mesh types on the accuracy of the numerical results. The flow aerodynamic around the NACA0012 hydrofoil is selected for validation. The numerical result is performed using the commercial software Ansys Fluent 2019R3 and is quantitatively compared with the experimental data for a wide attach angle. As the result, the discrepancy between the numerical and the experimental data of the lift, drag, and skin friction coefficients increases as the attack angle increases for all mesh types. The structured mesh produces the results that are closest to the experiment. The polyhedral mesh shows the fastest convergence but the results are not as accurate as in the structured mesh. On the other hand, neither numerical results nor computational time is insufficiently produced by using the triangular mesh.

Keywords—structured mesh, triangle mesh, polyhedral mesh, chimera mesh, NACA0012, Fluent

Determination of Aerodynamic Coefficients of Drone Propeller by 3D Scanning Technology and Blade Element Momentum Method

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Abstract:

The inspection and evaluation of the aerodynamic characteristics of propellers suitable for the drone design process is currently of interest to the UAV community in Vietnam. In this report, the research team presents the method of digital reconstruction of the small-sized propeller based on the laser scanning technology with high accuracy, reliable, robust and nondestructive manner. The aerodynamic coefficients $\boldsymbol{C_L, C_D}$ of the drone propeller are identified by the Blade Element Momentum (BEM) method, which is a combination of momentum theory, blade element theory and vortex theory. The simulation results obtained in the JBLADE software, which characterize the propeller performance, show an acceptable agreement with experimental results.

Keywords: 3D scanner, reverse engineering, propeller, blade element momentum theory

Motion analysis of wave energy conversion dual buoys using ANSYS-AQWA

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Abstract:

To analyze the motion of the dual buoy mechanism and provide a theoretical basis for the design of wave energy conversion systems, AQWA hydrodynamic analysis software is used. The structural model of each buoy and the connection of two buoys through the PTO system has been built. The problem of simulating the movement of each buoy under the impact of waves has been analyzed. The simulation results show that the size of the buoy at the wave surface has a great influence on the effect of the waves on the buoy, causing the bouy to move with very different speeds, amplitudes and phases. These results are the basis to guide the calculation and design of the size and shape of the two buoys so that the relative motion between the two buoys is the largest.

Keywords: ANSYS/AQWA software, wave energy conversion, dual bouys.

SOLID MECHANICS

Effect of Structure Properties on Biped Locomotion

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Abstract

This article addresses an effect of structure properties on walking behaviour of a humanoid robot. As you may know, the feet have an important role in bipedal walking since they directly interact with the environment. Thus, walking behaviour is sensitive to the foot features. In this paper, joint characteristics of the robot's foot have been investigated for our further understanding of locomotion mechanism. These properties are stiffness and damping factor of spring of passive toe joints. In addition, while considering the human walk, we discover that arm swing motion has a significant effect on angle of rotation, thus, the effect of the characteristic factor of shoulder joint has also been evaluated in the next stage. The study subject of this paper is a small humanoid robot named Kondo KHR-3HV belonging to the Kondo Kagaku company. The foot structure of the robot consists of a big toe and a tiptoe with passive joints using torsion spring. The arm swing mechanism using linear spring is applied to emulate arm swing motion of the humans. The results are collected and validated through dynamic simulation on Adams (MSC company, USA).

Keywords—Biped walk, structure properties, toe mechanism, arm

Exact receptance function of the axially load cracked beam carrying concentrated mass

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Abstract

This paper presents the derivation of the exact curvature receptance function of an axially loaded cracked beam carrying concentrated masses. The influence of the masses and axial force on the receptance curvature is investigated. When there are cracks, there are peaks in the receptance curvature. It is interesting that when concentrated masses are located at the crack positions the small peak in the receptance curvature is more significant than the case of where there is no attached mass. This result may be useful for crack detection: a mass can be applied to amplify small peaks in the receptance curvature to detect the small peak. However, these results are influenced by the axial force: the crack is detected better when the beam is compress, but it is more difficult to detect the crack when the beam is tensioned.

Keywords— Receptance, frequency response function, crack, axial force, concentrated mass

Force Control of an Upper Limb Exoskeleton for Perceiving Reality and Supporting Human Movement Using Feed-forward Model

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Abstract

There is much attraction in developing the upper limb exoskeleton in many applications such as supporting human movement, rehabilitation and training. This paper presents the dynamics analysis and control of the three degree of freedom (DOF) upper limb exoskeleton using the feed-forward model (FFM). In the upper limb exoskeleton, the interaction force between the human operator's hand and the end effector is uncertain and nonlinear due to the disturbance effect of Coriolis force, centrifugal force, gravitational force and friction force; it can be sensed by using a 3-axis force sensor placed at the end effector. In the feed-forward model, the interaction force is considered as an error or disturbance. The force control will reduce the error by using proportional integral derivative (PID) weight gains FMM. For stability, the derivative portion of the PID weight gains FFM is filtered by the low pass filter (LPF). The application of LPF-PID

weight gains FFM in control of the 1 DOF upper limb exoskeleton is shown in an experiment.

Keywords—3 DOF upper limb exoskeleton, Proportional Integral Derivative (PID) weight gains FFM, feed-forward model (FFM), human machine interaction force, force sensor, servo motor, perceiving reality, and rehabilitation

Free vibration of multi-span bi-directional functionally graded beams

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Abstract

Free vibration of multi-span bi-directional functionally graded material (2D-FGM) beams is presented by using a high-order deformation theory. The material properties of the beam are assumed to vary continuously in the thickness and longitudinal directions by a power-law distribution. The frequency parameter of the multi-span beam is computed with the finite element method. The accuracy of the derived formulation is confirmed by comparing the obtained results with the published data. The effects of material and number of spans on the frequency parameter of the beam are examined and discussed.

Keywords—2D-FGM, a high-order deformation theory, finite element method, multi-span

Hopf bifurcation of a mass-spring system with LuGre friction model

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Abstract

In this study, we analyze Hopf bifurcation of a spring-mass system placed on a conveyor belt moving at constant velocity using LuGre model with the Stribeck effect. The Stribeck effect occurs when relative velocity between two surfaces is low (i.e. near-zero velocity) for which the friction force monotonically decreases as relative velocity is increasing. To check the existence of Hopf bifurcation of system motion, we use implicit algorithm criterion developed by Liu, called Liu's criterion, on the basis of the Routh-Hurwitz stability criterion, which is stated in terms of the coefficients of the characteristic equations instead of those of eigenvalues of Jacobian matrix corresponding to the system's equilibrium point. The bifurcated limit cycles can be observed in phase space of dynamical systems. We show that the system has undergone a supercritical Hopf bifurcation in an appropriate range of bifurcation parameters.

Keywords— LuGre model, Stribeck effect, stability, Hopf bifurcation

Influence of Technological Parameters on the Quality of Hydroforming Product from Tube Billet

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Abstract

Hydroforming of products from tube billets is a process for forming complex parts of the automotive, bicycle, aircraft, shipbuilding, chemical, gas, oil, power plant construction industries, household appliances, etc. with fewer operations, lighter weight, better mechanical properties by using high pressure or low-pressure liquid punch. They are characterized by the use of tubes, thus allowing expansion to a variety of shapes. The quality of the hydroforming product from the tube billet depends on the key input technology parameters of the process. Product quality is characterized by accuracy in geometric dimensions, shape, surface quality (wrinkles, tears, etc.). There is a basis for optimal adjustment to improve product quality with great significance in practice. This paper presents the research results to determine the technological parameters and their influence on the quality of tube hydroforming products, such as liquid pressure - axial pressure - axial displacement, friction, and temperature. Research results help technologists to optimize technological parameters in the hydroforming process of the product from tube billet.

Keywords— tube hydroforming, process parameters, metal forming

Investigation of a sandwich plate with two MEE face sheets and FGM core layer from the nonlinear dynamic buckling point of view

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Abstract:

A sandwich plate with two Magneto-Electro-Elastic (MEE) face sheets and Functionally Graded Materials (FGM) core layer resting on an elastic foundation and in a thermal environment will be studied in this paper for the nonlinear dynamic buckling problem. The hypothetical plate model above is formed from the fact that MEE materials have been receiving special attention from the research community owing to their specialized performance and coupled behavior under thermal, electric, magnetic, and mechanical loads, while FGM has been introducing for controlling material response to deformation, dynamic loading as well as to corrosion and wear, etc. The combination of these two materials in the sandwich plate model is expected to create a remarkable new sandwich model. The establishment of all basic equations for the nonlinear dynamic buckling problem of this novel sandwich model will be solved by analytical methods, and the effects of geometrical parameters, temperature, electric and magnetic potentials on the nonlinear dynamic buckling of the sandwich plate will be shown in the numerical results of this study.

Keywords: Smart materials, MEE, FGM, plate, dynamic, vibration, analytical method

Nonlinear vibration in Dufing system subjected to narrow-bad colored noise excitation

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Abstract

The Duffing system, which is widely used in various physical and engineering problems, has still been a popular area of research during the last few decades. Many investigations have been performed to understand the complex behavior of Duffing system taking into account of different effects such as chaotic, fractional and random ones [1-6]. For Duffing oscillator subject to random excitation the well-known averaging method, originally given by Krylov và Bogoliubov and then developed by Mitropolskii, is a useful tool for obtaining approximate solutions. Since the effect of some nonlinear terms is lost during the first order averaging procedure, the higher order stochastic averaging method is developed to overcome this deficiency and to obtain more accurate approximate solutions of nonlinear systems subject to random white noises. The higher order averaging method is also being successfully extended to the cases of colored noise excitation [11-12]. In this paper Duffing system subjected to a narrow-band colored noise is investigated. The paper shows that an approximate solution can be found by the second order stochastic averaging method. The accuracy of the approximate solution is confirmed

by the Monte-Carlo method. The effects of the system parameters on the response are analyzed in detail. It is shown that the higher order averaging solution is more accurate than the one obtained by the traditional first order stochastic averaging method.

Keywords— Stochastic system, Higher order averaging, Duffing oscillator, Colored excitation.

Optimum buckling analysis of laminated composite plates reinforced by multiple stiffeners

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Abstract

This paper presents an optimization procedure developed in Abaqus2Matlab to obtain the optimum locations of stiffeners, fiber angles of the laminated composite plates subjected to compression, bending, and shear. Abaqus2Matlab is a computational tool that supports automatic linking between Abaqus and Matlab by transferring and creating the necessary files for the optimization procedure. In this procedure, a gradient-based interior-point optimization algorithm is employed to maximize the buckling coefficients until achieving the optimum design variables (locations, fiber angles) of the problem. The results of specific cases that used this method are compared with results found in the literature. The results of the maximum buckling coefficient with the optimum design variables of the laminated composite plates subjected to different types of loads and boundary conditions are studied in a detail.

Keywords: Buckling analysis, Abaqus2Matlab, Optimum design, Laminated composite plates, Stiffened plates

Parameters analysis on the vibration of composite ring-stiffened cylindrical shells in interaction with elastic foundation

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Abstract

This study presents the continuous elements method (CEM) for the vibration parameters analysis of composite inner ring-stiffness cylindrical shells resting on Winkler elastic foundation. The dynamic stiffness matrix of the considered structure has been built by using a procedure of assembling continuous elements of cylindrical shells and annular shells in contact with elastic foundations. Solutions on natural frequencies and harmonic responses obtained by our formulation are compared to results of other approaches and to those of FEM to demonstrate the advantages of CEM: higher precision, time and resources of computing saved, size model reduced even in medium and high frequency range. In addition, the influences of shell and foundation parameters are also investigation.

Keywords— Dynamics stiffness matrix, Continuous Element Method, composite shell, shells on elastic foundation, ring-stiffened cylindrical shells, vibration of shell

Research for static stability of the conical shells including foundation effects

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Abstract

This paper introduces how to establish and solve the linear static stability of the conical shells and the circular plate. The linear static stability equation system is the partial differential equation system with functional coefficient. This coefficient has infinite value at the the apex of cone and center of the circular plate. Therefore, the integrals that need to be computed during the resulting process are the singular integrals. The problem is that preselected solution must be appropriate, to satisfy the boundary condition and the singular integrals are converged and computed. This paper introduces the form of a preselected solution responsing such requirements. With the preselected solution, we can solve the linear static stability problem of the conical shells subjected to uniformly distributed load, including foundation effects, based on the Pasternak foundation model with two parameters on the elastic foundations. The linear static stability equation describing the proximity equilibrium state has been established, therefore the critical load has been found. The effect of material parameters and other parameters on the critical load was investigated.

Keywords - conical shell, preselected solution, linear static stability equation, singular integrals.

Self-Supervised Depth Estimation with Vision Transformer

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Abstract

While convolutional neural network can extract local features of image, Vision Transformer can process global features. In this work, we propose to apply self-supervised monocular depth estimation pipeline to train a network composes of Vision Transformer, which integrates local features and global features of input image to improve quality of predicted depth map. In addition, we propose a method of choosing loss weights in multi components self-supervised loss to improve the performance of depth prediction. Our work achieves a competitive result among other self-supervised depth estimation methods. Our code is available at: https://github.com/maxuanquang/SfMLearner-ViT/

Keywords—Depth estimation, self-supervised, vision transformer, convolutional neural networks, multi-loss balancing

Simulation superelastic behavior of shape memory alloy and applications reduce oscillations

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Abstract

Shape memory alloys (SMA) remember their shape due to thermoelastic martensitic phase transformation. These alloys have advantages in terms of large recoverable strain and these alloys can exert continuous force during use. The shape memory effect and superelasticity are two important properties of SMA. This paper addresses a one-dimensional model able to reproduce the shape memory alloy superelastic behavior, taking into account the different elastic properties between austenite and martensite. The model is based on a single scalar internal variable, the martensite fraction, for which evolutionary equations in rate form are proposed. The model's ability to simulate one-dimensional experimental data is evaluated. Finally, the superelastic property of SMA is used to reduce oscillations in cable-stayed cables. The results were compared for the case with and without SMA. The problem of the optimal design of the device is studied. The maximum dissipation energy depends on the cross-sectional area, the length, and the location of the SMA on the cable.

Keywords—Shape memory alloy, matensitic phase transformation, stay cable, superelastic

Vibration analysis of FGM ring-stiffened conical shells by Continuous Element Method

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Abstract

This research presents the continuous element (CE) formulation for the vibration analysis of FGM ring-stiffened conical shells. Using the solutions of the shell differential equations, the dynamic stiffness matrix of the investigated structure is evaluated. An algorithm of assembling conical and annular shells is introduced in order to compute the natural vibrational frequencies of FGM ring-stiffened conical shells. The CE solutions will be compared to those from other researches to emphasize the advantages of the continuous element method in terms of higher accuracy, saving computer time and resources and especially, the possibility to investigate the medium and high frequency ranges. The influences of shell and material parameters are also in consideration.

Keywords— Dynamics stiffness matrix, Continuous Element Method, FGM shell, conical shell, ring-stiffened conical shells, vibration of shell.

Finite element modeling for free vibration behaviors of piezoelectric cracked nanoplates with flexoelectric effects

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Abstract:

For the first time, the finite element technique is used to investigate the free vibrations of fractured nanoplates where linearly changing plate thickness and the flexoelectric effect are taken into account. Mindlin's first-order shear deformation theory is used to establish mechanical behavior relations and equilibrium equations for nanoplates. Because the phase-field variable is employed to describes the crack, it forms a continuum that is simple to compute and integrated. The present theory is reviewed for accuracy by comparing the computed data of this paper with those of published findings. The effects of geometric and material properties on the natural frequency response, vibration mode shapes, and charge polarization of fractured and variable thickness nanoplates are then investigated in this study.

Keywords: vibration, nanoplates, finite element method, flexoelectricity, first-order shear deformation, variable thickness