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Session FP1-1

FP1-1 #1006

A Full-Digital Quasi-Proportional Force Output Solenoid

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Abstract
In this paper, a new idea to design a novel full-digital quasi-proportional force output solenoid is proposed and realized. Unlike the conventional analogue proportional force output solenoid, the new design utilizes four parallel-connected switching solenoids together with binary coding technology to develop the novel full-digital 16-step quasi-proportional force output solenoid. After experimental tests, it is proved that the digital 16-step resolution of force output is satisfactory. Therefore, it is expected that such a new design may find some potential applications in the field of pneumatic or micro-fluidic valve technology.

Keywords: Pneumatics, Proportional Solenoid, Digital Fluid Power, Switching Solenoid, Binary Coding.

FP1-1 #1013

Position and Orientation Estimations of the Endeffector of a Robot Arm Using Kalman Filter

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Abstract
This paper presents the position and orientation estimations of the end-effector of a robot arm using the Kalman filter, which is integrated with an inertial measurement unit (IMU) and a CCD camera. The IMU signals are used to predict the position and the orientation of the end-effector, and the CCD image is used to correct them through identifying a feature point on the end-effector. In the filter, the state variables are defined as the errors of the position, the velocity, and the rotating angle. Since IMU signals might have biases, their estimation errors are also defined as additional state variables. This paper demonstrates the simulation and experimental results by performing an in-plane motion of the end-effector, and the results show that the estimations are reasonable to compare with the specifications of the IMU and the CCD camera.

Keywords: Robot arm; Kalman filter; Interal measurement unit; CCD camera.
Indoor Service Robot Development for Autonomous Navigation

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Abstract

Autonomous Navigation is the most important issues for mobile robot development. Mobile robot navigation system can be divided into self-localization, path planning and obstacle avoidance for indoor service execution such as security patrol or package delivery. Furthermore, how to select the navigation method to be a problem. In this work, the indoor service robot is designed and built with a 4WD mecanum wheel platform. Due to the laser ranger’s high precision, we applied the laser ranger to achieve the environment map construction, so the self-localization via particles filter (PF) and the path planning algorithms can be utilized with the map. The practical motion and safety avoidance strategies are also proposed for robot motion control.

Keywords: mobile robot, mecanum wheel, particles filter,

Development of an Intelligent Monitoring and Diagnosis System for an Industrial Robot

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Abstract

The focus of this paper is development of an intelligent monitoring and diagnosis system to prevent the failure of an industrial robot and to further identify the causes of such potential failures. The system described here enables efficient and sensitive monitoring of operation conditions for an industrial robot using principal component analysis (PCA)-based statistical process control (SPC) with Nelson Rules. Multi-class support vector machines (SVM) are then used to perform fault diagnosis. The system is applied to a Delta Electronics industrial robot to verify its effectiveness. This paper focuses on several faults causing performance degradation in an industrial robot.

Keywords: PCA; SPC; Multi-class SVM; Nelson Rules; Monitoring; Diagnosis.
Session FP1-2

FP1-2#1024

Automatic Alignment and Compensation Module for the Linear Positioning

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Abstract

Positioning calibration is a necessary procedure for machine tools and laser interferometers are commonly employed in the precision machine for the linear positioning verification. However, the calibration procedure is usually performed by the manual operation, it may cause the personal errors and inefficiencies. Therefore, two modules have been integrated with the laser interferometer. One is an automatic alignment module for the optical axes and the other is an automatic compensation module for the linear positioning calibration. Currently, an excellent calibration procedure depends on the experienced operator. The complicated adjustment process of the laser interferometer and low efficiency of the manual compensation to the controller may induce the personal error. By integrating these two modules, the measurement results indicate that the cosine error caused by misalignment can be reduced to 1 nm for about 106 seconds in the measuring range of 240 mm in the fine-tuning stage. After the automatic compensation of the positioning error, the measurement results reveal that the relative accuracy for the positioning errors can be enhanced about 92 %. Hence, the integrated development has the advantages of high transmission rate, convenient operation, avoiding the manual errors and improving the testing efficiency.

Keywords: Automatic alignment module; Automatic compensation module; Linear positioning, Machine tool; Calibration procedure.

FP1-2#1050

Augmented Reality Assisted Programming by Demonstration for Motion Planning of 3-Axis Glue Dispenser

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Abstract

This paper presents a novel augmented reality (AR) based interface for motion planning in 3-axis glue dispenser via programming by demonstration (PhD). The interface provides a set of interactive functions that assist a human planner to quickly determine the dispenser motion in a demonstration task. The planning is conducted in an AR environment that integrates virtual information in
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various forms into the video stream of a moving dispenser. The information is automatically prompted to the human planner while guiding the machine in 3D space. The focus is to facilitate generation of the dispenser tip’s moving path by enhancing human’s spatial reasoning, especially the relative position between the dispenser and the work part during the PbD process. This work demonstrates the practical value of AR as an interfacing technology in manufacturing automation.

*Keywords: Augmented Reality; Human-Computer Interface; 3-Axis Dispenser; Path Planning, Industry 4.0*

**FP1-2#1076**

**A Study of the Temperature Rising on Triaxial CNC Machine Tools**

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Abstract

Thermal deformation is the main factor affecting the machining accuracy of the tool. And for thermal deformation modeling approach depends on the machine set up temperature sensors to collect temperature changes in the information. To study the overall deformation of the overall structure of the machine tool, but also need to set a number of machine parts in a number of temperature sensors. This study establishes a temperature prediction model. Only need to enter the processing conditions and processing time, you can predict the 18 temperature on the machine temperature changes, so you can reduce the temperature sensor settings. And the experimental results show that the measured temperature and model predict the temperature error within ± 1°C.

*Keywords: CNC Machine tools; Temperature Estimation; Thermal Deformation.*

**FP1-2#1051**

**Automatic Recognition of Fillets and Holes in Solid Models**

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Abstract

Mesh generation is one of the key factors affecting the computational efficiency and accuracy in finite element analysis. There always exist some features on the CAD model, such as tiny holes of various types and fillets, which are insignificant from the analysis point of view but complicate matters during mesh generation. The aim of this study is to present a method for the recognition of fillets and holes of various types for the application in automatic mesh generation. A procedure for the recognition of fillets is developed to build the attributes and topological data of edges and faces related to fillets. An algorithm based on the loop data on the B-rep model is then developed for the recognition of holes. Several industrial parts are presented to verify the feasibility of the proposed method. Its application for automatic mesh generation is also demonstrated.

*Keywords: Holes recognition, Blend faces recognition, Feature recognition.*
Implementation of an Open Source Planar Linkage Mechanism Simulation and Dimensional Synthesis System

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Abstract

In this paper, an open source cross-platform single-degree-of-freedom planar linkage mechanism simulation and dimensional synthesis system, called Pyslvs, is presented. The geometric constraint solver of SolveSpace is used as one of the kernels in this Python 3 and PyQt5 based software. Another kernel is developed through the symbolic derivation by using the SymPy module. Given a series of tracking points and the type of the planar four-bar linkage, the software can be used to calculate feasible linkage topologies and associated dimensions by using the real-coded genetic algorithm, firefly genetic algorithm or differential evolution methods. At the end of this paper, the typical crank-rocker and Jansen’s linkage that demonstrate the operation and simulation process are tested in the Windows and Ubuntu operating systems.

Keywords: Open source software; Planar linkage mechanism simulation; Dimensional synthesis.
Session FP1-3

FP1-3#1058
Cutting-insert Selection and Cutting-Parameter Optimization for Turning Operations based on ANN and GA

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Abstract
In this paper a model for cutting inserts selection based on its features and working conditions in turning operations is presented. In this work, a database of inserts and its recommended cutting parameters are used to model feed rate (fn) and cutting velocity (vc). It also presents an optimization approach to find both optimal inserts and its cutting parameters. The optimization problem is constrained by working conditions like working material, cutting diameters, machine power available, etc. This approach uses Artificial Neural Networks (ANN) to model cutting parameters and Genetic Algorithm (GA) to find an optimal solution. To validate the ANN models a comparison between the error of training and testing datasets using mean square error (MSE), root mean square error (RMSE), median absolute deviation (MAD) and error density distribution is shown. The information to build the database was chosen from the Sandvik Coromant website, particularly, the insert model CoroTurn® 107.

Keywords: Cutting insert selection; Optimal Cutting Parameters; Artificial Neural Networks; Regression Models; Genetic Algorithm.

FP1-3#1073
Coordination of Makespan, Power Consumption and Yield Loss Management

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Abstract
Carbon footprint and energy-aware production have been widely discussed in recent year, and various approaches on energy saving have been investigated in different fields. However, most of the research only focuses on optimizing total power consumption instead of considering in other manufacturing objectives at the same time. Hence, it’s not only hard to come up with an efficient coordinated strategy but also hard to implement the research outcome to the industry. In this research, we construct three linear programming models (LP model) and use Gurobi as the solver to reach the goal of minimizing the makespan, power consumption, and yield loss. We also change the model solving sequence to find out the best strategy in different manufacturing environments.

Keywords: multi-objective LP model, power consumption, yield loss
Development of a Neural-network Surface Roughness Prediction Model for CNC End Milling

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Abstract
The surface quality by an end milling process is affected by machining process parameters. In the past the process parameters are usually set according to the suggestions of tooling companies, and thus it is difficult to control the surface quality or sometimes it takes a lot of time to achieve good surface quality. Therefore, this research aims at developing a surface roughness prediction model using the backpropagation neural networks for end milling processes. Results show that either the 6-10-1 NN model or the 5-3-5-1 NN model with different force features as some of the model inputs can be adopted as the surface roughness prediction model. This surface roughness prediction model can be further used in the future to search for the optimal process parameters for the desired surface quality.

Keywords: end milling, surface roughness model, backpropagation neural networks.

Degradation Assessment of Band Saws Using Self-organizing Map

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Abstract
Band saw machines are widely used in various industries for cutting metal raw material as a pre-processing step before accurate processing. Compared to machine itself, band saw blades usually degrade a lot faster and a much larger portion of user expenses come from purchasing it. Traditionally, the timing of replacing the band saw is determined by experience. In this study, a methodology employed to analyze the degradation status of band saws is present, including data collection, signal processing, feature extraction, and degradation assessment using self-organizing map.

Keywords: Band Saws; Degradation Assessment; Self-Organizing Map.
Session FP2-1

**FP2-1#1039**

**Design and Control of Five Axis Manipulator for Force Control in Polishing Operations**

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**Abstract**

In this paper, a five degree of freedom (DOF) manipulator was designed and manufactured for polishing purposes. The Denavit-Hartenberg algorithm was used to calculate the forward and inverse kinematics of the manipulators. The two controllers that were utilized are the force controller (which was based on impedance control) and PID controller. The latter was used to control the joint motion in order to position the end effector (polishing shaft), while the former was used to improve the precision of the polishing process. Arduino was responsible for the PID controller and another standalone PC was responsible for the force controller. The paper also highlights the creation of a polishing path which is used as tracking path for the end effector (this was achieved using NX). By using the force controller, the surface roughness of the workpiece decreased and thus, it can be stated that the precision of the polishing process has improved with the use of a force controller.

*Keywords: Force Control; Impedance Control; Manipulator; Cutter Location; Polishing*

**FP2-1#1048**

**Assembly System for Robot Arm under Non-Control Lighting Environment**

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**Abstract**

The purpose of this study is to present a smart faster classification and assembly system under non-control lighting environment for robot arm (HIWIN) with six degrees of freedom. A machine vision was integrated with robot arm to conduct pick and place process. Machine vision method was used to build coordinate measurement system. The image data from a CMOS camera was transmitted to a PC to calculate the parameters and then sent to controller of robot arm. Robot arm was used to pick the components from workspace into the boxes and assemble together. With the proposed system, the world coordinates of components are accurately determined and the coordinate conversion errors were evaluated and used them to control the movement of robot arm. Software used in this work is Visual Basic 6.0 and Visual Studio 2013. The results show that the smart faster classification and assembly system could detect and identify the shape and orientation of components correctly. With calibration error, the positive maximum error is 0.56mm and 0.79mm in X-direction and Y-direction, respectively. The negative maximum error is -0.54mm and -0.56mm in X-direction and Y-direction, respectively. The resolution of measurement system is 0.8mm. The proposed system is accurate, simple and effective.

*Keywords: Robot arm, camera calibration, machine vision, image measurement.*
**Robust Attitude Control of a Quadrotor using Rodrigues Parametrization**

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**Abstract**

This paper presents a novel flight control scheme for a quadrotor craft. We employed Rodrigues parametrization as an effective attitude representation with which a robust sliding mode attitude control was derived to achieve trajectory tracking flight. Specifically, given a planned trajectory, a PID controller is firstly employed to achieve the required translational motion, and then a robust attitude flight control law based on Rodrigues parametrization is derived to fulfill the desired attitude associated with the planned trajectory. Third, an embedded flight control board is devised to accomplish some basic flight control modes. The flight control board is realized in terms of two ARM Cortex M3 MCUs. The two-core architecture features its flexibility in maintenance and future development. Finally, the attitude control is tested in terms of an experimental setup; then, an outdoor GPS-flight test is carried out to demonstrate the effectiveness of the control.

**Keywords:** quadrotor, Rodrigues parametrization, trajectory tracking, sliding mode attitude control, ARM based flight control board.

**Optimal Design of a Double-Stator Switched Reluctance Motor**

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**Abstract**

The primary objective for this paper is to create a methodology to rapidly optimize double-stator switched reluctance motor (DSSRM). An analytical model of equivalent magnetic circuits for the air gap reluctances of aligned and unaligned positions is proposed and the optimal operation point of the magneto-motive force (MMF) can be determined. Genetic algorithm (GA) integrated of the proposed equivalent magnetic circuit is developed for rapid optimization of DSSRM to reach the maximum of the ratio of torque to volume of DSSRM. Compared to conventional switched reluctance motor (SRM), an illustrated example of a 3KW three-phase 12-Slot-8-Pole DSSRM is used to verify the efficiency of the proposed method. A simplified 2-D electromagnetic models are analyzed and simulated. Finally, results of the analytical calculations and the finite-element analysis (FEA) are validated by the proposed motor to show the accuracy of the designed strategy.

**Keywords:** rapidly optimize, double-stator switched reluctance motor, equivalent magnetic circuit, electromagnetic analysis,
genetic algorithm, finite-element analysis.
Session FP2-2

FP2-2#1011

A Study of an Intelligent Multi-Camera Video Surveillance System Based on Stereo Vision

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Abstract

The objective of this paper is to develop a multi-camera video surveillance system based on stereo vision for enhancing the functionality of traditional video surveillance system. The system consists of four main functions: binocular stereoscopic vision, hybrid autofocus with motion tracking, three-dimensional (3D) model reconstruction, and 3D infrared thermography. In order to achieve these functions, this paper presents an integrated approach to combine novel stereovision, autofocus technique, 3D reconstruction and infrared photography technique. First, stereovision and autofocus technique are integrated into this system to estimate zoom in ratio for tracking and recording more clear and valuable images of the moving target. In addition, this system can convert a set of stereo images into a disparity map using the speed-up robust features algorithm for reconstructing 3D models of the monitoring field and the moving target. Furthermore, a 3D thermal imaging technique is developed in this paper to establish a 3D thermography of the tracked moving target. Finally, experimental results show the validity and performances of the proposed system.

Keywords: Stereo Vision; Speed-Up Robust Features; Autofocus Technique; 3D Thermography; Infrared Photography.

FP2-2#1026

A Novel ECG Signal Analyzer for Intelligent Home System

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Abstract

Intelligent home means that management of appliances, air conditioning system, lights, security monitor system, and video/audio system can be controlled by smart phones. This study proposes a novel electrocardiography (ECG) signal analyzer for intelligent home system. Its major function is to transmit ECG signals of the elderly under care at home to his/her family and health care professionals. The health care professionals can provide instant health care if an emergency occurs. This system consists of four major processing stages: (1) the preprocessing stage for amplifying ECG signals and filtering noises; (2) the ECG signal transmitter/receiver stage for transmitting ECG signals to the signal receiver in patient's house through Bluetooth (IEEE 802.11b); (3) the QRS extraction stage for detecting QRS waveform using the Difference Operation Method (DOM); (4) the classification stage for determining heartbeat case by use of the Weighted Principal Component Analysis (WPCA). In this study, the heartbeat cases are classified into NORM, LBBB, RBBB, VPC, APC and PB cases. Records of MIT-BIH database are used for performance
The experiment results show that the total classification accuracy of the proposed system is approximately 94%.

**Keywords:** Intelligent Home; Weighted Principal Component Analysis (WPCA); Electrocardiography (ECG).

**FP2-2#1047**

**Design of Sensor Fusion Driver Assistance System for Active Pedestrian Safety**

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**Abstract**

In this paper, we present a parallel architecture for a sensor fusion detection system that combines a camera and 1D light detection and ranging (lidar) sensor for object detection. The system contains two object detection methods, one based on an optical flow, and the other using lidar. The two sensors can effectively complement the defects of the other. The accurate longitudinal accuracy of the object’s location and its lateral movement information can be achieved simultaneously. Using a spatio-temporal alignment and a policy of sensor fusion, we completed the development of a fusion detection system with high reliability at distances of up to 20 m. Test results show that the proposed system achieves a high level of accuracy for pedestrian or object detection in front of a vehicle, and has high robustness to special environments.

**Keywords:** Object detection, Optical flow, Sensor fusion, Short range lidar.

**FP2-2#1060**

**Deep Learning and Computer Vision Based Freeway Lane Detection**

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**Abstract**

Recently, an advancement in computer vision and deep learning based image processing enable the safety driver assistant system. Such advanced system can provide a safety precaution for drivers during driving of the vehicle on the freeway. Towards such goal, a lane detection approach was designed in this paper which can be used for intact lane departure and maintain a safe distance from the front vehicle to avoid the forward collision. In this work, the convolutional neural network (CNN) was used for highway road lane segmentation and feature extraction purpose. Besides, a sliding window technique with histogram was applied on the segmented images for lane detection. Finally, a perspective transformation was carried out to draw the front view of the lane and road. The experimental results have demonstrated the effectiveness of our proposed lane detection method.
A PC-Based Parallel Computing Platform with Real-Time Linux for Visual Feedback

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Abstract

Roll-to-roll coating and printing have been considered as potential low-cost high-throughput fabrication methods for flexible electronics. This paper presents the first step of a study aimed at one particular challenge confronting the application of roll-to-roll fabrication to flexible electronics, i.e., how to achieve high pattern registration accuracy for multi-layer printing at high web processing speed. In particular, a PC-based visual feedback platform with a real-time Linux operating system and the GPU-based CUDA (Compute Unified Device Architecture) parallel computing is proposed. Experiments with a photolithographic mask comprising parallel lines with widths from less than 10 μm to 100 μm-time parallel-computing platform was able to complete the visual feedback from capture, transmission, and saving of an image of 512 x 512 pixels from the CCD camera to the host PC to the completion of the line detection using the Canny edge detection and Hough line detection algorithms in 6.694 ms in average with a one-standard-deviation jittering of 0.288 ms. In comparison, a parallel-computing but with an ordinary vanilla Linux operating system, a non-real time operating system, incurred an intolerable one-standard-deviation jittering of 6.860 ms with an average processing time of 8.087 ms.

Keywords: Visual feedback; CUDA parallel computation; Real-time Linux.
A Study on the Holding Pressure & Feeding Back-Pressure Control for Hydraulic Plastic Molding Machine

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Abstract
The control performance of the injection-holding transition, holding pressure and the feeding backpressure was studied. Based on those studies, some improving methods were proposed. For the injection-holding transition control, the screw velocity is decelerated before the injection ending point, and when the pressure turns flat the system switch to pressure control loop with S-curve smoothly changing the pressure to the first section holding pressure. For the holding pressure control, constant pressure with precise time period was controlled for the first section pressure control to make the mold precisely packed. After that, a smoothly declined holding pressure control was proposed to prevent the plastics flow in/out of the mold during the cooling stage. For the feeding back pressure control, the hydraulic cylinder continues to maintain the back pressure, and the feeding motor rises the speed to the set value with S-curve and maintains constant speed thereafter. When the hydraulic cylinder reaches to the point before the end feeding position with a certain distance, the feeding motor decelerates to the minimum speed linearly according to the distance to the end feeding position. Finally, when the hydraulic cylinder reaches the end feeding position, the feeding motor stops immediately. At this point, the hydraulic cylinder will maintain the back pressure, and it will be stopped precisely at the end feeding position.

Keyword: injection-holding transition, smoothly declined holding pressure, feeding back-pressure

Automated Matrix LED Detection System

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Abstract
The Matrix Light Emitting Diode (Matrix LED) is one of the most widely used LED material in the industry. We realized that most of the defect inspections of the Matrix LED are still carried out by labors. With the rise of the labor cost and the instability of the manual inspection quality, it is needed to apply Automatic Optical Inspection (AOI). In this study, we propose an effective AOI system for Matrix LED. The system consists of three defect inspections, surface defects, Bright/Dark spot, and RGB Chroma. The surface defects are mainly detected by the findContours and the Canny edge detection. The accuracy of the proposed method
can reach up to 85.00%. The Bright/Dark spot detection is mainly based on the background subtraction and Morphology. Finally, the RGB Chroma detection is based on the support vector machine for classification, and its accuracy can reach up to 91.09%. Experimental results show that the proposed methods are effective and outperform the previous methods.

Keywords—Matrix LED; findContours; Canny edge detection; image processing; computer vision system; SVM;

FP2-3#1025

Study on Three Dimensional Metrology System with Automatic Calibration and Spot Guidance Technology for Metal Product Measurement

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Abstract

This paper proposed an innovative calibration method to accomplish the automation of the calibration work and to improve the precision of the calibration result. The calibration method of this system which can automatically track calibration points was accomplished by using Hough circle methods and sorting algorithms. In order to improve the accuracy while doing a measurement procedure, a reference point was established on the workpiece by using a single spot of the red laser with a wavelength of 650 nm. By using methods of HSV conversion and binary thresholding, a lot of pixels which represents the laser spot can be obtained. The center of those pixels can be treated as the center of the laser spot. By using the above method, the precision of the proposed measurement system can be improved. The image coordinates of the calibration system are converted to world coordinates to verify the measurement accuracy. There are 0.0026, 0.0011 and 0.0005 mm in X, Y and Z directions, respectively. In order to estimate the reliability of 3D measurement system, a measurement process was carried out with a testing sample. The result is compared to CMM and ATOS equipment. The conclusion shows that the 3D measurement system is simple, easy to use, low cost, and flexibility.

Keywords: non-contact measurement, three-dimensional measurement, automatic calibration, stereo vision.

FP2-3#1032

A Vision Inspection Method for Automatic Alignment of Twin Piezoelectric Heads in 3D Printing System

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Abstract
The purpose of this paper attempts to rapidly align the head arrays and monitor head conditions in a twin printheads printing system. In this paper, machine vision computation was conducted in order to manipulate the alignment configurations for a better image quality. The proposed vision inspection was implemented with a scanner and vision processing techniques as an offline system. Results of this paper showed an adequate alignment setting of twin printheads by image processing algorithms. Compared with manual alignment, the proposed system not only reduces the tedious and complicated processes but also saves lots of time. By setting the correlative coefficients to the printhead, users can clearly realize the printhead status and reach the expected printing quality. This paper may be of importance in explaining the printhead alignment configuration, as well as in providing users with a better understanding of multiple printhead operation for a 3D printing system.

Keywords: 3D Printing, Alignment, Piezoelectric printhead, Printhead array, Vision inspection

Sliding Mode Controller Design for CNC Machine

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Abstract
The control of a tri-axis CNC machine tool platform, which is driven by an AC servo motor is discussed in this paper. To establish a system model, the particle swarm optimization (PSO) algorithm was used to transform the X-Y platform of a machine tool into a transfer function before simulation and verification of digital control was done using MATLAB. The control methods used in this study include proportional-integral-derivative (PID) control, and sliding mode control (SMC). They were realized with C++ and the errors of motion trajectories generated by the controllers were observed. It was concluded, that of the three methods studied, SMC control produced the lowest error rate.

Keywords: PSO, PID, SMC, tri-axis CNC machine.
Development of a Wireless Network Monitoring System for a Gallium Nitride Power Module

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Abstract

In this study, we developed a gallium nitride (GaN)-based monitoring system, which involved GaN fabrication and parallel cascode package design, analysis of degradation and failure modes, inverter modulation, and wireless network monitoring. The parallel connection of the cascode GaN device with a large gate width (80 mm) can increase the total output current of the device and can improve the device power. The cascode switch using an Si-MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor) and the GaN device can replace the conventional MOSFET. Degradation and failure modes are considered in the cascade switch. Digital control with novel pulse width modulation can improve the performance of a GaN-based voltage source inverter (VSI). In this study, we used GaN devices in the VSI and monitored the electrical parameters by using a wireless network for sorting the uniformity from the threshold voltage and gate current.

Keywords: Gallium Nitride; enhancement-mode; cascode; degradation; no-dead time modulation; wireless network monitor.

A Novel Voltage-Current Based Speed Observer Applied to DC Servo Motor

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Abstract

This paper proposed a novel structure of speed sensorless observers for speed estimation of DC servo motors. The proposed observer is featured with simplification that only the input voltage and armature current response of the driving motor are required for the estimation. In contrast to the classical observers, such as Luenberger observers, which are susceptible to modelling uncertainty and disturbance, the proposed speed sensorless observer is demonstrated to possess the robustness and the ability of disturbance rejection according to the theoretical analysis. The effectiveness of the proposed observer is further verified with simulation results, and showing that the proposed speed sensorless observer achieves the accurate motor speed estimation in steady state even under the influence of modeling uncertainty and disturbance input.

Keywords: Speed Sensorless Observer; Sensorless; Modelling Uncertainty; Disturbance.
3D Automatic Optical Inspection Based on Digital Fringe Projection Techniques

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Abstract
In this study, a 3D non-contact measured system is developed for the golf club impact face radian measurement. This measured system improve the digital fringes projection associated with the phase-shifting technique for 3D surface radian measurement. This study establishes a more accurate relationship between the height and the phase values. A multiple polynomial function is adopted for the actual height measurement and the accuracy can be improved. In the real practical measurement validation, the developed DLP-based phase-shifting technique is applied to the golf impact face 3D measurement, the repeatability is better than that by coordinate measuring machine. The experimental results reveal that the developed optical measurement system can meet the accuracy level of the manufactured processes required by less than 2.54mm (0.1 inch).

Keywords: 3D shape measurement, digital fringe projection, phase-shifting technique, image clarity analysis on focus process.

A Self-Sensing Piezoelectric Stage for Fluidic Sampling

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Abstract
For driving a sampling capacity smoothly, this paper proposed a self-sensing stage which includes a piezoelectric actuator and position-sensing IC to develop an automatic feeding system. To fix piezoelectric actuator stably and avoid to influence the motion of piezoelectric actuator, finite element method was used to find the nodes of piezoelectric actuator. We designed an adjustable preload system for adjusting the positions of preload force which is used to calibrate the error in simulation and increase the efficiency of this system. The capacitive sensors instantly measured the capacitance which was used to distinguish the position of sampling capacity and the distance between sampling capacity and fluidic samples. To avoid overfilling the fluidic samples into sampling capacity, the velocity of piezoelectric actuator can be arbitrarily adjusted by pulse-width modulation (PWM) and achieve microstepping motion. Moreover, the driving circuit of piezoelectric actuator involving a phase-locked loop was used to automatically track the resonance frequency of piezoelectric actuator.

Keywords: Piezoelectric actuator; Capacitive sensor; Finite element method; Phase-locked loop; Driving circuit.
An Automated Colonoscope for Colon Diagnosis Using Arduino Control

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Abstract
Colonoscopy is the current gold standard for diagnosis and treatment of colon diseases. In order for physicians to conduct colonoscopy procedure more efficiently, an automated colonoscope concept is proposed to provide a new treatment option. The objective of this study is to automate the “straight” and “turning” motions of the colonoscope to alleviate its contact with the intestinal wall, thus improving the efficiency of the operation and reducing the discomfort for patients. The image signal is captured in real-time by the CCD camera originally installed at the distal tip of the colonoscope. Image data are processed and then fed into an Arduino module for automation task. Two joysticks are used to provide more options and freedom for physicians to maneuver. These automated features can be added directly onto existing colonoscope products without major modification of the colonoscope. Results show that the automated colonoscope prototype can advance inside the simulation model repeatedly and successfully. This automation concept is proven feasible for clinical practice and has great potential for full commercialization in the future.

Keywords: Automation; Colonoscope; Endoscope; Image Processing; Arduino.

Low Cost Impedimetric Biosensor for the Quantitative Detection of Chronic Kidney Disease

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Abstract
In this study, we have fabricated a simple disposable plastic based immunosensor for the detection of human serum albumin (HSA) based on electrochemical impedance spectroscopy (EIS). Interdigitated electrodes (IDEs) are fabricated on a polyethylene terephthalate (PET) substrate using a screen-printing protocol. Screen printed electrodes (SPEs) are highly suitable for fabrication of disposable electrochemical sensors because of their low cost, linear output, low power requirement, quick response and high sensitivity. Each immunosensor has two IDEs corresponding to the test and control site to improve specificity by performing differential analysis. To enable efficient immobilization of HSA antibodies, we have utilized dielectrophoresis (DEP) to trap microprobes (MPs) on the electrode surface. The MPs consist of micro particles with a polystyrene core and a silver shell that are conjugated to HSA antibodies via covalent chemistry. Immunosensing results show that the normalized impedance response is linearly dependent on HSA concentration with a current limit of detection of 0.15 mg/ml. For HSA concentration of 0.6 mg/ml, the normalized impedance variation is 3.02 times higher at the test site as compared to the control. Consequently, this disposable
immunosensing platform shows promise for use in point of care testing of CKD.

Keywords: Dielectrophoresis; Chronic Kidney Disease biomarker detection; Microprobes

SA1-2#1033

Innovative Automation System Design for PP-bag Mushroom Cultivations

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Abstract

Traditional PP-bag mushroom cultivation processes are subjected to large manpower needs, and most of them are not automation. In this study, a virtual plant environment is constructed and simulated by simulation software to implement integration between process planning and manufacturing execution. Machine automation and the plant layout problem have been solved on customer requirement. Moreover, the IIoT platform of Industry 4.0 technology which incorporates supervisory control terminal, individual automation module, and the internet through supervisory control and data acquisition control system allowed remote control and data acquisition, are implemented to design an innovative automation production system for PP-bag mushroom cultivations. In near future, if the functional automation modules inside this system are all integrated successfully and stably, the expectation of a flexible and reconfigurable smart manufacturing system is realized.

Keywords: PP-bag; Mushroom cultivation; Automation system; Industry 4.0; IIoT.

SA1-2#1040

Corneal Displacement and Intraocular Pressure Difference when Eyes are Rubbed

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Abstract

Cornea always endures external forces by blinking eyes, rubbing eyes, and external strike in ordinary life. If rubbing eyes is a habitual behavior, it may cause the huge damage to the eyes. When it surgers a long rubbing period of time, it may lead to keratitis, keratoconus, and corneal tissue lesions. Even more seriously, it will become visually impaired and blind. In order to measure the damage of rubbing eyes specifically, the authors use the porcine eyes to simulate the human eyes and do the rubbing tests. To investigate the eyes deformation, the bearing force, and the IOP changes are measured as function of the rubbing eyes’ depth. A device in static experiment is developed to observe relations among the IOPs, the force, the contact area, and the volume change at the same time. The mathematic model which is based on Hertz contact theory simulates the deformation; moreover, the effect of eyelid and tear film are considered to help get the distribution of shear stress and pressure on the cornea.

Keywords: eye rubbing, cornea, intraocular pressure
SA1-3#1041

Design and Analysis of Additive Manufacturing Processes for Artificial Cornea

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Abstract

The need for artificial corneas is both driven by the physiological response and the shortage of donor corneas over the world. Additive manufacturing enables us to produce the substitutes of the native tissues or even the customized tissues. This study designed and analyzed various additive manufacturing processes for the fabrication of artificial corneas. Owing to the soft property of the applied material, precision control was necessary. The proposed procedure involved the precise temperature and pressure control during the extrusion and the photocuring of the Poloxamer 407 hydrogel when printing the corneal scaffolds. The process then used additional air pressure support (45 Pa) and accurate temperature control (15°C) to provide suitable curing environment for the artificial cornea to achieve the desired shape and surface. The additional treatment enabled the manufacturing processes to achieve not only the clear and smooth surface but also the great mechanical and optical properties.

Keywords: 3D printing; Additive manufacturing; artificial cornea; photocuring; Poloxamer

SA1-3#1042

Optical Simulation of Wavefront Aberration of the Laminate Manufacturing Artificial Cornea Based on Zernike Polynomials

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Abstract

In this work, we simulate an eye model to analyze the optical quality of P-407-DA mixture, which is with biocompatibility property for manufacturing artificial cornea. We simulate three difference surface types by two different optimization methods and use the zernike polynomials to check their aberrations. The results show that biconic surface is the best surface type of these three surfaces in this work. Also, we found that increasing the asphericity in the surface of artificial cornea is important to approach the real cornea in our simulations. It is also found that the thickness of cornea and anterior chamber does not affect the aberration a lot.

Keywords: Zernike polynomials, wavefront aberration, artificial cornea
3D Construction and Bio-Printing of Human Corneas from Topographic Data

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Abstract
The purpose of this research is to construct cornea models and design fabrication procedures of artificial-printed corneas. First, the 3D model of human cornea can be established from mathematical model of a conicoid and topographic data. Next, the slicing and path planning software is modified to construct customized 3D printing path for artificial corneas. Finally, supports prototypes of cornea are designed for 3D printing application. The designed supports, the modified slicing and path planning software will be applied in self-developed bio 3D printer.

Keywords: CAD modeling, parametric modeling, topographic data, the slicing and path planning software, human cornea.

Stereo Vision System with Non-parallel Optic Axes for Small Object Contour Detection

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Abstract
In traditional stereo vision systems, two cameras that displaced horizontally are used to obtain two different views on a scene. By comparing two images, the object distance can be measured using triangulation. This method requires that the object being captured by both cameras. For observing the contour of small objects, such as human corneas, this requirement may be difficult to satisfy if we were to acquire a precise estimation using the configuration that the optical axes of both cameras are parallel to each other. Therefore, this paper presents the a stereo vision system with non-parallel optic axes. To acquire large images on both camera, the proposed system use two cameras with non-parallel optical axes so that the images of both cameras can be focused at the object. The experiment results showed that the system can correctly capture the contour of small objects.

Keywords: Stereo Vision System, Contour Detection, Distance measurement
Measuring the Arterial-Induced Skin Vibration by Geometrical Moiré Fringe
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Abstract
Heart disease and hypertension have become leading chronic diseases of aging population. The demand for self-measured blood pressure monitoring devices has much increased. Currently, the primary non-invasive blood pressure monitoring method is cuff-based. It is well developed and accurate. However, the measuring process is not comfortable, and it cannot provide a continuous measurement. To overcome this problem, methods such as tonometry, volume clamp method, photoplethysmography, pulse wave velocity, and pulse transit time are reported. However, the accuracy is not sufficient for diagnostics. Therefore, a personalized device that can perform sequential blood pressure measurement with a high accuracy and long-term examination is in need. To achieve this goal, we apply moiré interferometry to measure wrist skin vibration induced by radial artery. The 0.4-mm-pitched binary grating and tattoo sticker with 0.3 mm stripe pattern are used to perform geometric moiré. We demonstrated that the sensitivity and accuracy of this integrated system were sufficient to monitor arterial-induced skin vibration non-invasively. We validated our developed system with ECG signals collected by a commercial ECG system. According to the preliminary studies from measurement, the repeatability of wrist pulsation measurement was achieved with an accuracy of 99.6%. Finally, this method potentially can be used in a portable device for personalized health-care application.

Keywords: moiré interferometry, optical metrology, cuffless blood pressure sensor, personalized health care.

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Abstract
In the semiconductor industry, chemical mechanical polishing (CMP) process plays a significant role in wafer polishing to achieve globe planarization and nano-scale surface finishing. Most polishing parameters such as pressure, speed, temperature, polishing pad surface roughness, and slurry flow rate have influence on as-CMPed wafer quality. Traditionally, these parameters have been tested by various monitoring instruments on the CMP polishing machine. This study introduces a new type of smart wafer system
with multiple sensors and peripheral equipment such as the Android signal receiving and transmitting system, MySQL and the portable Arduino Bluetooth wafer force capture device. The main function of Smart Wafer System (SWS) is to detect the change of polishing force parameters during the polishing process. SWS has 5-point embedded film pressure sensors for data processing, storage and transmission. In the experiment, the SWS has been tested to acquire the force change during wafer polishing effectively.

**Keywords:** Chemical mechanical polishing, Wireless pressure feedback system, Wafer polishing pressure.

SA2-1#1066

**A Series of Programming Models for Command-driven Windows Platforms with VC++ Assemblies**

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**Abstract**

This paper is to propose a series of programming models so that the multiple document interfaces (MDIs) with user-defined commands can be integrated, controlled, and communicated with each other. Specifically, the individual resources and processing capabilities can be shared among such interfaces of a Windows platform for automatic measurement. In our approach, the assemblies of Visual C++ (or VC++) with common language runtime (CLR) are employed to progressively design a series of object-oriented container classes, for the command-driven Windows platform with the MDIs. In the experimental results, it is found that handling the events due to the activations of individual controls in those interfaces (or forms) is effective to meet the requirements of human-machine interactions.

**Keywords:** command-driven Windows platform, object-oriented container, programming model.

SA2-1#1074

**Linear Scanner Associated with A Scattering Mechanism for AOI of Ultrasonic Welded Plastics**

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**Abstract**

A linear scanner optical inspection (LSAOI) system was built for the In-Plane and Step-Error inspection of the plastic product with ultrasonic welding on the production line. The proposed systems involve a novel scattering mechanism design, laser scanner, data acquisition and controller integrated with an NI-LabVIEW program. The laser module adopts linear-type laser displacement sensor and associated data acquisition system, which allows scanning first and analyzing batch data to be set later. The scattering mechanism provides uniformly sparsing and positioning for the workpiece to be inspected. In average, this scheme saves 1.75 seconds for each piece compared to the former design at the real time. This novel LSAOI achieves that the new module increases productivity up to 38.9% and achieves less than 10% of gauge and repeatability rate (GRR) with higher than 1.74 of capability index (Cpk).
Keywords: Laser Scanner, scattering, LSAOI, plastic products, GRR, Cpk
Dispensing Simulation of Micro-Fluid in Jetting Dispensing System

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Abstract
The objective of this study is to evaluate the ejection characteristic of high viscosity fluid in jetting dispensing system. The dispensing system driven by dual piezoelectric actuators is proposed. The fluid velocity is evaluated with CFD simulation with various dispensing conditions. The viscosity of fluid, inlet velocity, nozzle diameter, dispensing time have been considered. The simulation results show that relation between each parameter. The geometry of nozzle is optimized to improve the dispensing performance. The fluid velocity in the nozzle is improved at both bottom and top positions. For the future work, the shape of droplet will be evaluated via simulation and validated through experiments.

Keywords: Jetting Dispenser; High-viscosity Fluid; Piezoelectric Actuator

Research and Development of an Automatic Scraping System

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Abstract
Over the years, Taiwan has been producing increasingly better precision machine tools. In the field of precision machinery production, the process of scraping is a critical aspect. Through scraping, components may have minuscule adjustments to their surface, in order to change the way, the surfaces interact with one another, such as in machines with sliding components. However, the process of scraping is currently done by hand, which not only takes extended periods of time to perform, but the resulting machine components may all have differing quality due to it being performed by hand, and susceptible to human error. This study proposes an automated scraping system in order to decrease the work-load of the artisans. The system is composed of a camera, pressure sensor and a structure which allows three-axis movement. Images of the work piece is captured by the camera, and through use of MATLAB code, the image is processed to reveal the quality of scraping on the surface, and what surfaces may need further scraping. Using the mechanism proposed, the automatic scraping system then begins to carry out the scraping process on the work piece using the pressure sensor to control the amount of force applied each time.

Keywords: Image Processing; Machine Tool; Scraping.
SA2-2#1067

A Preliminary Analysis of Self-Adjusting Blade Coating Process

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Abstract

Aimed at next generation high performance roll-to-roll coating and printing for high-end flexible electronics, this paper is focused on a new self-adjusting blade coating process. By adding an extra rotational degree-of-freedom, the self-adjusting blade coating is designed to compensate the inevitable thickness variation of the flexible substrate. In particular, a preliminary fluid dynamic analysis is presented to elucidate the effects of process parameters on the thickness of the coated films. The comparison between the theoretically predicted thickness and the experimental data shows that the analysis was able to predict the trend of the effects of process parameters on the film thickness. Deviations between the theoretical predictions and experimental data were also discussed.

Keywords: Self-Adjusting Blade Coating; Flexible Electronics Fabrication; Fluid Dynamic Analysis

SA2-2#1052

Studies on the Design of Support Structure by Topology Optimization for Additive Manufacturing for Bar Linkage

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Abstract

Due to the characteristics of Additive Manufacturing process, it has to provide the structure to support the hollow or overhang parts of the models. The support structure increases the use of materials, the printing time, and the post-fabrication treatments. Therefore, an appropriate design of support structure for additive manufacturing process will be important. In this study, the method of Topology Optimization is used for optimizing the design of support structure. First, we combined the model and the support structure that had not been designed yet, and traced the slice path made by the commercial software to decide where the load would be, and then set the volume of the support structure to the minimum. The feasibility for support structure was evaluated by Quad-tree method to make sure that the model can be produced successfully. Finally, the proposed Topology Optimization approach was tested by comparing with the commercial software. From the results, the proposed method reduced the printing time by 12.6% and also reduced the amount of material by 60%.

Keywords: Additive Manufacturing; Topology Optimization; Support Structure
SA2-3#1043

A Tunneling Piezoresistive Tactile Sensing Array for Tongue Pressure Monitoring

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Abstract

This work presents a highly sensitive tunneling piezoresistive tactile sensing array. The polymer-based sensing device was patterned with microdome structures by using membrane filter substrates. Characterization of the proposed sensing elements was conducted. The sensing array consists of an 8 × 8 sensing polymer-based sensing elements and Au interdigital electrode pairs. The arrangement substantially enhances the acquisition of signals. Preliminary measurement results are also provided.

Keywords: tactile sensing, microdome, conductive polymer, obstructive sleep apnea.

SA2-3#1045

A Wireless System Using a Tunneling Sensor Array in an Oral Appliance for Sleep Apnea Treatment

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Abstract

Sleep apnea is a serious sleep disorder, and the most common type is obstructive sleep apnea (OSA). Untreated OSA will cause lots of potential health problems. Oral appliance therapy is an effective and popular approach for OSA treatment, but making a perfect fit for each patient is time-consuming and decreases its efficiency considerably. This paper proposes a system-on-a-chip (SoC) enabled sleep monitoring system in a smart oral appliance, which is capable of intelligently collecting the physiological data about tongue movement through the whole therapy. A tunneling sensor array with an ultra-high sensitivity is incorporated to accurately detect the subtle pressure from the tongue. When the device is placed on the wireless platform, the temporary stored data will be retrieved and wirelessly transmitted to personal computers and cloud storages. The battery will be recharged by harvesting external RF power from the platform. A compact prototype module, whose size is 4.5 x 2.5x 0.9 cm3, is implemented and embedded inside the oral appliance to demonstrate the tongue movement detection in continuous time frames. The functions of this design are verified by the presented measurement results. This design aims to increase efficiency and make it a total solution for OSA treatment.

Sleep apnea is a serious sleep disorder.

Keywords: sleep apnea, smart oral appliance, SoC, sleep monitoring, tunneling sensor, prototype module.
Smart Oral Appliance to Monitor Sleep Apnea by Measuring Blood Oxygen Concentration

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Abstract
This paper presents a smart oral appliance for measuring blood oxygen concentration. The appliance uses a blood oxygen sensor to measure the oxygen content of the greater palatine artery in the oral cavity, enabling it to substitute for polysomnography by monitoring sleep and detecting the warning signs of obstructive sleep apnea. In this study, a biocompatible flexible cable (which was fabricated using a semiconductor process) connected the oral appliance and a blood oxygen module to control a commercial oxygen concentration detection sensor at different times to transmit red/IR two-wavelength light sources; a photodetector then received the reflected light and converted the current signal into a voltage signal, which was sent to the microprocessor for digital signal processing. Finally, this was transmitted to the computer for blood oxygen concentration calculation. The result indicates that it was able to detect the values of blood oxygen content from three examiners; the concentration was between 98% – 100%, which confirms to the expected values for a normal person.

Keywords: Parylene, Smart Oral Appliance, 2 SpO
Power Split Control Method for Wind Turbine Equipped with ECVT

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Abstract

In this paper a power split control strategy for wind power generator equipped with ECVT is proposed. This method utilizes a steady speed control method to rear shaft of the ECVT and direct drive method to the front shaft of ECVT. A servo motor was used to simulate fixed blade wind turbine characteristics which the transfer the rotational speed through an ECVT to the generators. ECVT concept was introduced in this setup to provide a speed ratio control between input rotor and output shaft at generator to provide a steady output speed for rear shaft connected to a high power generator, while the front end shaft of the ECVT powertrain is connected with a low power generator. In this paper a PID controller was used to manage the ECVT speed ratio for a constant output rotational speed at rear shaft and fixed gear reduction method at the front shaft for respective generators. This proposed power split control uses input rotational speed as estimator and output rotational speed from ECVT as feedback. The control program is written with LabVIEW using NI Compaq Rio as control and data acquisition interface. This research shows this methodology can provide higher power output by constant electricity generation via gear reduction mechanism for smaller 600W generator while a stable power output at the steady-state control using PID control for 5KW generator.

Keywords: ECVT; PID control; power split control; steady-speed control; wind power generation

Evaluation of the Performance of PV system with Single-Axis Tracker using SAM Model

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Abstract

The aim of this research is to study the energy production of single axis tracking photovoltaic (PV) power system when compared with fixed-mounting PV system. Two types of PV system in this study are installed including fixed mounting and single-axis tracking system at the outdoor research facility in Tainan County in Taiwan. The measurement of power generation is roughly consistent with simulation using SAM (System Advisor Model) simulation model. In addition to that, the results obtained in June, July, October, and November had some variations due to the some maintain and damage causes the electrical power decreased.
Our research method divided into the measurement and simulation and used two facilities including single axis tracking PV system and fixed axis PV system. The power output of single axis tracking PV system is higher than fixed axis PV system in 15.3% (measured) and 16.5% (simulated), respectively. It is shown that the simulation method can be used as a reference for the actual analysis and a forecast of the generation capacity of PV system.

**Keywords:** PV system; single axis tracking PV system; SAM Simulation model

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**Automatic Inspection and Classification Platform for Characteristics of Lithium Battery**

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**Abstract**

The electric characteristics of lithium (Li) battery such as the inner resistance and voltage were usually applied to evaluate the quality of Li battery. Traditionally, the inner resistance and voltage of Li battery were manually measured one by one, but measuring accuracy will be affected by the long measuring time while working all day. Therefore, the automatic inspection and classification platform was developed to quickly measure the inner resistance and voltage of Li battery and classify its degree in this study. In the platform, the techniques including the image recognition of Li battery’s direction (positive and negative), measuring the inner resistance and voltage of Li battery, and product classification by laser marking on the surface of Li batteries were integrated. From the results, the time for measuring the properties of Li battery and degree classification can be controlled less than 5 s of each battery cell. In addition, the measuring results can provide the information for quality control of Li battery and deliver the battery cell with consistent quality to the customer.

**Keywords:** Lithium Battery, Automatic Inspection, Product Classification
**Session SP1-2**

**SP1-2#1020**

**RWMR: RSSI-Based WIFI Mesh Routing for Reliable Industrial IoT**

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**Abstract**

Internet of Things (IoT) becomes popular in many applications but not fully practical and commercialized in industrial domain because of the unreliable nature of wireless communication. Therefore, this study focuses on developing a reliable routing algorithm of Wifi on Industrial IoT applications. WiFi is selected because it is the most popular in-building wireless media and is almost ubiquitous. Our **RSSI-Based Wifi Mesh Routing (RWMR)** is based on measuring RSSI strength and traffic load to decide the most reliable next-hop on the path from end device to the server. Two main design concepts of RWMR are: **Group and Layered Design** and **Score** mechanism. Layered Design provides routing service and ensures the shortest path. The **Score** mechanism quantifies the transmission status of each IoT node to have a score index so the best next hop can be chosen based on the RSSI, data load, and collision avoidance. Besides, RWMR also provide **Handover** to further enhance transmission reliability. The experiment results show that RWMR can provides the lower transmission delays than RSSI only based approach and close to ideal 1-1 scenarios. Because the delays are less than 15 ms, RWMR is sufficient to be applied for industrial IoT. Therefore, this realistic experiment shows that wireless transmissions can provide reliable low delay communications as the wired network.

**Keywords:** RSSI, Wifi, Industrial Internet of Things, Transmission delay, Mesh Routing

**SP1-2#1030**

**A Smart Logistics System for Real-Time Monitoring Based on Internet of Things**

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**Abstract**

This paper proposes a cargo management system, named i-Logistics, which consists of an electronic tape (etape), a QR code scan APP, an in-vehicle infotainment system (a vehicular telematics device), and a cloud-based platform. The dedicated Polyvinylidene fluoride (PVDF) sensors are mounted on the electronic tape for monitoring cargos. The QR code scan APP is used to burn a matching dedicated ID from QR code of Cargo, to electronic tape via BLE. The related messages of the dedicated ID and cargo status (such as broken and loss) are also sent to in-vehicle infotainment (IVI) system by BLE. Furthermore, the abnormal notified messages will be real-time recorded and uploaded to the cloud-based platform via 3G/4G networks when aberrant status of cargos is occurred. As a result, the proposed system can efficiently help to understanding the status of cargos and giving necessary
assistance, during truck transportation process.

Key words: Internet of Things (IoT), Logistics, Real-Time Systems, Cargo Management System, Transportation.

SP1-2#1059

Noninvasive Cuffless Blood Pressure Estimate Using Reflected Pulse Transmit Time via Cepstrum Analysis

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Abstract

A non-invasive, cuff-less blood pressure (BP) sensors with cepstrum analysis is proposed in this study. Increasing incidences of hypertension is the key factor attributing to the growth of the market of BP monitors. In addition, the monitor industry growth due to the growing awareness and demand for home use BP monitors. The proposed BP sensor features capability of long-time wearability, continuous measurements, low power and low cost. The sensor measures pulse signals of the radial artery vibration under the skin of a human wrist. In this research, 35 healthy young subjects (25±5 years old) were recruited as the study subjects. The reflected pulse transmit time is calculated by cepstrum analysis and using time period of two peaks. As the results, the correlations of blood pressure of cepstrum analysis are better than using the time period between two peaks of pulse signal.

Keywords: Blood Pressure, Reflected Pulse Transmit Time, Cepstrum Analysis.

SP1-2#1018

Development of a Teleoperation System with Realistic Tactile Sensation Based on Artificial Neural Networks

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Abstract

Recently, haptic technology has been applied to many applications to help humans to acquire more information concerning surrounding environments. In this research, a teleoperation system was developed to bring tactile sensation concerning object surface texture from a remote location to the local users. A force sensor and a PVDF sensor were used to design a data recording device, which was attached to a remote slave robot arm, for recording physical texture information. Two bending actuators were used to design a tactile rendering device, which was attached to a local user’s finger, for rendering realistic simulated tactile feedback. A well-trained neural network model was used to process the recorded signals online to find the driving voltage for the tactile rendering device. Based on the different sensitivity ranges of the mechanoreceptors in human glabrous skin, two tactile display modes were used to render the realistic simulated surface textures. The user test results showed that tactile discrimination was affected by genders, surface properties, and display modes.
Keywords: Haptics Feedback, Teleoperation, Realistic Tactile Sensation, Vibrotactile, Neural Networks.
Session SP1-3

SP1-3#1054

Development of Key Technologies for Robot Arm Based Autonomous Object Operation and Inspection

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Abstract
This paper aims to develop visual servoing techniques and object recognition/localization techniques so that the robot can precisely grasp the object randomly located in an uncertain place and perform defined operation. This paper also designs movable light source systems so as to generate thousands of possible image capturing possibilities, pairing with multiple cameras. In order to grasp objects of varied dimension and shapes, and can flip the object into a desired angle within the grip, this research also develops multi-functional gripper to assist in intelligent automation object operation tasks.

The successful execution of this project in the first year has generated some innovative multiple-axis robot based intelligent automation technologies for precision object operation, and at the same time, generated a fully autonomous object inspection machine.

Keywords: Industrial robot, autonomous inspection, autonomous assembly, visual servoing, trajectory planning, force-feedback control.

SP1-3#1044

Intelligent Image Segmentation Methodology

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Abstract
The purpose of the defect classification is to determine abnormal processes according to the target flaw type. However, a successful defect segmentation determines the quality of the subsequent defect classification. As we all know, different types of defects must use different image segmentation method in order to successfully reveal the flaws. Desired flaws can not be correctly extracted if an inappropriate image segmentation is used, leading to incorrect defect classification. In order to overcome the aforementioned problem, this study proposes an automatic selection mechanism of image segmentation method, which can choose one of the most suitable image segmentation methods based on the grey scale characteristics of an image. The experimental results show that the mechanism proposed in this paper increase the correct selection rate of image segmentation methods to 97.74%. The high classification rate implies the feasibility of the proposed mechanism.

Keywords: Feature Extraction; Intelligent Segmentation; Grey-level Histogram
A Hybrid Impedance and Fuzzy Logic Control Strategy

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Abstract

With the advance of automation technology in recent years, most of the manufacturing processes have been facilitated by robot arms, but the assembly tasks are being excluded and still rely on manpower. The major reason is that the robotic arm is not as flexible as human’s, and therefore robot arms are unable to complete the intricate assembly tasks, especially for the assembly of electronic components. Currently, all positions need to be calibrated precisely by using the control panel before applying the robot arm to the assembly tasks. However, several unpredictable situations such as excessive clearance, slippery, loose parts and so on, might cause the damage of the parts as well as the robot arm. As a result, a hybrid impedance and fuzzy control is proposed in this research. By mounting a force sensor on the robot end effector, the reactive force and torque could be measured during the peg-in-hole operation, and the position and the orientation of the robot arm could be adjusted in real time to overcome the position error due to misalignment. In addition, the speed and the routing strategy are incorporated into the control architecture to increase the assembly speed.

Keywords: Impedance control, Fuzzy control, Peg-in-hole operation