

SaA I:Best Paper

Session Chair:

Jingya Pavilion : July 15, 14:00 - 15:45, Saturday

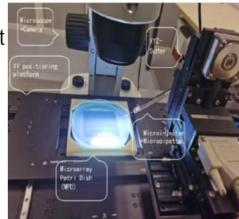
• 14:00~14:15

• 14:15~14:30

Design and Testing of an Automated Microinjection System for Batch Injection of Zebrafish Larvae

Ziqiang Chi, Qingsong Xu, Nana Ai, and Wei Ge
University of Macau, Macau, China

- An automatic high-throughput microinjection system is designed and developed for the first time
- It is applicable to batch injection of zebrafish larvae
- Experimental results show that the system works fast and ensures stable success rate and survival rate for the fish larvae microinjection



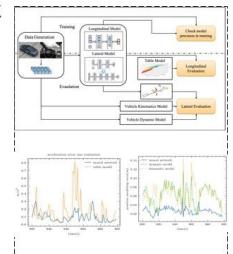
• 14:30~14:45

Vehicle Longitudinal and Lateral Dynamics Modeling by Deep Neural Network

Xiaoxu Cao, and Huiyun Li
Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China

Chunxiao Liu and Cong Qiu
SenseTime Group Limited, Shenzhen, China

- A data-driven method based on neural network is proposed to build the vehicle longitudinal and lateral dynamics model.
- The proposed network could learn the implicit dynamic model from the history data.
- The longitudinal acceleration modeling precision could be improved by 40%. the lateral distance mean absolute error of the neural network model is 0.026m while the traditional method is about 0.06m.



• 14:45~15:00

A 22-DOFs Bio-inspired Soft Hand Achieving 6 Kinds of In-hand Manipulation

Jianshu Zhou, Hanwen Cao, Junda Huang, Yunhui Liu
MAE, The Chinese University of Hong Kong, Hong Kong
Yunquan, Li, Yang Yang.

Mechanical Engineering, The University of Hong Kong. Hong Kong

- An anthropomorphic 22-DOFs soft hand, S-22, is presented with comparable dexterity of human hand.
- The excellent dexterity of S-22 is enabled by the novel V-joint, which is easily applied to build multi-DOF soft robots by arranging them in a desired order.
- the successful processing of 6 kinds of in-hand manipulation was presented to demonstrate hand capability.

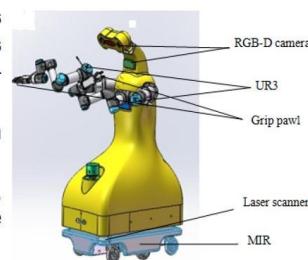


• 15:00~15:15

Development and initial experiments of an intelligent Dual-Arm mobile robot - Baymax-I

Wei Liu, Haitao Wang, Rui Wang, Dayong Wen, Tao Lu, and Shuo Wang
State Key Laboratory of Management and Control for Complex Systems,
Institute of Automation, Chinese Academy of Sciences

- The mechanism design of Baymax-I is based on modular concepts, which is mainly composed of main body, dual-arms and a mobile chassis
- Software systems is designed based on hierarchical structure
- Three experiments including SLAM, pressing the elevator and opening the fridge are performed



SaB I: Best Paper In Robotics

Session Chair:

Lanting Pavilion : July 15, 14:00 - 15:45, Saturday

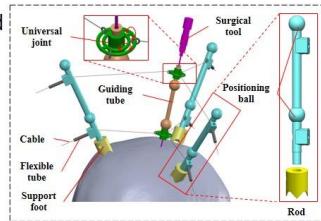
- 14:00~14:15

Reconfigurable Cable-Driven Parallel Robot with Adjustable Workspace Towards Positioning in Neurosurgery: A Preliminary Design

Changsheng Li, Jingchen Huang, Mengya Su, Diao Wu, Peng Xu, Yushan Xie, Fansheng Meng, Hao Wen, Huanyu Tian and Xinguang Duan

School of Mechatronical Engineering, Beijing Institute of Technology, China

- A cable-driven parallel robot is proposed for positioning in neurosurgery.
- The robot is reconfigurable and lightweight, which is suitable for being mounted on the skull
- The workspace is adjustable according to the surgical requirements

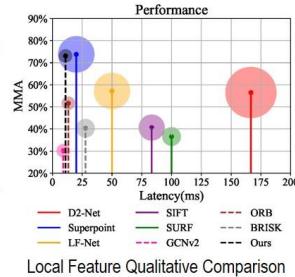


- 14:30~14:45

Self-supervised Feature Detection and Binary Description in Hamming Space for Mobile Platforms

Shenghao Li, Guibao Zhang and Qunfei Zhao
Department of Automation, Shanghai Jiao Tong University, China

- This paper proposes to use self-supervised learning and iterative hash for feature detection and description.
- Local features with repeatability and robustness are extracted with low latency and memory footprint.
- The proposed method empowers real-time feature-based tasks in Hamming space on mobile platforms.



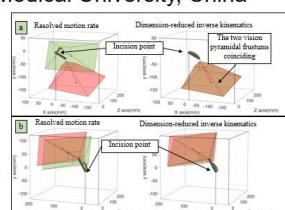
- 15:00~15:15

Inverse Kinematics Formulations of a Continuum Endoscope for a View Adjustment Similar to the da Vinci Endoscope

Lifei Deng, Zhonghao Wu, Yifan Wang and Kai Xu
Shanghai Jiao Tong University, China
Linhuai Wang

Department of Urology, Naval Medical University, China

- Two inverse kinematics formulations are investigated on a 6-DoF continuum endoscope to achieve view adjustment similar to the da Vinci endoscope.
- Dimension-reduced inverse kinematics formulation improves performances when resolved motion rate fails to converge.
- Dimension-reduced formulation has an 84.11% improvement compared with the resolved motion rate control.



Comparison results when the target visual point is (a) inside and (b) outside continuum endoscope's workspace

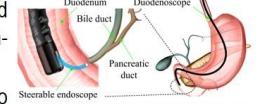
Data-Driven Modeling the Nonlinear Backlash of Steerable Endoscope Under a Large Deflection Cannulation in ERCP Surgery

Wei Jiang, Tao Yu, Xiao He, Yongming Yang, Hao Liu
Shenyang Institute of Automation, Chinese Academy of Sciences, China

Zhidong Wang

Department of Advanced Robotics, Chiba Institute of Technology, Japan

- The backlash limits the positioning and orientation accuracy of the tendon-sheath-driven endoscope under large deflection.
- We proposed to model the backlash of two DoFs endoscope by using a data-driven method.
- Trajectory following and orientation results show that the model can accurately describe the nonlinear backlash.



Backlash changes in left deflection during different up/down deflection of steerable endoscope
Left deflection: -0 deg, +30 deg, +45 deg, +60 deg
Up/Down deflection (deg): -100, -80, -60, -40, -20, 0, 20, 40, 60, 80, 100
The Nonlinear backlash of steerable endoscope in ERCP surgery

- 14:45~15:00

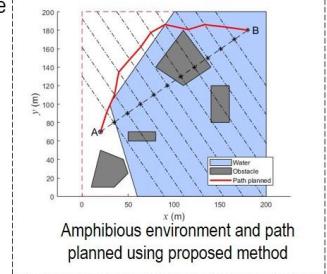
A Fireworks Algorithm Based Path Planning Method for Amphibious Robot

Yuanyang Qi and Junzhi Yu
College of Engineering, Peking University, China

Jincun Liu

College of Information and Electrical Engineering, China Agricultural University, China

- A path planning method adopting the Fireworks Algorithms (FWA) is proposed.
- An optimization model is designed aiming at the characteristics of path planning for amphibious robots.
- Simulation experiments are conducted to analyze and compare the performance of FWA variants.



SaC I:Computational intelligence in robotics I

Session Chair:

Meeting Room 1 : July 15, 14:00 - 15:45, Saturday

- 14:00~14:15

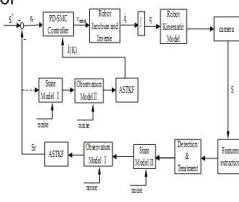
Uncalibrated Image-Based Visual Servoing Control based on Image Occlusion using Dual Adaptive Strong Tracking Kalman Filter

Xiaolin Ren and Hongwen Li

Changchun Institute of Optics,

Fine Mechanics and Physics, Chinese Academy of Sciences, China

- The scenarios of image features being lost or occluded with image features
- Dual adaptive strong tracking Kalman filter Scheme
- Image occlusion analysis



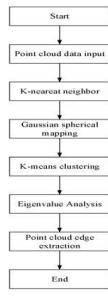
- 14:30~14:45

Fast and Accurate Edge Extraction Algorithm of Stacked Workpiece Point

Keping Liu and Runze Gao and Yan Li and Weibo Yu

Department of Control Engineering, Changchun University of Technology, China

- An algorithm for edge extraction of stacked artifacts is proposed.
- Gaussian sphere mapping and Kmeans clustering algorithm.
- Experiments show that the proposed algorithm can solve the problem.



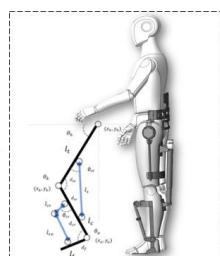
- 15:00~15:15

Impedance Control for a novel Composite Modular Lower-Limb Hemiplegic Exoskeleton

Ruoyu Bao, Pengbo Li, Bailin He, Zhilong Su, Can Wang and Xinyu Wu

Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen

- Proposes a control scheme based on impedance control to realise the smoothing control of the operating movements of the lower limb hemiplegic exoskeleton robot.
- Simplifies the control complexity of the whole system by means of a crank rocker structure of the ankle joint.



Design, Modeling and Estimation of an Innovative Continuously Transmission

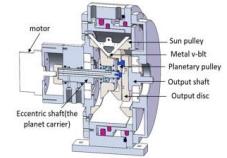
Zhipeng Liu and Shouqi Chen

Department of Precision Machinery and Precision Instrumentation, University of Science and Technology of China, Hefei, China

Linsen Xu

Institute of Advanced Manufacturing Technology, Hefei Institutes of Physical Science, Chinese Academy of Sciences, Hefei, China

- An innovative continuously variable transmission for robots.
- This simple and effective structure can effectively reduce manufacturing costs and improve motor efficiency .
- Continuous geometric model of the metal v-belt and analyzes the kinematics and dynamics of a single metal segment.
- The factors affecting the stability of the v-belt transmission ratio are analyzed .



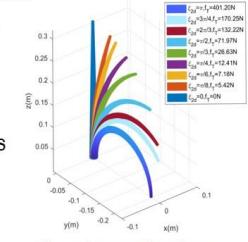
3D model of the innovative CVT

- 14:45~15:00

Dynamics modeling of a soft arm under the Cosserat theory

Jie Ma, Zhiji Han, Linsen Yang, Gaochen Min, Zhijie Liu, Wei He. Automation and Electrical Engineering, University of Science and Technology Beijing, China

- In this paper, inspired by the Lagrangian model of a rigid robot, a Newton-Euler inverse dynamics algorithm for an equivalent continuous manipulator is adopted to compute all matrices of the Lagrangian inverse dynamics model about the soft arm.
- The iterative process is also improved to increase the computational efficiency.
- Eventually, a minimal set of ordinary differential equations is given for later control design.



The relationship between the tension and desired angular strain

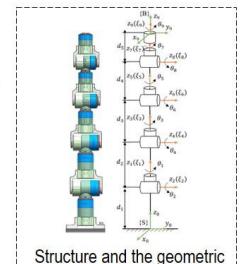
- 15:15~15:30

Trajectory Planning for Hyper-Redundant Manipulators Based on Lie Theory

Tianyu Liu and Mingchao Zhu

Space Robot Engineering Center, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun, China
University of Chinese Academy of Sciences, Beijing, China

- A discretized trajectory is generated by the cubic spline interpolation.
- Trajectory planning is achieved by finding the numerical solution of inverse kinematics (IK).
- IK algorithm combines feedforward and feedback control based on Lie theory.
- Redundancy is used to obtain the optimal configuration avoiding joint limits and singularities.



Structure and the geometric twist of the 9-DOF manipulator

SaD I: Motion control of robotic systems

Session Chair:

Meeting Room 2 : July 15, 14:00 - 15:45, Saturday

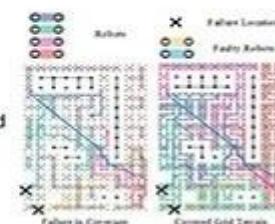
- 14:00~14:15

- 14:15~14:30

FT-MSTC*: An Efficient Fault Tolerance Algorithm for Multi-robot Coverage Path Planning

Chun Sun, Jingtao Tang and Xinyu Zhang
Software Engineering, East China Normal University, China

- Present a new efficient fault tolerance algorithm for multi-robot coverage path planning using optimization method.
- After failures, FT-MSTC* will minimize the overall maximum coverage cost while considering both the accomplished tasks and the remaining tasks.
- Our experiments show FT-MSTC* outperformed other coverage path planning algorithms in terms of the overall maximum coverage cost.

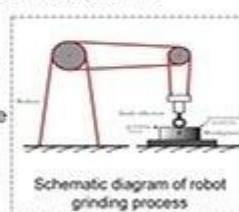


- 14:30~14:45

Error Constrained Hybrid Force/Position of a Grinding Robot

Chenglin Zhang, Ning Sun*, Yiheng Chen, Zehao Qiu,
Wenchuang Sang, and Yongchun Fang
Institute of Robotics and Automatic Information Systems,
College of Artificial Intelligence, Nankai University, China

- The contact force model between the environment and the robot is presented.
- A hybrid force/position control method is given and a force controller is proposed.
- By using Lyapunov methods, the stability of the system is proven.
- By numerical simulations, the effectiveness of the presented force controller is verified.



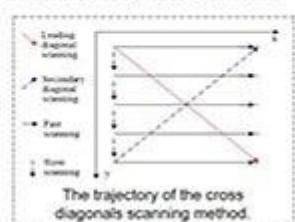
- 15:00~15:15

Correction of AFM image distortion caused by thermal drift

Yinan Wu

Institute of Robotics and Automatic Information System,
Tianjin Key Laboratory of Intelligent Robotics,
College of Artificial Intelligence, Nankai University, Tianjin 300350, China

- Thermal drift causes image distortion of an atomic force microscopy (AFM).
- A novel offline drift correction algorithm based on cross diagonals scanning is proposed to reconstruct high-quality AFM images.
- The performance of the proposed method is verified by convincing experimental and application results.



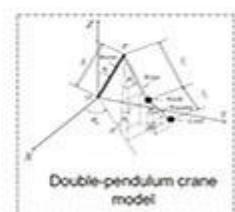
- 15:30~15:45

Sliding Mode Control Approach for Double-pendulum Rotary Cranes

Zheng Tian, Huimin Ouyang and Huan Xi

College of Electrical Engineering and Control Science, Nanjing Tech University,
China

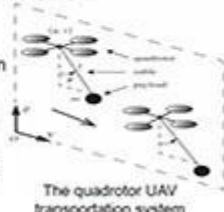
- A variable damping algorithm is proposed to solve the load/hook suppression problems.
- Disturbance observer is used to decouple it into two independent linear systems.
- A sliding mode controller with a nonlinear sliding surface is designed.
- Simulation results demonstrate the effectiveness of the proposed method.



Adaptive Neural Network Control of Quadrotor Unmanned Aerial Vehicle Transportation Systems

Xiao Liang, Zhuang Zhang, Hai Yu, Yang Wang, Ning Sun
Institute of Robotics and Automatic Information Systems, College of
Artificial Intelligence, Tianjin Key Laboratory of Intelligent Robotics,
Nankai University, Tianjin 300350, China

- An adaptive controller is proposed based on sliding manifolds and RBFNNs.
- RBFNNs are utilized to compensate for system uncertainties/disturbances.
- The stability of the system can be guaranteed by Lyapunov techniques.
- Simulation results show superior performance and robustness of the proposed adaptive NN controller.



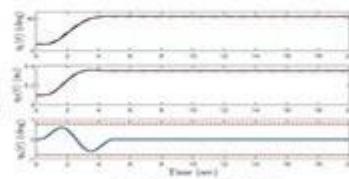
- 14:45~15:00

A Time Optimal Trajectory Planning Method for Offshore Cranes With Ship Roll Perturbations

Ran Zhang and He Chen

School of Artificial Intelligence, Hebei University of Technology, China

- A time optimal trajectory planning method is proposed for offshore cranes.
- Differential flatness property is utilized to better tackle the system couplings.
- Different kinds of physical constraints are successfully considered.

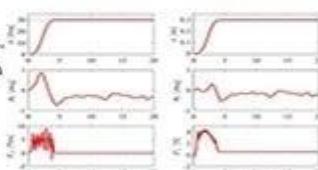


- 15:15~15:30

Saturated PD with sliding mode control method for 4-DOF tower crane systems

Menghua Zhang, Member, IEEE, Fugong Sun, Jin Zhang, Changzhi Ma, and Zaixing Zha

- It is robust against uncertain system parameters and external disturbances.
- The trajectory tracking controller can achieve finite-time convergence.
- The designed controller needs no payload-swing feedback.



SaA II: Best Student Paper

Session Chair:

Jingya Pavilion : July 15, 16:15 - 18:00, Saturday

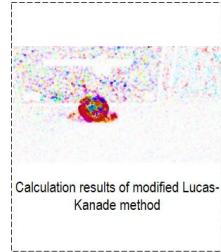
- 16:15~16:30

A Moving Target Detection and Localization Strategy Based on Optical Flow and Pin-hole Imaging Methods Using Monocular VisionShun Wang¹, Qingqiang Guo¹, Sheng Xu^{2,3} and Dan Su^{2,4}

¹School of Control Science and Engineering, Shandong University, Jinan, Shandong, China
²Guangdong Provincial Key Lab of Robotics and Intelligent System, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences and CAS Key Laboratory of Human-Machine Intelligence-Synergy Systems, Shenzhen Institute of Advanced Technology, Shenzhen, China

³Shandong Institute of Advanced Technology, Chinese Academy of Sciences, Jinan, Shandong, China
⁴Orbtec Inc., Shenzhen, China

- This paper is concerned with moving target detection and localization based on monocular vision.
- The modified Lucas-Kanade optical flow method is applied to calculate optical flow.
- The two-level image segmentation strategy from coarse to fine is also designed.
- A low computational cost target localization algorithm is developed based on pin-hole imaging theory.



- 16:45~17:00

Uncertainty Aware Mobile Manipulator Platform Pose Planning Based on Capability Map

Yuhao Meng, Yujing Chen and Yunjiang Lou

School of Mechanical Engineering and Automation, Harbin Institute of Technology Shenzhen, China

- Mobile manipulator platform has great pose uncertainty in clutter and dynamic environment.
- Find a platform pose with higher manipulability expectation under the uncertainty.
- Use a uncertainty distribution based filter to the feasible platform poses.
- Achieve higher manipulability expectation with less computing time increase.



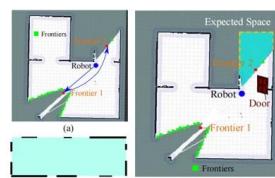
- 17:15~17:30

A Prior Information Heuristic based Robot Exploration Method in Indoor Environment

Jie Liu, Yong Lv, Yuan Yuan, Wenzheng Chi, Guodong Chen and Lining Sun

Robotics and Microsystems Center, School of Mechanical and Electric Engineering, Soochow University, Suzhou, China

- A new exploration strategy is proposed on the basis of the prior information heuristic.
- A lightweight network model is proposed for the recognition of the heuristic objects.
- Experimental studies demonstrate the effectiveness of the proposed method.

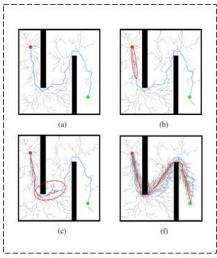


The influence of prior information heuristic on the selection of frontiers.

- 16:30~16:45

Sliding-Window Informed RRT*: A Method for Speeding Up the Optimization and Path SmoothingChenming Li¹, Chaoqun Wang², Jiankun Wang³, Yutian Shen¹¹EE, CUHK, HKSAR, China; ²CSE, SDU, China;Max Q.-H. Meng³³Department of Electronic and Electrical Engineering, SUSTech, China

- A sliding-window method is proposed to accelerate the convergence of Informed RRT*.
- The Softmax Action Selection-like method is applied to balance the exploration and exploitation, and guarantee the probabilistic completeness.
- Simulation experiments are carried out to demonstrate that our method can improve performance significantly.



- 17:00~17:15

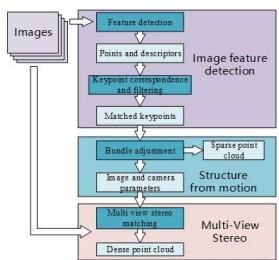
Virtual reality navigation system of nasal endoscopy with real surface texture informationZ. Cui^{1,3}, Y. He¹, P. Zhang¹, Y. Hu¹, H. Jin², S. Liu³

1-Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences

2-Shenzhen Broadcare medical robotics co. Ltd., Shenzhen, China

3-Harbin Institute of Technology, Shenzhen, China

- 3D reconstruction of nasal cavity based on monocular nasal endoscopic images
- Variable-scale registration of monocular reconstruction model and CT model
- Collision-free path planning of nasal endoscope under the anatomical constraints of nasal cavity
- Experiments and discussion



Flow chart of nasal 3D reconstruction

SaB II: Best Paper In Control

Session Chair:

Lanting Pavilion : July 15, 16:15 - 18:00, Saturday

- 16:15~16:30

- 16:30~16:45

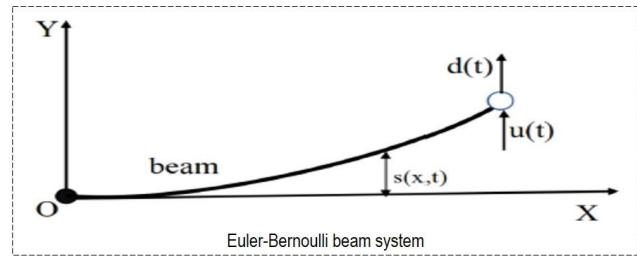
Adaptive Vibration Iterative Learning Control of a Flexible Beam via Backstepping Technique

Yu Liu, Xiaoqi Wu and Yanfang Mei

Automation Science and Engineering, South China University of Technology, China

Yilin Wu

Computer Science, Guangdong University of Education, China



- 16:45~17:00

Inverse Kinematics and Master-Slave Control for a 7-DoF Tendon-Driven Humanoid Robot Arm

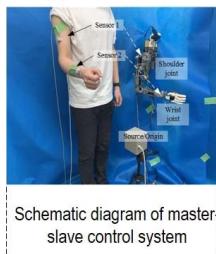
Zhenyu Sun and Wenyang Li

Department of Mechanical Engineering and Intelligent Systems, The University of Electro-Communications, Japan

Xiaobei Jing and Xu Yong

Shenzhen Institutes of Advanced Technology, China

- Analysis of Kinematics and Inverse Kinematics of 7-DOF Robot Arm.
- The mapping relationship between robot arm joints and human arm joints.
- Research on master-slave control strategy.
- Communication based on ROS/ARM/FPGA.



- 17:15~17:30

Robust Image-based Landing Control of a Quadrotor on an Unknown Moving Platform Using Circle Features

Jie lin, Yaonan Wang*, Zhiqiang Maio, Hang Zhong et al.

College of Electrical and Information Engineering, Hunan University, China

- Image kinematics using circle features have simple form and decoupling properties for the landing system.
- The proposed controller does not incorporate depth of the target feature needed by IBVS-like approaches.
- The controller does not depend on the explicit knowledge of the landing platform.
- The prescribed transient and steady-state behavior of close-loop signals are guaranteed.

**Dual Arm Coordination with Coordination Diagram based on Teleoperation Demonstration**

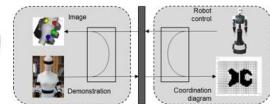
Guoyu Zuo, Zichen Xu, Lu Liu, and Daoxiong Gong

Faculty of Information Technology, Beijing University of Technology, China

Jianfeng Li

Faculty of Materials and Manufacturing, Beijing University of Technology, China

- This paper proposes a dual-arm coordination algorithm to improve the efficiency of coordination.
- Consider both robot's actions and operating sequences for tasks that require multiple operations with both arms.
- The coordination diagram in time domain is designed to more clearly represent the situations of trajectory collisions and find the collision free coordination action law.



- 17:00~17:15

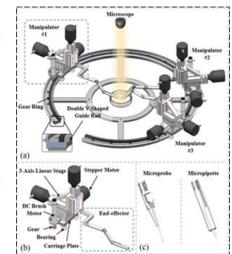
Rail-Guided Robotic System for Multi-Configuration Cooperative Micromanipulation Based on Formation Control

Haojun Hu, Huaping Wang, Qing Shi, Han Tao

Qiang Huang and Toshio Fukuda

Beijing Advanced Innovation Center for Intelligent Robots and Systems, Beijing Institute of Technology, China

- This paper presents a multi-configuration cooperative microrobotic manipulation system for executing multi-process.
- The method based on leader-follower and artificial potential field is proposed to achieve multi-configuration formation.
- Experimental results have verified the efficacy of the proposed method.



SaC II:Robotic Control I

Session Chair:

Meeting Room 1 : July 15, 16:15 - 18:00, Saturday

- 16:15~16:30

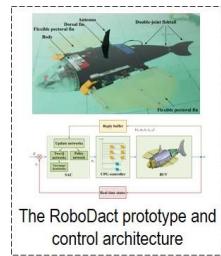
- 16:30~16:45

Locomotion Control of a Hybrid Propulsion Biomimetic Underwater Vehicle via Deep Reinforcement Learning

Tiandong Zhang, Rui Wang, Yu Wang, and Shuo Wang

Institute of Automation, Chinese Academy of Sciences, China
School of Artificial Intelligence, University of Chinese Academy of Sciences, China

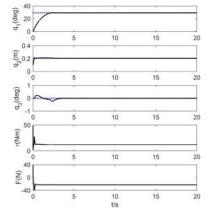
- A novel locomotion control method of biomimetic underwater vehicle (BUV) is proposed based on deep reinforcement learning.
- A hybrid propulsion BUV named RoboDact is presented with two flexible long fins and a double-joint fishtail.
- The feasibility and effectiveness of the proposed control method is demonstrated after extensive comparative simulations.

**Stabilizing control for an offshore crane with unknown parameters**

Zhi Li, Xin Ma and Yibin Li

School of control science and engineering Shandong University, China

- The Dynamic model of an offshore boom crane is established in the presence of ship roll motion
- A parameter independent coupling controller is proposed which combines the proportional derivative controller and the SMC, to regulate the cargo to desired positions.
- The closed-loop stability is analyzed and the effectiveness is verified via simulation results

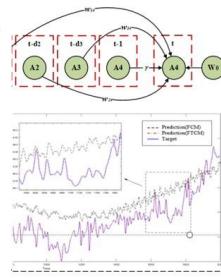


Simulation results under regular waves

- 16:45~17:00

**IEEE RCAR 2020 Digest Template
Prediction of Key Parameters of Coal Gasification Process Based on TM-FTCM**Congbin Jiang, Dan Wang, Cuiping Gong, Gang Zhang, Wen Gu, Lifeng Yang and Xingqiang Ding
Changzheng Engineering Co., Limited, China

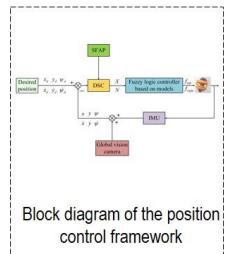
- The development of coal chemical industry has become a concern
- The time delay leads to the prediction model problems of poor interpretation and low accuracy.
- The method effectively solves the problem of inaccurate prediction model due to delay .



- 17:00~17:15

Dynamic Surface Control for an Underactuated Underwater Biomimetic Vehicle-Manipulator SystemXuejian Bai^{1,2}, Yu Wang², Rui Wang², Shuo Wang^{1,2}, Min Tan^{1,2}¹School of Artificial Intelligence, University of Chinese Academy of Sciences, China²State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- This paper proposes a position control method based an improved dynamic surface control.
- A surge force adaptive process is designed to solve the underactuated problem of the UBMS.
- Simulations and experiments validate the control method's feasibility and robustness in the application of UBMSs.



- 17:15~17:30

sensor development using novel multi-activation functions based ensemble echo state network

Yan-Lin He, Yan-Ming Pan, Yuan Xu*, Qun-Xiong Zhu*

College of Information Science & Technology, Beijing University of Chemical Technology, Beijing, 100029, China;

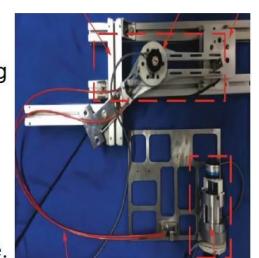
Email: xuyuan@mail.buct.edu.cn (Y. Xu); zhuqx@mail.buct.edu.cn (Q.X. Zhu)

In recent years, due to the continuous expansion of the scale of chemical industry, chemical industry data presents the characteristics of high dimensionality, large quantity, and strong nonlinearity, which greatly increases the difficulty of process modeling. Data-driven soft-sensing modeling methods have been widely used. Echo State Network, as a typical recurrent neural network, plays an important role in the field of time series prediction. However, the traditional Echo State Network (ESN) only uses a single kind of activation functions. Faced with strong coupling and high nonlinear influencing factors, the prediction performance of ESN will decrease. In order to solve the above problem, this paper proposes a variety of different activation functions into the Echo State Network to improve the ability to deal with complex process data. In the proposed method, three kinds of activation functions are utilized. In order to test the performance, High Density Polyethylene (HDPE) industrial process data is used. The simulation results show that the proposed method can achieve better performance in terms of accuracy than other models.

- 17:30~17:45

Saturated nonlinear control of robots with series elastic actuatorsJie Cheng, Xuexin Zhang, Tairen Sun
School of Electrical Information and Engineering, Jiangsu University, ChinaHongjun Yang
The Institute of Automation, Chinese Academy of Sciences, China

- Two saturated nonlinear controllers are proposed based on singular perturbation (SP) and Energy Shaping (ES).
- The SP-based saturated controller requires the stiffness being relative large.
- The ES-based saturated controller requires accurate stiffness knowledge.



SaD II:Design and control of pneumatic and soft robotic system

Session Chair:

Meeting Room 2 : July 15, 16:15 - 18:00, Saturday

• 16:15~16:30

RRT-GoalBias and Path Smoothing Based Motion Planning of Mobile Manipulators with Obstacle Avoidance

Jun Shao

School of Mechanical Engineering, Zhejiang University, China

Jianfeng Liao and Wei Song and Jason Gu and Shiqiang Zhu

Zhejiang Lab, China

Hao Xiong and Zheng Chen

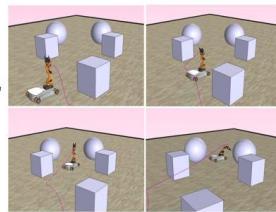
Ocean College, Zhejiang University, China

- The motion planning based on the RRT-GoalBias algorithm and path smoothing is proposed.

- The kinematics model of mobile manipulator, constraints of configuration and obstacle avoidance are given.

- The RRT-GoalBias algorithm is applied and modified to generate an initial path.

- A novel post-processing algorithm is proposed to smooth and optimize the initial path.



• 16:30~16:45

Experimental Study on Dynamic Characteristics and Fatigue of McKibben Pneumatic Artificial Muscles

Chen Wenlin, Ma Tianhua, Zhang Ying, Hao Lin*,

Wang Shuopeng, Liu Meng, Wang Rixin

Mechanical Engineering and Automation, Northeastern University, Shenyang, China

- Dynamic output characteristics of the PAMs.
- Fatigue life test of the PAMs.
- This paper focuses on the dynamic hysteresis behavior related to the load of PAMs.



Experimental platform of fatigue life tests of PAMs.

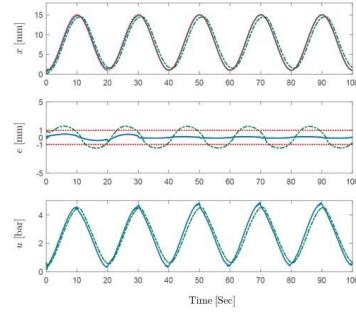
• 16:45~17:00

A Repetitive Learning Controller for PAM-Actuated Exoskeleton Robots With Motion Constraints

Tong Yang, Yiheng Chen, Ning Sun*, and Yanding Qin

Institute of Robotics and Automatic Information Systems (IR AIS), College of Artificial Intelligence, Nankai University, China

- New repetitive learning-based error-constrained control for uncertain PAM-actuated exoskeleton robot systems
- Accurate tracking control and effective error constraints
- Asymptotic convergence of tracking errors by Lyapunov-based stability analysis



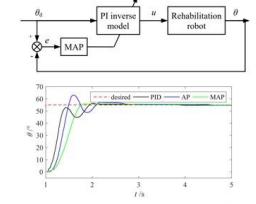
• 17:00~17:15

Hysteresis Compensation of an Elbow Joint Rehabilitation Robot Featuring Flexible Pneumatic Artificial Muscle Actuation

Yuankai Xu, Yanding Qin, Jianda Han

College of Artificial Intelligence, Nankai University, China

- A PAM actuated robot is developed for the elbow joint rehabilitation and movement assistance
- Direct inverse modeling method is utilized to obtain the inverse hysteresis model of the system
- A modified AP algorithm is used to dynamically update the weights of the inverse model



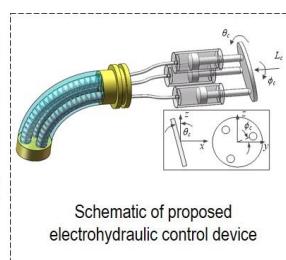
Block diagram of the controller and experiments results

• 17:15~17:30

Design and Test of an Electrohydraulic Control Device for Three-Chamber Soft Actuators

Tao Wang, Zhen Chen, and Shiqiang Zhu
Ocean College, Zhejiang University, China

- An electrohydraulic control device with decoupling function is developed by using a swash plate mechanism.
- Stretched length, bending angle, and yaw angle of three-chamber soft actuators can be independently controlled.
- A prototype is fabricated and experimental results verify the effectiveness of the proposed concept.

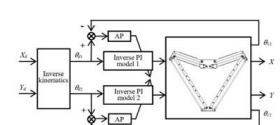


• 17:30~17:45

Closed-loop Control of a Pneumatic Artificial Muscle Actuated 2-DOF Delta Mechanism with Adaptive Hysteresis Compensation

Haoqi Zhang, Yuankai Xu, Yanding Qin, Jianda Han
College of Artificial Intelligence, Nankai University, China

- Direct inverse modeling approach was utilized to obtain the PAM's inverse hysteresis model.
- The parameters of PI inverse model are identified online by AP algorithm.
- The control performance is verified by trajectory tracking.



Block diagram of the closed loop control system

SuA I:Sensing technology and recognition

Session Chair:

Jingya Pavilion : July 16, 14:00 - 15:45, Sunday

- 14:00~14:15

- 14:15~14:30

3-D Logic Motion Sensing of Polyvinylidene Fluoride based Flexible Interactive Electronics

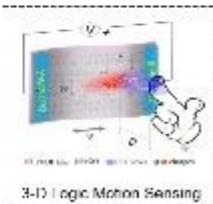
Pengcheng Wu, Guanglin Li, and Yanlong Tai

Shenzhen Institutes of Advanced Technology, CAS, Shenzhen, 518055, China

Zhenguo Yang

Department of Materials Science, Fudan University, Shanghai 200433, China

- Fabricate a new 3D tactile sensing technology based on rGOPF flexible film
- Achieve a logic potential responds to various tactile motions accurately
- Applications to human-machine interactions, human finger electronics



- 14:30~14:45

sEMG-Based Gesture Recognition Using GRU With Strong Robustness Against Forearm Posture

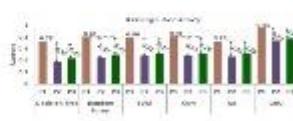
Rui Chen^{1,2}, YuanZhi Chen¹, Weiyu Guo², Chao Chen²,

Zheng Wang², Yongkui Yang^{2*}

¹Guilin University of Electronic Technology, China

²Shenzhen Institute of Advanced Technology, Chinese Academy of Science

- Propose a novel sEMG based gesture recognition that uses GRU;
- The proposed gesture recognition is robustness against different forearm postures.
- The average classification accuracy of the proposed gesture recognition achieves a accuracy of 90%.



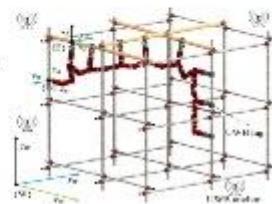
- 15:00~15:15

Localization of Biped Pole-climbing Robots in Spatial Trusses

Jingheng Chen, Shaobin Zhuang, Shichao Gu, Yisheng Guan and Haifei Zhu*

School of Electromechanical Engineering, Guangdong University of Technology, China

- A two-stage localization method based on ultra-wideband (UWB) sensors is proposed.
- The proposed method can locate the robot with a position error less than 100mm and an orientation error less than 5°.
- The proposed method can be applied to global localization of biped pole-climbing robots moving in spatial trusses.



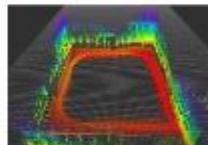
- 15:30~15:45

Low-cost and Robust Mapping and Relocalization Method Base on LidarInertial Odometry

Pengfei Qu, Shenliang Li, Jinyang Zhang
Zhansheng Duan and Kuizhi Mei

Department of Electronic and Information Engineering,
Xi'an Jiaotong University, China

- The design of low cost and robust mobile robot platform
- Ego-motion estimation with IMU and solid state Lidar
- 3D point clouds features extraction and selection
- The mapping of 3D point clouds and the method of relocalization.



A Framework for Human-Exoskeleton Interaction Based on sEMG Interface and Electrotactile Feedback

Shengcai Duan, Can Wang, Mengyao Li, Zhilong Su,

Jiaqing Liu and Xinyu Wu

Shenzhen Institute of Advanced Technology

University of Chinese Academy of Sciences, China

- Six-types motion intention is recognised by LSTM neural network based on sEMG of arms.
- The electrotactile is applied to feedback of five kinds states of exoskeleton and making up for the losing proprioception.
- Muscle fatigue of arms during use of exoskeleton is monitored and quantified with sEMG.



- 14:45~15:00

Semantic Scan Context: Global Semantic Descriptor for LiDAR-based Place Recognition

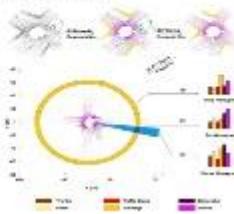
Yuxiang Li, Pengpeng Su, Ming Cao, Haoyao Chen and Xin Jiang

Harbin Institute of Technology, Shenzhen, China

Yunhui Liu

The Chinese University of Hong Kong, China

- A global semantic descriptor for finding loop closures using 3D LiDAR.
- Ring keys and sector keys based on semantic histograms for fast retrieval and alignment.
- Three-stage retrieval for fast and accurate matching of the proposed descriptors.
- Competitive performance in challenging situations for place recognition.



- 15:15~15:30

Research on SLAM of Corridor Environment Based on Multi-sensor

Fei Wang , Haiyan Shao Member, IEEE, Qingshuai Zhao

School of Mechanical Engineering, University of Jinan, China

Zhiqian Feng

School of Information Science and Engineering, University of Jinan, China

- Firstly, a multi-sensor environment awareness platform was built
- Secondly, the data of each sensor was collected and processed and fusion was realized based on the EKF algorithm of weighted observation multi sensor
- Finally, the cartographic algorithm was optimized at the back end and the map construction of corridor environment was realized.



- 15:45~16:00

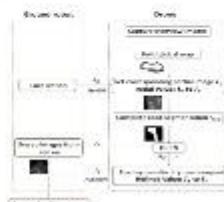
Collaborative Recognition of Feasible Region with Aerial and Ground Robots through DPCN

Yunshuang Li, Zheyuan Huang, Zexi Chen,

Yue Wang and Rong Xiong

Department of Control science and engineering, Zhejiang University, China

- A collaborative system with aerial and ground robots is proposed to assist the ground to gain precise information of feasible region
- It contributes to ground robots' interacting with the environment.
- The match between heterogeneous images is done by deep phase correlation network.
- Our system has great accuracy and efficiency.



SuB I: Human-Machine Interface and Intelligent Interactions I

Session Chair:

Lanting Pavilion : July 16, 14:00 - 15:45, Sunday

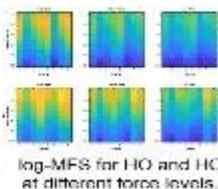
• 14:00~14:15

• 14:15~14:30

Toward reducing the effect of force variations on electromyography pattern recognition by Mel-frequency spectrum

Yan Liu, Lan Tian, Yue Zheng, Xiaomeng Zhou, Xiangxin Li*, and Guanglin Li
Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China

- The energy distributions in frequency of different force levels were similar for the same motion class
- A Mel filter bank is applied to the power spectrum to achieve the Mel-frequency spectrum (MFS)
- For the un-trained high and low force levels, the accuracy increased by about 27% and 11% than TD feature set (MAV, WL, ZC, SSC)

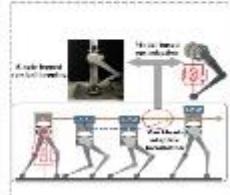


• 14:30~14:45

Workload-adaptive Vertical Hopping of A Single-legged Robot using Model-based Optimization

Yongming Yue, Yu Zhang, Wei Gao and Shiwu Zhang
Department of Precision Machinery and Precision Instrumentation, University of Science and Technology of China, China

- Explored workload adaptive vertical hopping using a single-legged robot.
- Fast gait generation given system workloads using SLIP based models and advanced Nonlinear Programming tools
- Experimental verification on physical platform with $\pm 4\%$ accuracy under up to 190% robots weight



• 14:45~15:00

Knee Joint Exoskeleton Device Based on Biological Motion Principle

Wenyuan Liang^{1,2} and Ying Liu^{1*}
National Research Center for Rehabilitation Technical Aids, China
Key Laboratory of Rehabilitation Technical Aids for Old-age Disability, China

- A knee joint exoskeleton device that is designed based on the biological motion principle of human knee joint
- In order to follow the powering patterns of human walking, two one-way bearings and one set of gears are adopted to construct the knee joint exoskeleton device
- The biological motions of femoral-on-tibial extension and tibial-on-femoral flexion can be adaptively imitated by the proposed device

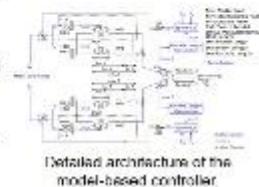


• 15:15~15:30

An Integrated Virtual Hand Platform for Evaluation of Model-Based Control of Hand Prostheses

Zhuo-Zhi Zhang, Jie Zhang, Chuan-Xin M. Niu, and Ning Lan
Laboratory of NeuroRehabilitation Engineering, School of Biomedical Engineering, Shanghai Jiao Tong University, China

- Integrate the neuromorphic model of muscles with the FTS based sensory feedback in the virtual hand platform.
- Explore the compliant properties of the model based biomimetic control system using the tendon driven virtual hand
- The control mode of the biomimetic controller was automatic switched depending on the external load conditions.

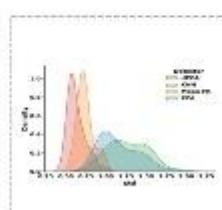


• 15:00~15:15

Detecting Movement Timing from Primate Intracortical Signals for Brain-machine Interfaces in Dynamic Environment

Chenyang Li, Yiheng Zhang, Tianwei Wang, Xinxu Xu, Qifan Wang, Ruichen Zheng and He Cui
CAS Key Lab of Primate Neurobiology, CEBSIT, Shanghai

- Movement timing recognition is neglected in current HMI decoding
- Detecting movement timing is an outlier detection of recorded intracortical signals from unlabeled dataset
- dPCA-based detector gives the best performance across 9 simultaneously recording set

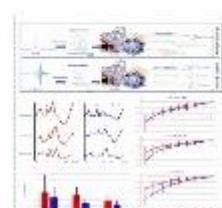


• 15:30~15:45

Auditory Brainstem Responses evoked by Swept-tone in Unilateral Sensorineural Hearing Loss Patients

Xin Wang^{1*}, Jingqian Tan¹, Boya Wang¹, Mingxing Zhu¹, Yao Pi¹, Xiuchen Wang¹, Cheng Wang¹, Chen Wang¹, Feng Wan¹, Shixiong Chen² and Guanglin Li¹
Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen
Shenzhen College of Advanced Technology, University of Chinese Academy of Sciences, Shenzhen
Guangdong-Hong Kong-Macao Joint Laboratory of Human-Machine Intelligence-Symbiosis, Shenzhen

- A swept-tone method which adjusted the show-up times of different frequency components based on the basilar-membrane model is proposed.
- The proposed swept-tone method in ABR test shows advantages on morphology, time-saving, and hearing threshold evaluation.
- The swept-tone ABR could help with more accurate and efficient disease diagnosis.



SuC I:Robot Mechanism I

Session Chair:

Meeting Room 1 : July 16, 14:00 - 15:45, Sunday

• 14:00~14:15

• 14:15~14:30

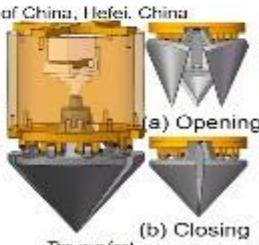
Design and Analysis of a Novel and High-efficiency Axe-foot Part for Razor Clam Inspired Anchoring Robot

Bingxin Zhao, Linsen Xu,
Hefei Institutes of Physical Science, Chinese Academy of Sciences, Hefei, China

Lei Liu

University of Science and Technology of China, Hefei, China

- A novel and high-efficiency axe foot part for razor clam inspired anchoring robot
- The axe foot of the robot plays an important role in the movements of the robot
- The rationality of the axe-foot part design is proved by mechanics analysis and dynamic analysis.
- The actual burrowing ability and anchoring ability of the axe-foot part is verified by the results of these experiments.



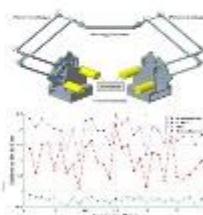
• 14:30~14:45

Kinematic Self-calibration of a 3-DOF Parallel Mechanism with III-conditioned Identification Matrix

Xingguang Duan, Lixing Jin and Changsheng Li

Beijing Advanced Innovation Center for Intelligent Robots and Systems, Beijing Institute of Technology, China

- Redundant actuation parallel mechanism
- Self-calibration of the kinematic calibration
- III-conditioned identification matrix
- TSVD, RR and Liu estimation algorithm

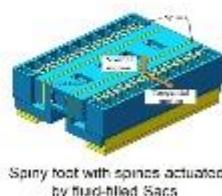


• 15:00~15:15

Design of a Spiny Foot with Fluid-filled Sacs for Climbing Robots

Yanwei Liu, Xiang Huang, Hao Pan, Shujuan Li, Pengyang Li
School of Mechanical and Precision Instrument Engineering, Xi'an University of Technology, China

- The spiny foot was inspired by the fluid-filled sac in gecko's foot for force distribution
- All spines' tangential and normal motion of are actuated by two fluid filled sacs respectively
- The spiny foot is capable of adapting to the complex topography of rough wall surfaces.
- The spiny foot prototype is able to carry 540 g extra payload on inverted rough surfaces.



• 15:30~15:45

Configuration Synthesis and Structure Design of a Reconfigurable Robot for Muscle Strength Training

Jianfeng Li, Pengfei Zhang, Qiang Cao and Mingjie Dong
Faculty of Materials and Manufacturing Technology, Beijing University of Technology, China

Liwei Jiang

CSSC System Engineering Research Institute, China

- The configuration of muscle strength training device suitable for all joints was synthesized.
- A reconfigurable robot configuration was proposed for muscle strength training.
- The three dimensional structure of the muscle strength training robot was designed.
- The reconfigurable simulation was carried out to verify the muscle strength training configuration.



State Sensing of Spinal Surgical Robot Based on Fusion of Sound and Force Signals

Meng Li^{1*}, Xiaozhi Qi¹, Fengqiang Cuan², Hailiang Jin³, Ying Hu², Wei Tian⁴

¹Hainan Institute of Technology(Shenzhen), China

²Shenzhen Institute of Advanced Technology, CAS, China

³Shenzhen Biodesign medical robotics co., Ltd., China

⁴Shenzhen Beigang Jishuitan Hospital, China

- This paper proposes a state sensing method of spinal surgical robot based on multi-source information.
- The IMM and SVM is performed to train and identify the feature quantities of the sound and force signals.
- The effectiveness of the proposed identification method is verified and compared by using multi-parameter experiments.

• 14:45~15:00

Design and Simulation of a Hip Exoskeleton for Lateral Walking

Zhang Zhewen and Cao Wujing

Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences

- The effect of lateral walking training on human rehabilitation is analyzed and discussed.
- Analysis of transverse walking gait law.
- Structural design of lateral walking assist exoskeleton.
- The mathematical modeling and simulation are carried out for the mechanism design



• 15:15~15:30

Bronchoscopic Interventional Surgery Robot which Constrained by a Shear-Fork Mechanism

Jie Li¹ and Chao Han²

¹School of Mechanical Engineering, Shenyang Jianzhu University, China

Tao Yu³, Xiao He⁴, and Hao Liu⁷

²State Key Laboratory of Robotics, Shenyang Institute of Automation, China

Zhenming Jiang⁵ and Lei Sun⁶

³First Hospital of China Medical University, China

- Research and Development of Bronchoscope Interventional Robot Delivery Mechanism.
- Requirements Analysis and Master Plan
- Structure Design and Build Control System
- Model Testing and Analysis.



SuD I: Vision I

Session Chair:

Meeting Room 2 : July 16, 14:00 - 15:45, Sunday

- 14:00~14:15

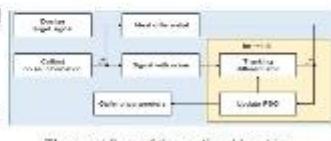
- 14:15~14:30

Design of Optimal Tracking Differentiator Based on Particle Swarm Optimization

Yang Gao and Dapeng Tian

Key Laboratory of Airborne Optical Imaging and Measurement, Changchun Institute of Optics, Fine Mechanics and Physics, CAS, China
University of Chinese Academy of Sciences, China

- An optimal parameter design method for tracking differentiators.
- It is proved that the function of filter and error is convex.
- An off line parameter design method based on PSO



- 14:30~14:45

A Survey of Image Clustering: Taxonomy and Recent MethodsJiaxin Liu¹, Dongwei Wang², Siqun Yu^{1,2*}, Xueliang Li¹, Zhi Han^{1,2} and Yunlong Tang^{1,2}

¹ State Grid Shandong Electric Power Research Institute, Jinan, China
² School of Advanced Technology, Peking University Shenzhen Graduate School, Shenzhen, China
* Correspondence: yu_si@pku.edu.cn; tangyl@pku.edu.cn
† State Key Laboratory of Intelligent Information Processing: Shenzhen Research Institute, Shenzhen University, Shenzhen, China
B State Key Laboratory of Shandong Electric Power Research Institute, Jinan, China

- Image clustering is a fundamental problem in computer vision domain. In this survey, we provide a comprehensive review for image clustering including traditional clustering methods and deep clustering methods. The main contributions of this paper can be summarized as follows:
- (i) We provide an overview of modern machine learning techniques for image clustering. For each type of image clustering methods, we provide detailed descriptions on representative models, and make the necessary comparisons. (ii) We collect abundant resources on image clustering, including state-of-the-art models, benchmark data sets, common evaluation metrics and visualization methods. This survey can be used as a practical guide for understanding image clustering.



- 15:00~15:15

An Infrared Image Enhancement Algorithm for Gas Leak Detecting Based on Gaussian Filtering and Adaptive Histogram Segmentation

Xiaoxi Nie

School of Resources and Environment, University of Electronic Science and Technology of China, Chengdu, China

Wei Chen

Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China

- Separate the image into detail and background layers using a Gaussian filter.
- Enhancement of detail layers using adaptive histogram segmentation.
- Image enhancement by means of local mapping.

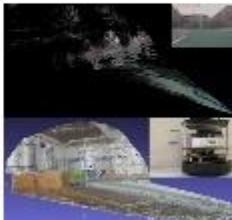


- 15:30~15:45

Colorful Reconstruction from Solid-State-LiDAR and Monocular VersionJinyang Zhang, Pengfei Qu, Shenliang Li
Kuiwei Mei and Zhansheng Duan

Faculty of Electronics and Information Engineering of Xi'an Jiaotong University, Xi'an, Shaanxi, China

- The fusion is both of LiDAR's higher precision depth and version's colorful texture.
- New solid-state LiDAR has denser pointcloud than convention Velodyne LiDAR, the former contains more details.
- The cheaper LiDAR improved robot perception ability with a wide range of applications



Robotic arm grasping through 3D point clouds recognition

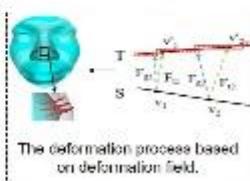


2021 IEEE International Conference on Real-Time Computing and Robotics

- 14:45~15:00

3D Facial Similarity Measure Based on Deformation FieldJiajun Ma, Guoyuan Liang, Yu Liang, Xinyu Wu
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

- Construct a composite deformation field based on distance transform and correspondence relationship.
- Local similarity and global similarity are calculated based on smooth deformation path.
- The similarity measurement results are in line with the expectation through experiments on the synthetic data and the real data.



- 15:15~15:30

A Depthwise Separable Convolution Based 6D Pose Estimation Network by Efficient 2D-3D Feature FusionQi Feng, Chaochen Gu, Jianqi Qin and Rui Xu
Department of Automation, Shanghai Jiao Tong University, China

- A novel 2D-3D feature fusion module is proposed to enhance feature extraction in 6D pose estimation network.
- The depthwise separable convolution is integrated to our 6D pose estimation network, which drastically accelerates the model training speed and decreases the model storage space, yet achieves on par or better results than state-of-art methods.



SuA II:Mobile Robots I

Session Chair:

Jingya Pavilion : July 16, 16:15 - 18:00, Sunday

• 16:15~16:30

• 16:30~16:45

IEEE RCAR 2020 Digest**The Design of an Aerial/Ground Dual-modal Mobile Robot for Exploring Complex Environments**

Daoxun Zhang, Ce Guo, Haoran Ren, Pengming Zhu, Ming Xu and Huijun Lu
Robotics Research Center, College of Intelligence Science and Technology, National University of Defense Technology, China

- A novel design of a dual modal mobile robot
- The robot possess aerial and ground movement capability.
- The robot has high energy efficiency and rapid maneuverability.



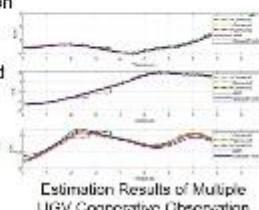
The aerial-ground dual-modal mobile robot prototype

• 16:45~17:00

Unmanned Aerial Vehicle's State Estimation with Multiple Unmanned Ground Vehicles Cooperative Observation Based on Set-Membership Filter

Jikang Hou, Jiayi Li and Wei Dong
School of Mechanical Engineering, Shanghai Jiao Tong University, China
Yi Ni
Shanghai Electro-Mechanical Engineering Institute, China

- There are usually problems with low observation accuracy or robustness and prior assumptions about noises.
- Set-Membership Filter (SMF) method is applied to the cooperative observation system.
- The application of SMF algorithm in single and multiple UGVs cooperative observation system with obstacles are researched respectively.
- Experiments are conducted to verify accuracy and effectiveness of SMF method.



Estimation Results of Multiple UGV Cooperative Observation

• 17:15~17:30

Autonomous mobile robot navigation in uncertain dynamic environments based on deep reinforcement learning

Zhangtan Lu and Ran Huang
College of Information Science & Technology, Beijing University of Chemical Technology, China

- This paper proposes E2E navigation based on deep reinforcement learning
- Use multi-time environmental information to ensure continuous navigation
- The proposed method has the property of safe and fast navigation in uncertain dynamic environments.
- Simulation results have verified the efficacy of the proposed method.



Global navigation route

• 17:45~18:00

Extreme Maneuvering Control and Planning of Multi-rotor UAV for High-speed Invading Target Avoidance

Wenhao Sun, Xiaoyang Zhang, Guanglian Lin, Hongpeng Wang, Jianhua Han
College of Artificial Intelligence, Nankai University, China

- Adopt a hybrid control system to control the extreme maneuvering of UAV
- Apply extreme maneuvers to dynamically evade high-speed intrusion targets.
- The results are verified by simulation experiments.

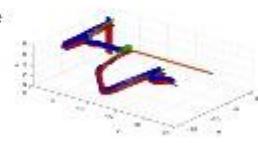
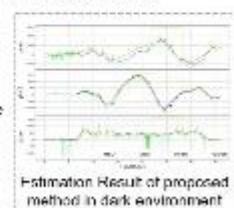


Diagram of UAV extreme maneuvering dynamic obstacle avoidance

A cooperative positioning approach of Unmanned Aerial Vehicles with Accuracy and Robustness

Ziwei Zhou, Ziyi Lin, Wei Dong and Xiangyang Zhu
School of Mechanical Engineering, Shanghai Jiao Tong University, China
Yi Ni
Shanghai Electro-Mechanical Engineering Institute, China

- A novel cooperative positioning approach named is proposed, which is comprised of a marker-based position estimation and an end-to-end UAV detection.
- A data fusion algorithm is applied to ensure the accuracy and robustness of the localization.
- Extensive experiments under different environments are carried out to verify the effectiveness of the proposed method.



Estimation Result of proposed method in dark environment

• 17:00~17:15

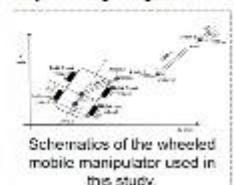
Kinematic control of mobile manipulators subject to physical constraints and noise disturbances

Xiaoxiao Li and Zhihao Xu and Xueteng
Guangdong Key Laboratory of Modern Control Technology, Institute of Intelligent Manufacturing, GDAS, Guangzhou, Guangdong, P. R. China

Shuai Li and Kanyang Jiang
School of Engineering, Swansea University, Swansea, United Kingdom

Li Jiang
School of Intelligent Manufacturing, Wuyi University, Guangdong, China

- Considering the kinematic control of wheeled mobile manipulator subject to physical limits and external noise disturbances.
- Proposing an HMOC scheme incorporating path following and physical constraints' compliance based on the quadratic program.
- Validating efficiency of the HMOC scheme and the designed solver via simulation.



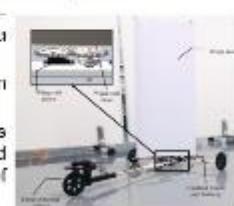
Schematic of the wheeled mobile manipulator used in this study.

• 17:30~17:45

Modeling and Implementation of Tacking for Wing Sail Land-yacht

Yihan Huang, Yang Jiao and Xinyu Chen
The Chinese University of Hong Kong, Shenzhen, China
Lianxin Zhang, Xiaoqiang Ji and Huihuan Olan
Shenzhen Institute of Artificial Intelligence and Robotics for Society, The Chinese University of Hong Kong, Shenzhen, China

- A novel lightweight design of low cost three-wheeled land-yacht with a T-frame and a foamed wing sail is proposed.
- A model is developed to predict the minimum initial velocity for upwind steering (tacking).
- An acceleration error function C in the model is identified by a series of experiments, and tacking experiments with a high success rate of 94.7% verify the steering model.



SuB II:Human-Machine Interface and Intelligent Interactions II

Session Chair:

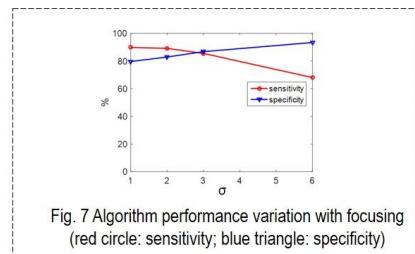
Lanting Pavilion : July 16, 16:15 - 18:00, Sunday

- 16:15~16:30

IEEE RCAR 2020 Digest Template**Performance Assessment of Artificial Intelligence Medical Device Software Using Synthetic Data**

Hao Wang, Xiangfeng Meng, Chao Zhang, Jiage Li

Institute for Medical Device Control, National Institutes for Food and Drug Control , 31 Huatuo Rd, Daxing ,102629, Beijing, China



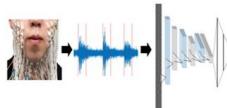
- 16:45~17:00

The effects of different training modes on the performance of silent speech recognition based on high-density sEMG

Y. Pi, M. Zhu, Z. Yang, X. Wang, C. Wang, H. Zhang, S. Chen, and G. Li

The CAS Key Laboratory of Human-Machine Intelligence-Synergy Systems, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China

- There are two different training modes for SSR.
- Using different training modes might lead to a big difference in the performance of the same model.
- The CNN model using the signals from a single subject performed better in these metrics, but it was only suitable for the SSR of the same subject.



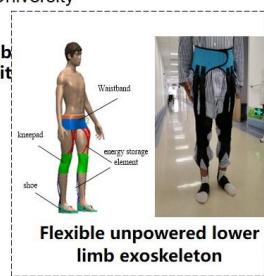
- 17:15~17:30

**IEEE RCAR 2020
Simulation design of flexible Unpowered lower limb exoskeleton**

Yongfeng Wang, Yanan Diao, Yunkun Ning, Guanglin Li, and Guoru Zhao*

Shenzhen Institutes of Advanced Technology
Hubei Polytechnic University

- (1) Conventional unpowered lower limb exoskeleton pay less attention to gait energy efficiency
- (2) the structure design for flexible unpowered lower limb exoskeleton with rubber energy storage element.
- (3) the musculoskeletal model with exoskeleton is established, the variable ranges of the elongation of elastic elements for the ankle is bigger than hip during walking



- 16:30~16:45

Evaluation of Phantom Finger Sensation Evoked by Electrical Stimulation for Transradial Amputee: A Case Study

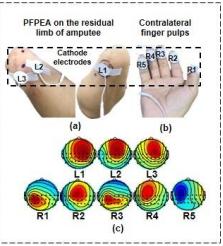
Yingying Wang, Xi Tang, Naifu Jiang, Lan Tian, Yue Zheng, Xiangxin Li, Guanglin Li*, and Peng Fang*

The CAS Key Laboratory of Human-Machine Intelligence-Synergy Systems, Shenzhen Institutes of Advanced Technology, China

Jun Xie

The School of Mechanical Engineering, Xi'an Jiaotong University, China

- The non-invasive Electrical Nerve Stimulation (TENS) is used to reestablish the sensory function for a limb amputee
- An approach based on electroencephalogram (EEG) is proposed to evaluate the evoked somatosensory information
- Somatosensory information evoked at different positions of the stump could be distinguished by characteristics of Event-Related Potential (ERP)



- 17:00~17:15

Asynchronous steady-state visual evoked potential brain-computer interface application: True and false positive rate comparison between with and without eye-tracking switch paradigms

Jun Xie and Huanqing Zhang

School of Mechanical Engineering, Xi'an Jiaotong University, China

- This paper proposed eye-tracking switch based asynchronous BCI paradigm to reduce the false positive rate.
- Results showed that the false positive rate was reduced to less than 10%.
- Meanwhile, the recognition accuracy can also be improved to a certain extent.



SuC II:Robotic control

Session Chair:

Meeting Room 1 : July 16, 16:15 - 18:00, Sunday

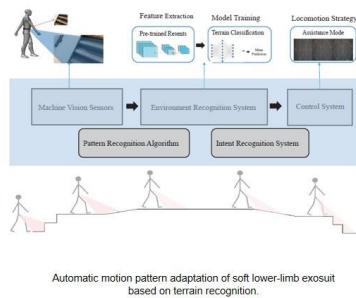
- 16:15~16:30

environment classification and recognition for soft lower-limb exosuit

Ni Jiangpeng and Wang Zhuo

Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences

- Reliable environmental context prediction is critical for wearable robots to assist terrain-adaptive locomotion.
- terrain classification and recognition system (TCRS) is designed for lower-limb soft exosuit robots.
- The results in this study may lead to novel context recognition strategies in reliable decision-making, improved intelligent system design in various applications.



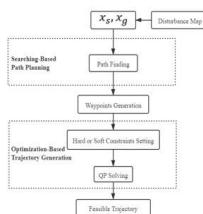
- 16:45~17:00

Optimized Underwater Manipulator Path Planning to Minimize The Disturbance on Robot

Xiaodi Liu , Xin Wang* and Xiaotian Cai

Mechanical Engineering and Automation,
Harbin Institute of Technology Shenzhen, China.

- The goal of the path planning in this paper is to cause the smallest possible variation in disturbance moments to the robot body.
- Generates a disturbance map by data collection, on the basis of which the path search is then carried out.
- Develop an algorithm based on the path search of the underwater manipulator and the optimized trajectory generation to minimize the disturbance to the robot body.



- 17:15~17:30

Reinforcement Learning of Serpentine Locomotion for a Snake Robot

Mr. Ke Qiu and Mr. Yikai Lv

School of Mechanical Engineering

Mr. Hang Zhang

College of Electrical Engineering

Mr. Yunkai Wang, Dr. Chunlin Zhou and Dr. Rong Xiong
College of Control Science and Engineering , Zhejiang University, China

- The locomotion control of the snake robot.
- A central pattern generator (CPG) model for providing serpentine locomotion.
- Reinforcement learning (RL) for getting optimal model parameters.



Research on Balance Control of Cube Robot

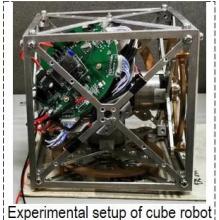
Qingsong Yin, Feifei Wang, Siliang Lu, Yuan Fan

College of Electrical Engineering and Automation, Anhui University, China

Yongbin Liu, Guoli Li

National Engineering Laboratory of Energy-Saving Motor and Control Technology, Anhui University,China

- Mechanical structure of cube robot was design
- State-space equation were derived from system dynamics modeling
- The closed-loop state-space equation of robot system was simulated
- Balance control of cube robot was tested and verified by the experimental setup.



- 17:00~17:15

Development of a Virtual Training System for Master-Slave Hip Replacement Surgery

Riwei Zhang, Q. Liu, S. Cai, C. Wang, X. Zhang, L. Duan, Y. Lu,

B. Zhang, Z. Wu, J. Guo

School of Automation, Guangdong University of Technology, Guangzhou, China
The First Affiliated Hospital of Shenzhen University, Shenzhen, China

- The Virtual Training System helps surgeons to better adapt to the robotic system.
- The System improves the surgeons' proficiency in Hip Replacement Surgery.
- The System provides vivid and intuitive perception, improves the understanding of the remote manipulation.



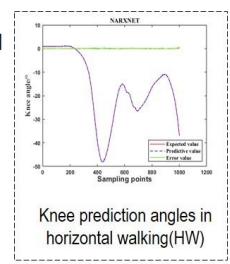
- 17:30~17:45

Angle Estimation for Lower Limb Joint Movement Based on VMD-NARX Algorithm

Xin Shi, Jieyi Zhang, Pengjie Qin, and Rongyi Liu

College of Automation, Chongqing University, China

- A variational mode decomposition (vmd) algorithm based on neural network is proposed
- The lower limb angle prediction model based on NARX neural network is established
- The RMSE of NARX prediction model based on variational mode decomposition is lower than 2



SuD II:Learning I

Session Chair:

Meeting Room 2 : July 16, 16:15 - 18:00, Sunday

• 16:15~16:30

• 16:30~16:45

Efficient Learning-based Trajectory Tacker for Quadrotor at High-speed Flight

Peng Peng, Gang Chen and Wei Dong

School of Mechanical Engineering, Shanghai Jiaotong University, China

Yi Ni

Shanghai Electro-Mechanical Engineering Institute, China

- This paper aims to improve the accuracy of the trajectory tracking of the quadrotor.
- Combining traditional PID controller with the idea of neural network modeling based MPC.
- The tracking performance is obviously improved both in simulation and experiment.



• 16:45~17:00

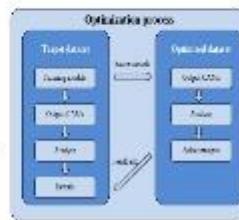
Deep Convolutional Neural Network Transfer Learning**Optimization Based on Visual Interpretation**

Yibo Xu, Jiongming Su, Fengtao Xiang, Ce Guo, Haoran Ren,

Huimin Lu

College of Intelligent Science, National University of Defense Technology, China

- Introduce "feedback" to pre-recognize optimized datasets
- Visual interpretation of military images using class activation mapping
- Optimization of the training set for the test set



• 17:15~17:30

Socially-Aware Multi-Agent Following with 2D Laser Scans via Deep Reinforcement Learning and Potential FieldYuxiang Cui, Xiaolong Huang, Yue Wang, Rong Xiong
CSF, Zhejiang University, China

- We propose a potential field based method for formation control and goal assignment.
- We propose a deep model of socially-aware following policy trained by reinforcement learning.
- Our method can be applied to random environments with an arbitrary number of robots.
- We train the policy in a decentralized policy sharing multi-agent simulation environment.



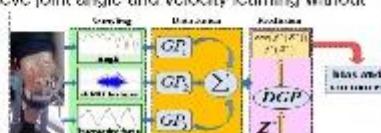
• 17:45~18:00

Evolving Gaussian Process based Learning of Knee Angle and VelocityJiantao Yang¹, Yong He², Chen He¹, and Ping Shi^{1*}

1. Institute of Rehabilitation Engineering and Technology, University of Shanghai for Science and Technology, China

2. CAS Key Laboratory of Human-Machine Intelligence Synergy Systems, Shenzhen Institutes of Advanced Technology, China

- Dependent Gaussian process is established to fuse multi-source information from each of the human exoskeleton subsystems.
- Gradient estimation model is then performed to obtain the joint velocity.
- The proposed model can achieve joint angle and velocity learning without velocity measurement.

**Human Parsing with Edge Enhancement**

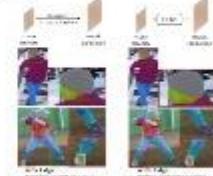
Lei Ma and Liqing Zhang

RCMI, Shanghai Jiao Tong University, China

Jian Wang and Jie Shao

AI Lab, ByteDance Inc., China

- Focusing on enhancing body's edge segmentation performance of the human parsing problem.
- Three aspects: feature extraction, context embedding, and edge refinement.
- Refining the body's edges in the up-sampling procedures in a coarse-to-fine fashion.
- Achieved excellent performance, mIoU 54.05% on LIP dataset, and mIoU 60.88% on PASCAL-3D+ Person-Part datasets.



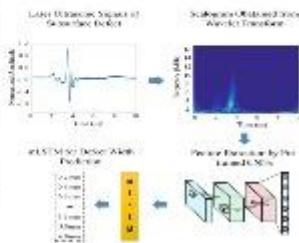
• 17:00~17:15

Automatic Quantification Of Subsurface Defects By Analyzing Laser Ultrasonic Signals Using Convolutional Neural Networks And Wavelet

Haowen Feng, Gaolong Lv, Dan Chen and Shifeng Guo*

Shenzhen Institutes of Advanced Technology, University of Chinese Academy of Sciences, China

- Establish validated numerical model to obtain sufficient laser ultrasonic signals for training the CNN model.
- Convert the laser ultrasonic signals into the scalograms (images) via wavelet transform.
- Input scalograms to the pre-trained CNNs model to identify the defect features automatically.



• 17:30~17:45

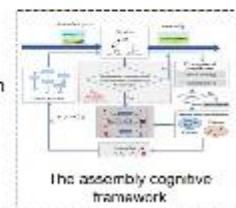
A robot assembly framework with "perception-action" mapping cognitive learning

FengMing Li, TianYu Fu, GuoQing Chu, Rui Song* and YiBin Li

1 School of Control Science and Engineering, Shandong University, Jinan, 250061, China

2 School of Mechanical and Electrical Engineering, Harbin Institute of Technology, Harbin 150008, China

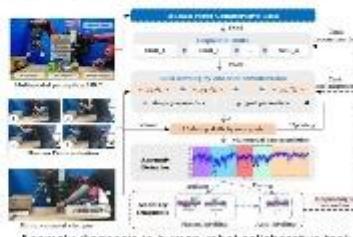
- the proposed framework integrates the cognitive recognition and online control strategy of the assembly state.
- it can monitor the unknown state of the robot in the process of assembly contact in real time.
- It can recognize the new assembly state, update the assembly experience knowledge base in real time, and guide the robot to complete the assembly work.



• 18:00~18:15

Robot Multimodal Anomaly Diagnosis by Learning Time-lagged Complex DynamicsLin Yang², Wu Yan¹, Zhihao Xu¹, and Hongmin Wu^{1*}Institute of Intelligent Manufacturing, Guangdong Academy of Sciences, China
Advanced Potential Key Laboratory of Electronic Information Product Reliability Technology, China

- A novel method of multimodal anomaly diagnosis by learning the time lagged dynamics of anomalies detected during an Human-robot collaborative task.
- A time-lagged variational auto-encoder model (TVAE) is first proposed to compress complex multivariate dynamics into simpler manifolds.
- The manifolds are used to filling a dynamic time warping based K-nearest neighbors model for anomaly diagnosis in a multi-classes classification scheme.



MoA I: Vision II

Session Chair:

Jingya Pavilion : July 17, 8:30 - 10:15, Monday

• 8:30~8:45

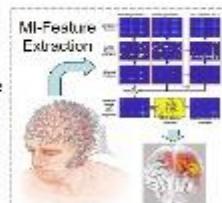
• 8:45~9:00

Short-Time Fourier Transform Covariance and Selection, A Feature Extraction Method for Binary Motor Imagery Classification

Yue Ma, Liangsheng Zheng, Zhengkun Yi, Yang Xiao, Can Wang, and Xinyu Wu
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

- A feature extraction method STFT covariance that integrates spatial time frequency domain information is proposed.
- The novel feature selection method, the infinite feature selection, is introduced in the proposed method to improve the stability and effectiveness.
- Good classification average accuracy and stability of $83.8\% \pm 14$ are obtained in the BCI Competition IV DataSet IIb.

• 9:00~9:15

**Total Variation Regularized Low-Rank Tensor Decomposition with nonlocal for single image denoising**

Shengchuan Li¹, Yanmei Wang^{2,4,5}, Qiong Luo^{2,3,4,5}, Kai Wang², Zhi Han^{1,4} and Yandong Tang^{3,4}

- State Grid Liaoning Electric Power Research Institute, Shenyang, China
 - State Grid Shandong Electric Power Company, Shandong, China
 - State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang, China
 - Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Sciences, Shenyang, China
 - University of Chinese Academy of Sciences, Beijing, China
- Sparse noise and Gaussian noise are modeled separately.
 - Introducing the non-local prior into tensor decomposition with TV model.
 - Experiments prove the effectiveness of the proposed method.

• 9:30~9:45



Comparison of different methods under different noise cases

High-Precision Pose Estimation Method of the 3C Parts by Combining 2D and 3D Vision for Robotic Grasping in Assembly Applications

Nan Zhang, Yixin Xie, Xiansheng Yang, Haopeng Hu and Yunjiang Lou
School of Mechanical Engineering and Automation, Harbin Institute of Technology, Shenzhen, China

- This paper presents a high-precision 6D pose estimation method for robotic grasping in assembly applications.
- The Mask R CNN is used to map and extract point cloud of the component.
- An accurate estimation of component pose is got by PCA and ICP, and the robot can grasp accurately after hand-eye calibration.

• 10:00~10:15



The high-precision assembly experiment platform

An Eyelashes Segmentation Method Based on Improved Inter-class Variance Maximization Algorithm

Hanlong Zhang

Shenzhen Institute of Advanced Technology Chinese Academy of Sciences, University of Chinese Academy of Sciences, China

Wei Chen

Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

- Restrict the location of the region of interest by pupil position.
- Limit the grayscale range by the average grayscale of the iris.
- Calculation of thresholds by the Otsu algorithm in the case of restricted position area and restricted grayscale range.

**A full-body 3D reconstruction using planar mirrors**

Pengju Xie, Yuping Ye, Lijun Shu and Zhan Song
Shenzhen Institute of Advanced Technology, University of Chinese Academy of Sciences, China

- This paper proposed an SL-based full-body 3D reconstruction method utilizing two planar mirrors.
- Our method adopted the light reflection principle and comprehensively considered the calibration problem essential for the point cloud registration.



• 9:15~9:30

Stereo calibration of defocus cameras without the limitation of overlapping fields of view

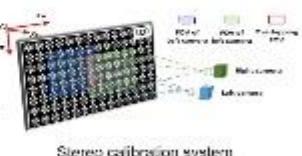
Xiaokai Song and Xiangcheng Chen

School of Automation, Wuhan University of Technology, China

Wenyuan Liang

National Research Center for Rehabilitation Technical Aids, China

- Each feature point is coded by the phase-coding method.
- Stereo calibration can be realized even if the cameras are defocused.
- Without the limitation of the cameras' overlapping fields of view.



Stereo calibration system

• 9:45~10:00

A High-Precision Assembly System of 3C Parts Based on 6D Pose Estimation and Visual Servoing

Yixin Xie, Nan Zhang, Xiansheng Yang and Yunjiang Lou
School of Mechanical Engineering and Automation, Harbin Institute of Technology, Shenzhen, China

- This paper presents an automatic high-precision assembly system.
- A pose compensation strategy and real-time visual servoing approaches are flexibly implemented.
- Can tackle the assembly tasks even if two parts both exist uncertain poses.



The high-precision assembly experiment platform

MoB I:Advanced Control I

Session Chair:

Lanting Pavilion : July 17, 8:30 - 10:15, Monday

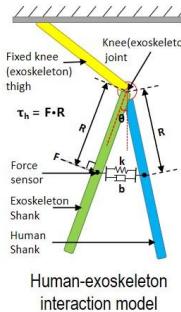
• 8:30~8:45

• 8:45~9:00

Adaptive Admittance Control of Human-Exoskeleton System Using RNN Optimization

Pengchen Lian, Yong He, Yue Ma, Jingshuai Liu and Xinyu Wu
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

- A new adaptive admittance control law is proposed, which provides a harmonious human-exoskeleton interaction.
- The proposed admittance control law is further optimized by Jordan Recurrent Neural Network(JRNN).
- Compared with fixed admittance control, the proposed method significantly improves the interaction level.



Human-exoskeleton interaction model

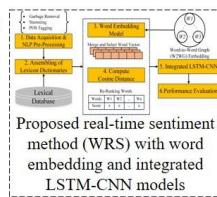
• 9:00~9:15

IEEE RCAR 2020 Digest Template

WRS: A Novel Word-embedding Method for Real-time Sentiment with Integrated LSTM-CNN Model

Abdur Rasool^{1,2}, Qingshan Jiang¹, Qiang Qu¹, Chaojie Ji³
1Shenzhen Key Lab for High Performance Data Mining, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China
2Shenzhen College of Advanced Technology, University of Chinese Academy of Sciences, China
3Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China

- Propose a novel Word-to-Word Graph (W2WG) embedding for the real-time sentiment (WRS).
- Two neural networks integrate (LSTM-CNN) to gain the highly efficient features.
- Experiment with IMDB and real-time Twitter data and achieved effective results.



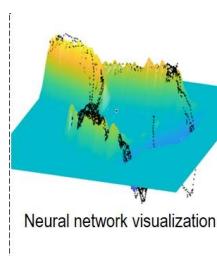
• 9:30~9:45

Force Tracking Control for Electro-Hydraulic Actuators Based On RBF Neural Networks

Xinhui Tian, Honglei An, Zhitong Zhang, Xu Chang, Hongxu Ma and Qing Wei

Robot Research Center, College of Intelligence Science and Technology, National University of Defense Technology, China

- The static relationship between velocity-force-input has been demonstrated in hydraulic actuators.
- The least square method and RBF neural network are used to identify this relationship.
- The performances of force-tracking and disturbance-rejection have been improved.



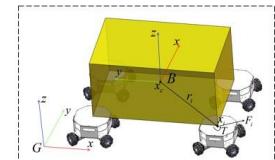
Distributed Adaptive Control of Multiple Robots for Cooperative Load Transportation

Bo Zhang, Pudong Liu, Runhao Xi, Youqiang Ye and Shiyu Chen
College of Mechatronics and Control Engineering, Shenzhen University, China

Yao Cui

Research & Development Institute of Northwestern Polytechnical University In Shenzhen, China

- An adaptive control (MRAC) method based on model reference is proposed.
- The common load state space model of multiple omnidirectional mobile robots is established.
- The controller of automatic adjustment of control parameters is designed to approach the reference model.
- Prior knowledge of robot position and load characteristics is not needed to control the robots transport load.



Multi-robot transport system

• 9:15~9:30

Fixed-time leader-follower consensus based secondary voltage control for microgrid under directed communication graph

Junkang Ni,
School of Automation, Northwestern Polytechnical University

Hui Cao,

School of Electrical Engineering, Xi'an Jiaotong University

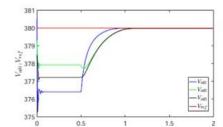
Xinghua Liu, Lei Yang,

School of Electrical Engineering, Xi'an University of Technology

Liansong Xiong

School of Automation, Nanjing Institute of Technology

- A fixed-time leader-follower consensus based secondary voltage controller is proposed.
- The proposed consensus scheme achieves fixed-time consensus tracking for multi-agent systems under digraph.
- The proposed consensus scheme achieves secondary voltage restoration within a fixed time.



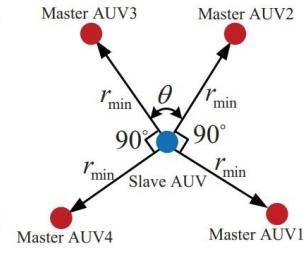
The voltage responses of the DGs under control

• 9:45~10:00

Optimality analysis for formation of Multi-AUV cooperative positioning based on genetic algorithm

Junqi Qu, Gongwu Sun, Jun Zhang, Xinguang Li, and Ying Mao
China Ship Scientific Research Center

- the measurement equation of correlation between measurement information and measurement error is established.
- the performance evaluation function of multi-AUV formation configuration is established based on the information matrix
- the analysis method of optimal formation configuration is proposed based on the genetic algorithm.



MoC I:Learning II

Session Chair:

Meeting Room 1 : July 17, 8:30 - 10:15, Monday

- 8:30~8:45
- 8:45~9:00

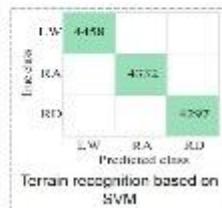
Recognition and Gait Cycle Prediction Using IMU

Zhuo Wang, Yu Zhang, Jiangpeng Ni,

Xinyu Wu, Yida Liu, Xin Ye and Chunjie Chen*

Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences

- Terrain recognition based on intersection angle only quickly recognizes the terrain when walking stably, and its robustness is limited.
- Terrain recognition based on SVM is achieved to 100% after introducing the Gaussian kernel function.
- Wiener one step prediction is applied in predicting the GC, the error from which is less than 4.35%.



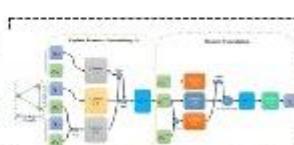
- 9:00~9:15

Multi-Agent Trajectory Prediction Based on Graph Neural Network

Haozhe Du, Zhike Chen, Yufeng Wang, Zheyuan Huang, Yunkai Wang and Rong Xiong

Institute of Cyber Systems and Control, Zhejiang University, China

- Construct ZJUNictSSL dataset for multi-agent prediction problems
- Propose a heterogeneous graph neural method for multi-agent prediction problems.
- Our method focuses on environment and tasks of agents in problems.
- Present a new view for graph-like scenes in multi-agent prediction problems.

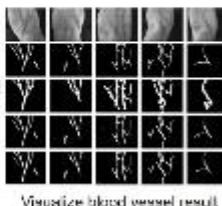


- 9:30~9:45

Automatic Venous Segmentation in Venipuncture Robot Using Deep Learning

Tianbao He, Chuangqiang Guo, Li Jiang, and Hansong Liu
State Key Laboratory of Robotics and System,
Harbin Institute of Technology, China

- Establish a data set of human arm venous blood vessels for training deep learning models.
- Use deep learning models to replace traditional digital image processing methods to identify veins.
- Real-time automatic segmentation of veins in the venipuncture robot.



- 10:00~10:15

Finger Joint Angle Estimation based on sEMG signals and deep learning method

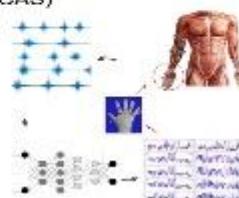
Chentel Ma and Lisheng Xu

College of Medicine and Biological Information Engineering,
Northeastern University, China

Weiyu Guo and Guanglin Li

Shenzhen Institute of Advanced Technology (SIAT), Chinese Academy of Sciences (CAS)

- Continuous finger movement estimation based on sEMG signals
- Simultaneous 10 DoFs joint angle output on 8 complex finger movements
- Modified AlexNet outperforms ResNet, LSTM and GRU on 8 abled subjects



Multi-Stage Decision-Making Skill Learning for Soccer Robot

Zhike Chen, Zhiye He, Haozhe Du, Chenrui Han, Rong Xiong
College of Control Science and Engineering, Zhejiang University, Hangzhou, China

- Hierarchical Reinforcement Learning method is used to learn complex multi-stage decision-making skill
- The method is validated by learning skill for robot on small size soccer robot platform
- Our method has the advantage on higher success rate comparing with traditional methods



- 9:15~9:30

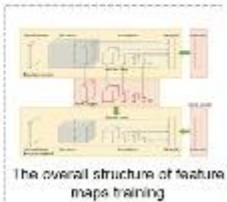
Feature Maps Training for Substation Defect Detection

Xingyu Yan, Yaqing Ma, Ning Wang, Yuxing He and Hui Cao
School of Electrical Engineering, Xi'an Jiaotong University, China

Jie Zhou

CGN New Energy Holdings Co., Ltd, China

- Feature maps of complex networks are used in training
- a loss function is designed to meet different training targets
- Heat pixel is proposed in object detection to trade-off the background and the foreground.
- This paper summarizes the common object detection requirements in substations and carries out experiments.

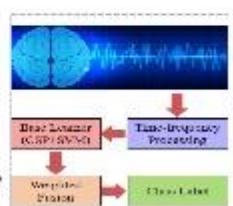


- 9:45~10:00

Time-frequency decomposition-based weighted ensemble learning for motor imagery EEG classification

Liangsheng Zheng, Yue Ma, Mengyao Li, Yang Xiao, Wei Feng and Xinyu Wu
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

- Time-frequency decomposition-based weighted ensemble learning (TFWE) is proposed to improve the classification performance of MI-EEG.
- The basic learner with time-frequency diversity can distinguish I+G based MI tasks accurately
- The TFWE method can achieve an accuracy of 81.50% on a public data set.



MoD I:Robot Mechanism II

Session Chair:

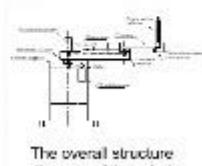
Meeting Room 2 : July 17, 8:30 - 10:15, Monday

- 8:30~8:45
- 8:45~9:00

A new structure of end-effector traction upper limb rehabilitation robot

Liaoyuan Li Jianhai Han Xiangpan Li Bingjing Guo Pengpeng Xia
School of Mechanical and Electrical Engineering, HAUST, China
Gangqin Du
Department of Neurology, First Affiliated Hospital of HAUST, China.

- 2 horizontal rotary joints and 1 vertical pneumatic joint
- Realize rehabilitation training in three-dimensional space with compact structure
- Realize passive and active rehabilitation training.
- With passive and active compliance and safety.



- 9:00~9:15

Bionic Design of a Self-Reconfigurable Modular Robot for Search and Rescue

Guangju Gao, Jingshuai Liu, Yong He,
Jianquan Sun and Xin Yu Wu
Shenzhen College of Advanced Technology, Chinese Academy of Sciences, China

- A novel self-reconfigurable modular robot for search and rescue
- The modular robot can be connected or disconnected according to the actual task requirements
- The robot has a strong flexibility to cross obstacles in a disaster environment



- 9:30~9:45

Research status and Development trend of Inspection Robot for Steam Generator Heat Transfer Tubes

Kuan Zhang, Biying Xu, Zhenming Xing, Jie Zhao, Jizhuang Fan*
State Key Laboratory of Robotics and System,
Harbin Institute of Technology, China

- The key technologies are analyzed in detail.
- Summarize the existing problems and challenges
- Prospects the future development trend



- 10:00~10:15

Design and motion performance of new inspection robot for Steam Generator heat transfer tubes

Biying Xu, Ge Li, Zhenming Xing, Jie Zhao and Jizhuang Fan*
State Key Laboratory of Robotics and System,
Harbin Institute of Technology, China

- Remote control inspection robot for Steam Generator heat transfer tubes
- Structural modeling and kinematic
- Modular control system
- Tube sheet motion experiments and performance analysis



Design of a Quadruped Wall-Climbing Robot (WCR) with a Three-Row Opposed Gripping Mechanism

Shengchang Fang, Chao Xie, Xuan Wu, and Xiaojie Wang
Institute of Intelligent Machines, Hefei Institutes of Physical Science, Chinese Academy of Sciences, Hefei

- A quadruped climbing robot with a three-row opposed gripping mechanism is designed.
- The degree of freedom of the robot is demonstrated and adopting the trotting gait as the climbing mode.
- The feasibility of the mechanical structure and gait scheme is verified.
- The prototype of the robot is made and a preliminary experiment is carried out.



The robot can attach to the wall with four feet equipped with three-row opposed grippers

- 9:15~9:30

A Modular Rehabilitation Lower Limb Exoskeleton for Stroke Patients With Hemiplegia

Pengbo Li, Wenhao Wei, Ruoyu Bao, Bailin He, Zhilong Su, Can Wang and Xinyu Wu
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen

- A modular exoskeleton robot, including an independent hip joint, knee joint and ankle joint.
- Not cause additional harm to the human body
- SIAT-II meets the design requirements, light, modular, versatile, and suitable for left or right leg.



- 9:45~10:00

Design and implementation of variable stiffness rigid-soft coupling pneumatic actuated joint

Jinfeng Zhao, Changqu Wu, Wenbiao Wang, and Guanjun Bao
College of Mechanical Engineering, Zhejiang University of Technology, China

- Rigid-flexible coupling joint with variable stiffness
- Attitude sensing for soft body robots
- Stiffness test experiment of soft-body



MoA II: Vision III

Session Chair:

Jingya Pavilion : July 17, 10:45 - 12:30, Monday

- 10:45~11:00

Masked GAN for Unsupervised Depth and Pose Prediction with Scale Consistency

Chaoqiang Zhao and Yang Tang

East China University of Science and Technology, China

- We introduce a masked GAN framework for unsupervised pose and depth estimation.
- We discuss the effect of unreconstructed regions on adversarial learning.
- We consider the scale-inconsistent problem and propose a adaptive constraint for a better global trajectory prediction.
- Both the pose and depth networks proposed in this paper show competitive results on public datasets.

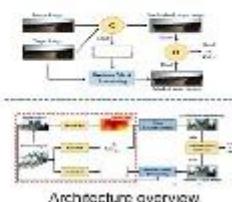
- 11:15~11:30

Multi-robot real-time cooperative localization based on high-speed feature detection and two-stage filtering

Zeyu Zhou, Wei Tang, Zenghui Wang, Lijian Wang, and Renyuan Zhang

Automation, Northwestern Polytechnical University, China

- a high-speed feature detection and transformation method based on visual information is proposed
- a multi-robot cooperative localization method based on two-stage EKF is established for dynamic real scene
- a lightweight multi-robot information intersection mechanism is utilized to deploy the system in actual platform.



- 11:45~12:00

Design of scanning robot for atherosclerosis detection via photoacoustic imaging

Yongjian Zhao, Yuting Shen, Fei Guo

School of Information Science and Technology, ShanghaiTech University

Li Liu

Department of Electronic Engineering, the Chinese University of Hong Kong, Hong Kong, China

- Designing a rotating scanning robot for photoacoustic Imaging of cervical atherosclerosis.
- It can replace the doctor's manual inspection. Play the role of liberating hands.
- Photoacoustic imaging has been applied as a perception of this Robot



- 12:15~12:30

Visualized Small-size Pipeline Model Building Using Multilink-articulated Wheeled In-pipe Inspection Robot

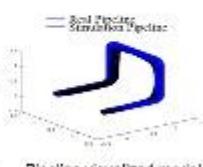
Dianzhen Guo and Jianjun Yuan

Shanghai Robotics Institute, Shanghai University, China

Zhaohan Yuan

Robotics Institute, Shanghai Jiao Tong University, China

- The robot is suitable for the inspection of pipelines with diameters between 120mm and 180mm.
- The visualized pipeline model building is based on small size inertial measurement unit (IMU) and encoder.
- A multi-sensor data fusion algorithm is used to improve the accuracy of the visualized pipeline model.



MoB II:Advanced Control II

Session Chair:

Lanting Pavilion : July 17, 10:45 - 12:30, Monday

• 10:45~11:00

Form-finding of Tensegrity Structures Utilizing a Nonlinear Fletcher-Reeves Conjugate Gradient Method

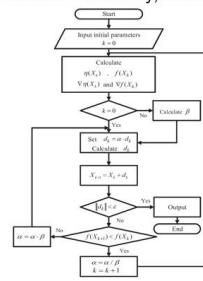
Liming Zhao and Keping Liu and Zhongbo Sun

Department of Control Engineering, Changchun University of Technology, China

Chunxu Li and Long Jin

Center for Robotics and Neural Systems, University of Plymouth, UK
School of Information Science and Engineering, Lanzhou University, China

- A conjugate gradient form-finding algorithm is developed for form-finding of tensegrity systems.
- The form-finding problems are transformed into unconstrained optimization problems.
- The initial conditions have been utilized to explore the configuration details.

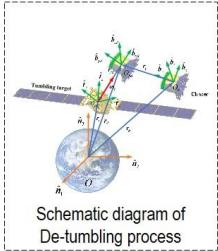


• 11:15~11:30

Prescribed Performance Sliding Mode Control for Safe De-tumbling a Rolling Target by Eddy CurrentChenmeng Zhai, Panfeng Huang, Gangqi Dong and Xiayao Liu
Research Center for Intelligent Robotics,

Northwestern Polytechnical University, Xi'an, 710072, China

- Eddy current break is considered as one of the most promising methods because of the non-contact characteristic.
- The desired trajectory is calculated with a perpendicular configuration between the chaser and the target.
- An SMC based on prescribed performance is proposed to ensure that the chaser can always run in the safety constraint.



• 11:45~12:00

Stereo Matching Algorithm Based on Two-phase Adaptive Optimization of AD-Census and Gradient Fusion

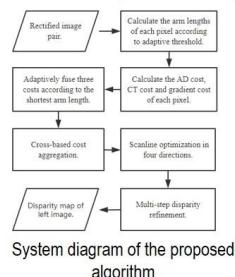
Hao Liu

School of Optical and Electronic Information, Huazhong University of Science and Technology, Wuhan, China

Wei Chen

Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China

- An adaptive cross arm construction method is proposed.
- Gradient information is used as one of the similarity measurement criteria.
- AD, CT and gradient cost are adaptively fused according to the shortest arm length.



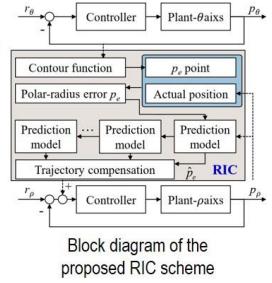
T-22

• 11:00~11:15

Precision RIC Contouring Control Method for Polar Coordinate Motion Systems

Ze Wang, Ran Zhou, Chuxiong Hu and Yu Zhu

Department of Mechanical Engineering, Tsinghua University, China



• 11:30~11:45

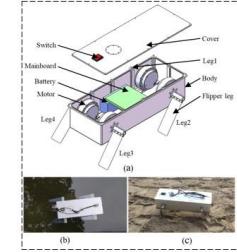
Passively Deformable Flipper Legs for An Amphibious Quadruped

Ning Guo, Zujun Bai, Wei Gao and Shiwu Zhang

Department of Precision Machinery and Precision Instrumentation, University of Science and Technology of China, China.

Haoyao Chen

College of Mechanical Engineering and Automation, Harbin Institute of Technology Shenzhen, China.



- An amphibious quadruped that possesses four newly designed passively deformable flipper legs.
- Five passively deformable flipper legs with different stiffness distribution.
- Experiments were conducted under three different environments to find the optimal stiffness distribution.

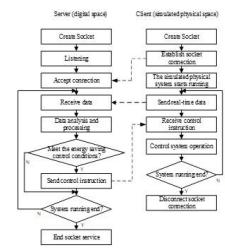
• 12:00~12:15

A Digital Twin Simulator for Real Time Energy Saving Control of Serial Manufacturing System

Junfeng Wang, Yaqin Huang and Delian Tang

Department of Industrial and Manufacturing System Engineering, Huazhong University of Science and Technology, China

- A digital twin simulator for the energy saving control of discrete manufacturing system is established and digital twin-based operation framework of energy-efficient manufacturing system is described.
- The realization methods of digital twin model, key indicator visualization, as well as the interactive methods between physical space and digital space are discussed.



MoC II: Planning and Navigation

Session Chair:

Meeting Room 1 : July 17, 10:45 - 12:30, Monday

• 10:45~11:00

• 11:00~11:15

The Navigation and Control Study of UAV for Cross-domain Bridge Collaboration Detection

Yuchen Yan, Yizhai Zhang, Panteng Huang
School of Astronautics, Northwestern Polytechnical University, China

- Proposed a path planning method and UAV control method.
- Designed the UAV control system to track and control the planned path.
- Establish the kinematics and dynamics model of the UAV.
- Design a four-channel PID controller to realize the trajectory and altitude control of the four-rotor UAV.

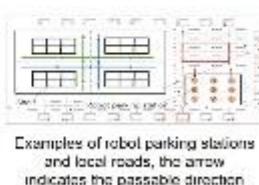


• 11:15~11:30

Task Allocation and Path Planning of Many Robots with Motion Uncertainty in a Warehouse Environment

YinBin Shi, Biao Hu and Ran Huang
College of Information Science and Technology, Beijing University of Chemical Technology, China.

- The more robots are deployed, the higher efficiency logistics operation will be.
- The decentralized auction-based scheme is used to allocate tasks.
- We take the robot's motion uncertainty into account and predict the robot density.
- We also design an effective scheme to sufficiently avoid the robot collision.

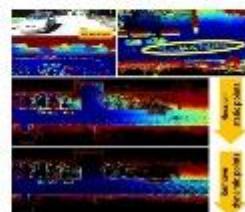


• 11:45~12:00

Method for Static 3D Point Cloud Map Building using Multi-View Images with Multi-Resolution

Chen Yao, Hu Zhu, Shipeng Lv, Dingyuan Zhang, Zhenzhong Jia*
Department of Mechanical and Energy Engineering,
Southern University of Science and Technology, China

- Multi-view image-based algorithm to robustly detect the discrepancy and correct unreliable calculation of projected images.
- A novel recover-then-remove mechanism to generate a pure reliable static 3D point cloud map and exclude dynamic points.
- Different view with various resolution to enhance the quality of static maps with adjustable motion ambiguity.



• 12:15~12:30

Trajectory Planning for Collaborative Transportation by Tethered Multi-UAVs

Chongxu Pei and Fan Zhang and Panteng Huang and Hang Yu
Research Center for Intelligent Robotics,
Northwestern Polytechnical University, China

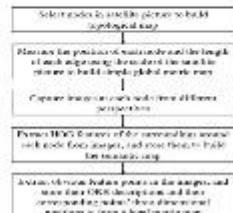
- A multi-robot cooperative trajectory planning method with constraints is proposed.
- A hybrid A* algorithm with cluster obstacle avoidance is used for path search.
- Some special route constraints of UAV swarm flight are defined.
- The trajectory is optimized by nonlinear optimization with the problem of trajectory smoothing.



A Hierarchical Semantic Map for Large-scale Outdoor Environment

DI Zhang and De Xu
Research Center of Precision Sensing and Control, Institute of Automation, Chinese Academy of Sciences, Beijing

- Make full use of the pre-known knowledge of environment.
- Use HOG features of landmarks to store semantic information.
- Use ORB feature points and their 3D position to form the local metric map.
- Build topological map, simple global metric map, semantic map, and local metric map.



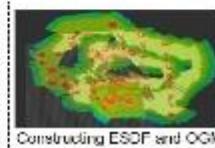
• 11:30~11:45

A GPU Mapping System for Real-time Robot Motion Planning

Yizhou Chen and Ben M. Chen
Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong, Hong Kong, China
Shipeng Lai, Feng Lin
Pang Cheng Laboratory
Biao Wang

Department of Automation Engineering, Nanjing University of Aeronautics and Astronautics, Nanjing, China.

- Construct Occupancy Grid Maps (OGMs) and Euclidean Signed Distance Fields (ESDFs).
- Optimize the global ESDF storage and address the limited observation problem in an efficient manner.
- Can be applied to robotics onboard sensors.
- Propose a real-time robot mapping system on GPU.



• 12:00~12:15

IEEE RCAR 2020 Digest Template Paper Title in One or Two Lines

Yujing Chen and Yunjiang Lou
School of Mechatronics Engineering and Automation,
Harbin Institute of Technology Shenzhen

- We construct a vector field histogram based on the observed static obstacles and pedestrians.
- An objective function is proposed to get an optimal direction of the mobile robot.
- We introduce a fuzzy inference system to generate smooth and efficient motion.
- The proposed planner is tested on a robot in various densely crowded scenarios.



Robot navigation in dense crowds by the proposed planner

MoD II:Robotic Control

Session Chair:

Meeting Room 2 : July 17, 10:45 - 12:30, Monday

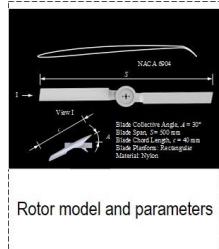
• 10:45~11:00

• 11:00~11:15

Hover Performance Experimental Setups for a Miniature Mars Rotorcraft Design and Preliminary Experiments

Chunguang Fan, Pengyue Zhao, Jianwei Wu and Zongquan Deng
Ultra Precision Research Institute, Harbin Institute of Technology, China

- Design of experimental setups for a miniature Mars rotorcraft.
- The measurement of lift by hover test stand is in an indirect way, by which the effect of rotor system's gravity is reduced.
- The results show that at the maximum speed of hover test stand, the lift generated by the rotor can achieve approximately **120 gf**, which means that it is possible for a coaxial rotorcraft with **200 g** mass to fly in Martian atmosphere.



• 11:15~11:30

Liquid Metal Universal Micro-Gripper

J. Zhou, K. Wang, S. Li, J. Hu, J. Yang, H. Yang, X. Li, and L. Sun
College of Mechanical and Electrical Engineering, Soochow University, China
S. Zhang

Department of Precision Machinery and Precision Instrumentation, University of Science and Technology of China, China
Z. Huan, W. Ma
School of Electrical Engineering and Automation, Xiamen University of Technology, China

- We have developed a universal micro-gripper based on liquid metal, which can grip small objects of various shapes, materials and sizes.

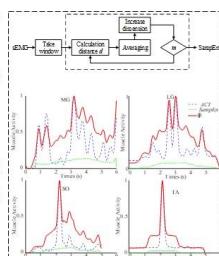


• 11:45~12:00

Estimation of muscle activation during ankle rehabilitation

Jianfeng Li, Yu Zhou, Mingjie Dong*, Ran Jiao
Faculty of Materials and Manufacturing, Beijing University of Technology, China
Liwei Jiang
CSSC System Engineering Research Institute, China

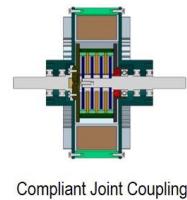
- A new method based on sample entropy to judge muscle activation state is proposed.
- Sample entropy is used to modify Hill muscle model..
- This algorithm is suitable for judging by sEMG.
- The muscle activation state during ankle rehabilitation training is measured more accurately.



Transmission Characteristics of Compliant Joint for Rehabilitation Robot Based on Magneto-rheological Fluid Variable Stiffness

Wei Wei and Fugang Yi and Bilei He and Shibo Cai and Guanjun Bao
College of Mechanical Engineering, Zhejiang University of Technology, China

- Magneto-rheological fluid is kind of the solid-liquid materials with magneto-sensitive rheological property;
- The compliant joint of robots based on magneto-rheological fluid has the characteristics of active variable stiffness;
- The shear transmission of magneto-rheological was proposed to facilitate the operation compliance and intrinsic safety.



• 11:30~11:45

Stiffness-Tunable and all-soft electrical smart material made by magnetic liquid metal and sponge

K. Wang, J. Zhou, S. Li, J. Hu, J. Yang,
M. Liu, H. Yang, X. Li, and L. Sun
School of Mechanical and Electric Engineering, Soochow University, China
S. Zhang

Department of Precision Machinery and Precision Instrumentation, University of Science and Technology of China, China
Z. Huan and W. Ma
School of Electrical Engineering and Automation, Xiamen University of Technology, China

- We present a novel and easy method to design and manufacture mechanically durable, all-soft electrical and stiffness-tunable MLM-sponge elastomer.



• 12:00~12:15

Pan-tilt Control Method Applied to Mobile Robots

Wei Huang*, Baichuan Den, Wenfeng Zou
the Project manager of Project management center, HuiZhou Power Supply Bureau, Guangdong, China

- Runfeng Lou, Tingyi Yuan, Chuqi Xiong
Faculty of Electrical Engineering, Xi'an Jiaotong University, ShanXi, China.
- In this paper, particle swarm optimization algorithm is used to optimize the weight and threshold of BP neural network.
 - BP neural network is used to realize the online control of three parameters of digital PID.
 - PSO-BP reasonably determine the initial weights of neural network, and overcome the neural network easy to fall into local minimum.



TuA I: Vision I

Session Chair:

Online : July 18, 8:30 - 10:15, Tuesday

- 8:30~8:45

- 8:45~9:00

Dilated Nearest-Neighbor Encoding for 3D Semantic Segmentation of Point Clouds

Xiaoyuan Fan, Lei Wang and Jun Cheng
Shenzhen Institute of Advanced Technology, (CAS), China
Shan Jiang and Senwei Ma
University of Michigan, United States

- A dilated nearest-neighbor encoding is introduced to the point cloud sampling network.
- One end to end point cloud semantic segmentation framework has been presented.
- We have achieved better performance than state of the art methods on the large scale benchmark S3DIS dataset.

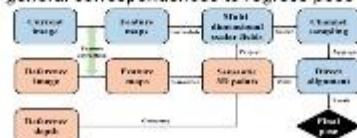


- 9:00~9:15

Direct alignment with generalized correspondences: A unified framework for visual pose estimation

Xiaqing Ding, Yue Wang and Rong Xiong
Control Science and Engineering, Zhejiang University, China

- A multi dimension field based unified framework is proposed that can summarize both direct and indirect structure-based visual pose estimation methods, where the differences exist on the data association front end.
- Arbitrary shapes with the same semantic information on different images can be introduced as constraints in this framework without explicit modeling.
- A hybrid visual pose estimator is designed based on a three-layer of pyramid constructed with general correspondences to regress pose from coarse to fine.



- 9:30~9:45

Panoptic Lintention Network: Towards Efficient Navigational Perception for the Visually Impaired

Wei Mao^{1,2}, Jiaming Zhang¹, Kailun Yang¹, Rainer Stiefelhagen¹
IAI, Karlsruhe Institute of Technology, Germany
Binn-German School, Tongji University, China

- VerConv models Multi-scale and Channel Interactions
- Lintention learns long-range dependencies in linear time & space
- Panoptic Lintention Net. Fewer Parameters, Fewer FLOPs, Better Performance
- A Wearable Assistive System: Fulfill the navigational perception needs of the visually impaired

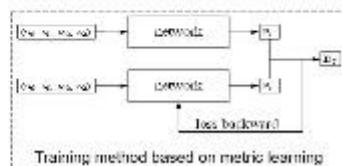


- 10:00~10:15

Calibration and Measurement of Large Distortion Binocular Cameras Based on Fully Connected Neural Network

Tianwei Wu
Zhongke Shijie Technology Co., Ltd, China
Xilong Liu, Mengjuan Chen, Xuejian Ma, Wenxiang Qin, Tingyu Yan
and Jiawei Lu
Chinese Academy of Sciences Institute of Automation, China

- Large distortion model
- Data drive calibration
- Metric learning
- High flexibility and stability



Complementary Multi-Branch CNNs Towards Real-World 3D Point Classification

Zifeng Tang, Fusheng Hao, Qieshi Zhang, Jun Cheng, Jin Zhang, Shuai Yuan
CAS Key Laboratory of Human-Machine Intelligence-Synergy Systems, Shenzhen Institute of Advanced Technology, Chinese Academy of Science, China

- Conventional point-based convolution models are accelerated by utilizing the voxel based indexing, which reduces 30% time in searching neighbors.
- A point-based spherical CNN is proposed to directly process point clouds
- In MBCNN, a fusion strategy is utilized to gain features more comprehensively.



- 9:15~9:30

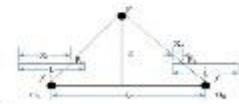
Research on AGV Navigation System Based on Binocular Vision

Changsheng Ai , Dunyang Geng , Zhengguang Qi , Lei Zheng
School Of Mechanical Engineering, University of Jinan, China

Zhiqian Feng

School Of Information Science And Technology, University of Jinan, China

- This paper presents an AGV navigation method using binocular camera.
- Position and orientation deviation of vehicle body relative to lane line by binocular camera
- The pose deviation of the vehicle body relative to the lane line is verified experimentally.
- The experimental results show that the posture obtained by the camera is reliable and stable.



- 9:45~10:00

Perception Framework through Real-Time Semantic Segmentation and Scene Recognition on a Wearable System for the Visually Impaired

Yingzhi Zhang, Haoye Chen, Kailun Yang,
Jiaming Zhang and Rainer Stiefelhagen
Institute for Anthropomatics and Robotics,
Karlsruhe Institute of Technology, Germany

- We designed a unified perception framework for assisting visually impaired people
- The real-time wearable system based on multi-task architecture feedbacks object information and scene classes via speech signal.
- In the experiments, we verified the systems' accuracy and efficiency on public datasets and real world scenes



TuB I:Modelling I

Session Chair:

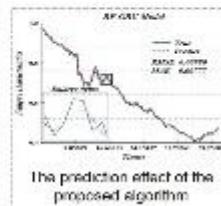
Online : July 18, 8:30 - 10:15, Tuesday

• 8:30~8:45

• 8:45~9:00

Prediction Method of Lower Limb Muscle Fatigue Based on Combining Random Forest and Gated Recurrent Unit Neural NetworkXin Shi, Shuyuan Xu, Pengjie Qin, Gaojie He, and Zhengli Leng
College of Automation, Chongqing University, China

- Muscle fatigue reduces the stability of human-computer interaction
- Random forest algorithm improves the lag phenomenon of GRU prediction
- Compared with RNN ~ LSTM ~ GRU and BPNN, the algorithm has higher prediction accuracy and generalization



• 9:00~9:15

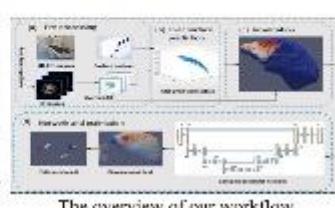
Internal Motion Estimation during Free-Breathing via External/Internal Correlation Model

Yangyang Shi

Wuhan Research Institute of Posts and Telecommunications, China
Yuqi Tong and Ruotong Li and Weixin Si'

Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

- Two-step external/internal correlation model
- MLS based liver surface prediction
- CNN based non-rigid registration
- Accurate estimation of the target structures
- Improve clinicians' perception of vessels and tumors



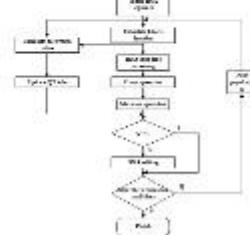
• 9:30~9:45

Genetic algorithm based on octopus learning mechanism

Zhang Lifeng and Wu Qiuixuan

School of Automation, Hangzhou Dianzi University, Hangzhou

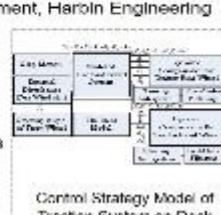
- Use a single RNA chain to represent the individuals of the population
- Imitating the octopus's A-to-G RNA editing method to replace traditional gene mutations, using behavioral learning to design the RNA chain
- Use behavioral learning to design the RNA chain, and determining the possibility of RNA editing by evaluating the RNA chain.



• 10:00~10:15

A Stability Control Strategy for Tractor-Aircraft System on DeckHongbo Liu and Xiaodong Yang
School of Mechanical and Power Engineering,
Harbin University of Science and Technology, ChinaNengjian Wang
Mechanical and Electrical Engineering department, Harbin Engineering University , China

- An active rear-wheel steering and compensative front-wheel steering control strategy is presented.
- Aircraft parameters diversity, marine environment uncertainty and the characteristics of steering subsystem are considered.
- The proposed controller provides the basic robustness to parametric uncertainties and external disturbance.

**Design and Implementation of A Novel Internet of Things Irrigation System With A Precision Irrigation Robot**

Minghan Chen, Yilong Sun, Boyi Liu, Bingjie Yan

The RoboAI-Lab, Harbin University, China

Xulai Li, Kai Lu, Tenglong Ren, Bin Ma, Yangyang Tian

Harbin Jiaotong Zhongguang Technical Col Ltd, China; Harbin Vocational College of Political Science and Law, China; The College of Intelligence and Computing, Tianjin University, China; State Grid Henan Electric Power Company Research Institute, China

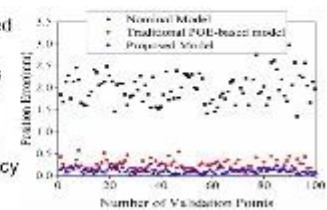
- This paper designs and implements the IoT irrigation system based on an intelligent path planning algorithm and designs and manufactures the agricultural irrigation robot combining the Internet of Things. The system transmits humidity information to the server through the soil humidity sensor, and performs path planning through an improved path planning algorithm.



• 9:15~9:30

A Generalized Kinematic Error Modeling Method for Serial Industrial Robots Based on Product of Exponentials FormulaZeyin Zhao, Xin Wang, Jiafan Chen and Mengzhong Chen
School of Mechanical Engineering and Automation,
Harbin Institute of Technology Shenzhen, China

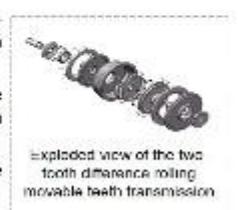
- Based on POE formula, a generalized kinematic error model is proposed.
- The Levenberg-Marquardt method is used to identify the unknown model parameters.
- Experiments carried out on an Efort ECR5 robot have verified the accuracy of the model.



• 9:45~10:00

Characteristic Analysis and Virtual Modeling of Two-tooth Difference Rolling Movable Teeth TransmissionYanfang Wang , Weiwei Song and Rongyu Ge
College of Mechanical Engineering, University of Jinan, China

- Structure and Transmission Principle of Two-tooth Difference Rolling Movable Teeth Transmission
- Kinematical Pair and Tooth Profile Curve Analysis of Two-tooth Rolling Movable Teeth Transmission
- Virtual Modeling of Two-tooth Difference Rolling Movable Teeth Transmission



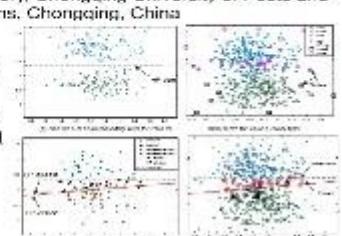
• 10:15~10:30

A Fast-Incremental SVM Algorithm for Online Motor Imagery-Based Brain-Computer Interface

Oin Jiang, School of Computer Science and Technology, Chongqing University of Posts and Telecommunications, Chongqing,China

Yi Zhang, Xiao-Yi He, and Ke Ren, Advanced Manufacturing and Automation Engineering Laboratory, Chongqing University of Posts and Telecommunications, Chongqing, China

- An incremental SVM learning method based on natural neighbor clustering
- A nonparametric filter to reveal the underlying structure of the train set and the test set
- Less training time and storage consumption



TuC I:Robotic Control

Session Chair:

Online : July 18, 10:45 - 12:30, Tuesday

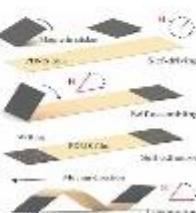
- 10:45~11:00

Magnetic sticker with water-triggered adhesiveness for object manipulation

Xiong Yang and Yajing Shen

Biomedical engineering, City University of Hong Kong, China

- Magnetic sticker with directional magnetization and water triggered adhesiveness
- Manipulate object, especially the targets with small size and flexible material
- The thin thickness makes it more suitable for the tasks in limited space.
- They can also cooperate with other stickers to achieve a more complex and precise manipulation task.



- 11:15~11:30

A data-driven shared control system for exoskeleton rehabilitation robot

Feng Li, Yong He^a, Jinko Li, Jiangpeng Ni and Xinyu Wu
Guangdong Provincial Key Lab of Robotics and Intelligent System, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen 518055, China.

- A novel shared control system is designed, which solve the problem of exoskeleton robot system integration
- A gait trajectory revision mode based on data iteration is designed.
- The modular development of human-machine interaction interface is realized to make the exoskeleton rehabilitation robot system more humanized and visual.

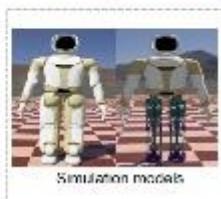


- 11:45~12:00

Effects of Backlash on the Walking Stability of Biped Robots

Yisen Hu, Hongyu Ding, Jingchen Li, Wenguang Wang and Jianxin Pang
UBTECH Robotics, Inc., Shenzhen, China
Xinyu Wu
Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China

- Dynamics simulation is used to analyze effects of backlash on walking
- Series parallel mechanism works better than series mechanism under effects of backlash
- Coupled movement of knee and ankle joints reduces effects of backlash.

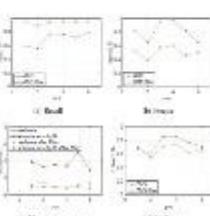


- 12:15~12:30

Estimating Pose of Object and Manipulator Grasping Control

Dong Wang, Dong Yang, Qinghui Pan, Chaochao Qiu, Yongxiang Dong, Jie Lian
School of Control Science and Engineering, Dalian University of Technology, China

- Using the RANSAC algorithm and affine invariant principle to filter out false match pairs based on GMS algorithm
- Combined with depth image, the least square SVD method is used to solve the rotation and translation matrix of the object. We use this matrix to estimate the pose of object
- The control of the end effector based on the projection angle has good experimental results



Tactile Grasp Stability Classification Based on Graph Convolutional Networks

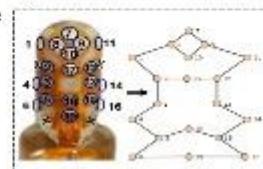
Tingting Mi^{1,2}, Dashun Que¹, Senlin Fang², Zhenning Zhou², Chaohang Ye², Chengliang Liu², Zhengkun Yi² and Xinyu Wu^{2,3}

¹Wuhan University of Technology

²Shenzhen Institutes of Advanced Technology

³SIAT Branch, Shenzhen Institute of Artificial Intelligence and Robotics for Society

- Transform the electrode values of the BioTac sensor into a graph structure
- Complete the convolution operation on the tactile graph
- Present two fusion strategies to integrate the features of multiple sensors

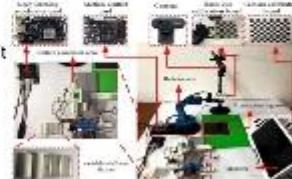


- 11:30~11:45

FPGA-based Deep Learning Acceleration for Visual Grasping Control of Manipulator

Halbin Yin^a, Haiping Hong and Jing Liu
Key Laboratory of Hubei Province for Digital Manufacture, School of Mechanical and Electronic Engineering, Wuhan University of Technology, China

- Use FPGA to accelerate neural network.
- Use Vivado and Petalinux development kit to build software and Hardware system.
- Kinematic analysis enables the robot to grasp the target.

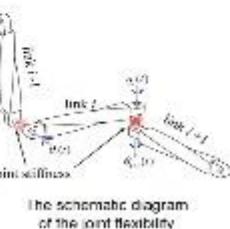


- 12:00~12:15

Dynamic Modeling and Vibration Analysis of a 6-DOFs Industrial Robot Considering Joint Flexibility

Guodong Shen¹, Sheng Xu^{1,4}, Chunjie Chen^{2,4} and Qiang Wang¹
¹Shandong Institute of Advanced Technology, Chinese Academy of Sciences, Shandong, 250102, China
²Guangdong Provincial Key Lab of Robotics and Intelligent System, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen, 518055, China
³CAD Key Laboratory of Human-Machine Intelligence-Cognitive Systems, Shenzhen Institute of Advanced Technology, Shenzhen, 518055, P.R. China

- This paper is concerned with the dynamic modeling and vibration analysis of multi-DOFs industrial robot considering joint flexibility.
- A dynamic model based on Kane method developed to analyze the vibration characteristics under different joint stiffness parameters.
- The results of the proposed strategy can be used to design an accurate model-based controller for an industrial robot.



- 12:30~12:45

Dispensing robot for toxic drugs in pharmacy intravenous admixture services

H. Jin¹, P. Gao¹, J. Cao¹, Y. He², Y. Hu², Y. Liu³
¹-Shenzhen Broadcare Medical Robotics co. Ltd., Shenzhen, China
²-Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences
³-Peking University Shenzhen Hospital, Shenzhen, China

- Structural design of dispensing robot on environmental control and protection of toxic drugs
- The robot dispensing precise suction scheme for vial and ampoule
- Comparative experiment and analysis of suction residue



The overall structure of the dispensing robot

TuD I:Mobile robots I

Session Chair:

Online : July 18, 10:45 - 12:30, Tuesday

- 10:45~11:00

- 11:00~11:15

A Localizability Estimation Method for Mobile Robots Based on 3D Point Cloud Feature

Ying Liu and Jingchuan Wang

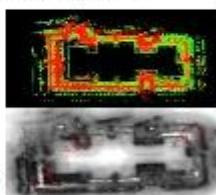
the Department of Automation, the Institute of Medical Robotics, Shanghai Jiao Tong University, China

Yi Huang

Kingscience Intelligent Technology Co., LTD., Nanjing

- Firstly, we propose a real-time point cloud clustering algorithm with multiple constraints based on depth map.
- Localizability is set to be equal to the strength of the constraints associated with 3D point cloud.
- Based on the method of using information matrix theory, this paper integrates the Fisher's information matrix and point cloud features to estimate localizability.

- 11:15~11:30



Workspace Analysis of a Dual-arm Mobile Robot System for Coordinated Operation

Yue Meng, Ziqi Zhao, Weinan Chen, Xiao Xiao, and Max O.-H. Meng

Department of Electronic and Electrical Engineering, Southern University of Science and Technology, Shenzhen, China

- The mechanical and software structure of dual-arm mobile robotic system is introduced;
- DH method is used to establish forward kinematics of the robotic arm;
- The workspace is analyzed by Monte Carlo method. The shape and boundary of the workspace is provided;
- Cooperative operation with the dual-arm is demonstrated.

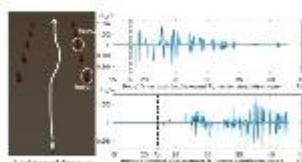
- 11:45~12:00



Computational Efficient Simulation of Kelvin Wake for Unmanned Surface Vehicles

Yao He, Qinbo Sun, Weimin Qi, Xiaoqiang Ji and Huihuan Qian
Shenzhen Institute of Artificial Intelligent and Robotics for Society (AIRS)
The Chinese University of Hong Kong, Shenzhen, Guangdong, China.

- Propose a computation efficient simulation of Kelvin Wake using J.J. Stoker's analysis
- Modify J.J. Stoker's model to make the simulation accurate
- Equip the simulation function into a Unmanned Surface Vehicles simulator

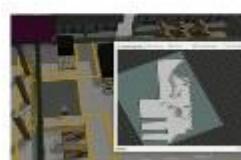


- 12:15~12:30

Construction and evaluation of SLAM and navigation system for mobile robot based on diverse environments

Haodong Wang ,Wei Guo and Yu Fu
the State Key Laboratory of Robotics,
Harbin Institute of technology, China

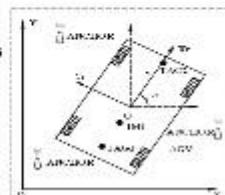
- Construction of diversified environment and robot system
- SLAM trajectory and computer resource evolution
- TF coordinates and ground truth extraction



Research of AGV Positioning and Navigation System Based on UWB

Changsheng Ai , Lei Zheng , Dunyang Ceng , Zhengguang Qi
School of Mechanical Engineering, University of Jinan, China

- A navigation method combining UWB and inertial measurement unit (IMU) is proposed.
- The time-based wireless positioning principle is used to obtain the UWB positioning data.
- The Kalman filter algorithm is used to fuse the UWB measurement data and IMU calculation data.
- The experimental results show that the error of UWB is less than 75mm in the static condition.



- 11:30~11:45

Stereo Vision-based Autonomous Navigation for Oil and Gas Pressure Vessel Inspection Using a Low-cost UAV

Leijian Yu, Erfu Yang, Beiya Yang, Andrew Loeliger and Zixiang Fei

Department of Design, Manufacturing and Engineering Management, University of Strathclyde, United Kingdom

- The ORB-SLAM3 is improved by the image contrast enhancement capability
- A stereo vision-based autonomous navigation approach is developed
- The ROS-Gazebo-PX4 simulator is customised deeply to simulate the real scenario.
- The effectiveness of the proposed approach is demonstrated in the developed simulation environment.



UAV autonomous navigation inside of the pressure vessel

- 12:00~12:15

Research on Graph-Based SLAM for UVC Disinfection Robot

Xuan Tan and Xidong Zhou

College of Electrical and Information Engineering, Changsha University of Science and Technology, China

Hui Zhang, Hang Zhong and Li Liu

School of Robotics, Hunan University, China

- The aim of the present work is to contribute in the fight against the spread of Covid-19.
- It can automatically, efficiently and accurately carry out autonomous mobile disinfection of the hospital indoor environment.
- The real time localization accuracy is about 0.04m, which provides high reliability localization for autonomous navigation.



TuA II: Advanced Control I

Session Chair:

Online : July 18, 14:00 - 15:45, Tuesday

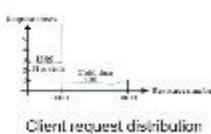
- 14:00~14:15

- 14:15~14:30

High-Speed Proxy Cache Management Strategy Based on Comprehensive Resident Value and Generation

Chunmei Huang, Min Xiang, Yuzhou Jiang and Zhong Xia
School of Automation, Chongqing University of Posts and Telecommunications, Chongqing

- This paper proposes an efficient proxy cache management strategy named HPCMCSRVG
- The strategy based on generational garbage collection mechanism
- The strategy based on the 80/20 rule.
- The strategy can significantly reduce backbone network traffic consumption and proxy cache response delay.



- 14:30~14:45

Joint Torque Feedback-based Decentralized Neuro-optimal Control of Input-constrained Modular Robot Manipulator System

Bing Ma and Yuanchun Li

Control Science and Engineering, Changchun University of Technology, China

- A novel decentralized neuro-optimal control method of input-constrained MRM system is presented.
- Adaptive dynamic programming
- Joint torque feedback technique
- Actuator saturation constraints
- Experimental verification



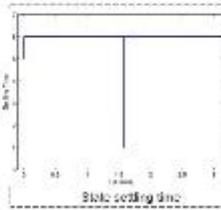
2 DOF MRM experimental platform for verification of the developed method

- 15:00~15:15

Optimized Design of Settling Time for Multi-model SystemsMiaomiao Wang¹ /hendong Sun²

1. Academy of Math. & System Science, Chinese Academy of Sciences
2. College of Automation, Shandong University of Science & Technology

- The problem of settling time optimization for a class of multi-model systems is addressed.
- An upper bound estimate is obtained based on the path-wise contraction of stabilizability
- The proposed design procedure is an algorithm that terminates in a finite number of steps
- A numerical example is presented to validate the proposed scheme



- 15:30~15:45

Ripple Minimization of PMLSM Using Robust Two Degrees-of-Freedom controller and Thrust Ripple Observer

Mingfei Huang^{1,2}, Yonglinge Deng¹, Hongwen Li¹, Jing Liu¹ and Meng Shao¹

1.Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun 130033, China;

2. University of Chinese Academy of Sciences, Beijing 100049, China.

- Permanent-magnet linear synchronous motor;
- Robust two-degree-of-freedom control;
- Thrust ripple observer .

Design and Position Servo Control of an Active Body-Weight Support Training SystemChao Wei¹, Tao Qin^{1*}, Xin Meng¹, Jinxing Qiu¹, Qilong Meng¹ and Bo Li^{1,2}

1.Mechanical Engineering, Hubei University of Arts and Sciences, China
2.Xiangyang Institute of Advanced Manufacturing Engineering , Huazhong University of Science and Technology, China

- An active BWSTS with double-shoulder suspension based on cable-driven was designed for rehabilitation training
- The mathematical model of the system drive unit was established by using mechanism analysis method
- The position servo control strategy with disturbance feedforward compensation was proposed to improve the system loading accuracy
- The system simulation model was built to prove the effectiveness of the position servo control strategy



- 14:45~15:00

Finite Representability of Discrete-time Switched Linear Systems/hendong Sun¹, Miaomiao Wang²

1. College of Automation, Shandong University of Science & Technology
2. Academy of Math. & System Science, Chinese Academy of Sciences

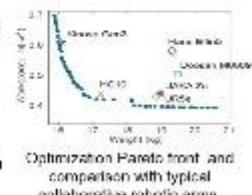
- In this work, the finite representation problem was addressed for a class of discrete-time switched linear control systems with decoupled controllable/uncontrollable states.
- We showed that, the problem is solvable when the uncontrollable sub mode is finite representable
- Constructive design procedures were developed in the proof of the main result.

- 15:15~15:30

Optimization Design of Configuration, Structure and Drive Train Synthesis for Serial Robotic ArmsJingchen Li^{1,2}, Jia Liu², Hongyu Ding¹,Yisen Hu^{1,2} and Jianxin Pang¹

¹UBTECH Robotics Inc., China
²Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China

- New method for optimally integrated designing a robotic arm for desired functions and performances.
- Complete and efficient co simulation framework for optimization
- A design example demonstrates the application of designing a light-weight arm with maximized workspace



- 15:45~16:00

Planning strategy for intruder agent based on game theory and artificial potential field

Jiahong Xu and Xiaofeng Liu

College of IoT Engineering, Henan University, China

- Propose a improved artificial potential field (APF).
- The finite pure strategy matrix is obtained by considering the opponent's response iteratively base on the APF
- Particle Swarm optimization is taken to compute approximate Nash equilibrium based on the pure strategy matrix

TuB II:Wearable robots

Session Chair:

Online : July 18, 14:00 - 15:45, Tuesday

- 14:00~14:15

A Human-Computer Interaction Scheme of Lower-Limb Power-Assist Flexible Robot

Deliang Zeng, Lei Sun, Xin Chen, Yuntao Li, Mu Zhu, Xinxian Gong
Tianjin University of Technology

- A human mechanical and electrical system.
- Improving the walking state of the senior citizen.
- Understanding the movement of the subjects according to the hip joint angle.
- Playing an important role in rehabilitation training, maintaining and restoring the ability of the elderly.

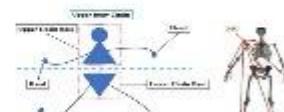


- 14:30~14:45

A Pilot Study on a Multimodal Wearable System by Applying a Two-Chain Biomechanical Model in the Alpine Ski Slalom

Ye Wang, Tianqi Shao, Peng Jiang, Lin Wang and Guanglin Li
SIAT, Chinese Academy of Sciences, China
Gongbing Shan
Kinesiology & Physical Education, University of Lethbridge, Canada

- Proposing a wearable system to monitor, acquire and fuse multi-source signals in real-time for skiers
- Adopting the two-chain biomechanical model as a basis
- Demonstrating multiple IMUs can work simultaneously in the same coordinate system with high consistency



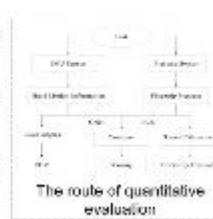
The two-chain biomechanical model

- 15:00~15:15

Quantitative evaluation of hand functions using a wearable glove with multiple sensors

Chaoyue Yin, Quan Liu, Wei Meng, Qingsong Ai
School of Information Engineering, Wuhan University of Technology, China

- Evaluate hand functions using a wearable glove with multiple sensors.
- Obtain range of motion and evaluate flexibility.
- Use neural network to score automatically based on setting rehabilitation task.
- The accuracy of automatic scoring (classification) can reach 94.3%.

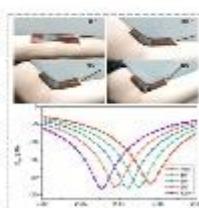


- 15:30~15:45

Graphene Film Based Wireless and Flexibly Wearable Sensor for Human Joint Angle Measurement

Rongguo Song, Zelong Hu, Shaolu Jiang, Li Ma, Qingsong Ai and Daping He
Wuhan University of Technology, China

- A wireless wearable angle sensor based on flexible graphene film microstrip antenna is proposed.
- The flexible graphene film has low density of 1.45 g/cm^2 and high conductivity of 10^6 S/m .
- The graphene sensor has a good positive linear relationship between frequency response and bending angle.
- The graphene sensor has radiation capabilities and can transmit detection information wirelessly.

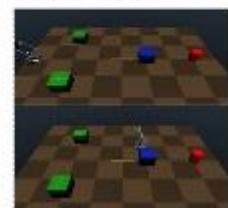


A Motion Planning Method Based on HRL for Autonomous Exoskeleton

Yao Dong, Yong He, Zhilong Su, JiangPeng Ni,
Wei Feng, Xinyu Wu

Guangdong Provincial Key Laboratory of Robotics and Intelligent System, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen 518055, China

- Propose a Motion Planning algorithm(HRPO) to solve the path planning and gait policies of autonomous exoskeleton(Auto-LFF).
- HRPO contains two levels: High level path planning controller (HLP), Low-level gait generation controller(LG).
- HLP is responsible for planning a reasonable path in various complex terrains; LG generates a movement gait and executes actions to complete the interaction with the environment.



- 14:45~15:00

The Measuring ZMP of Self-balancing Exoskeleton Robot is Calibrated by Using The Neural Network

Yang Xu and Yang Xiao

School of Automation, Chongqing University of Posts and Telecommunications, Chongqing

Yue Ma, Liangsheng Zheng and Yong He
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen

- The footplate is used with the double-deck structure in this experiment.
- The footplate makes the ZMP have a large measurement error.
- Four kinds of neural networks are used to calibrate measured position of ZMP.



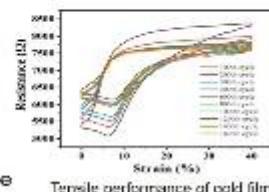
- 15:15~15:30

Cycle stability of flexible stretchable electrode

Jing Sun, Qingsong Li, Rui Su, Hang Zhao, Guanglin Li*, Zhiyuan Liu*

Neural Engineering Center
Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences
1068 Xueyuan Road, Shenzhen 518055, China

- The gold film electrode produces small cracks
- The resistance of the flexible stretchable electrode generally decreases during 1 to 600 cycles
- The resistance change is not large after 600 cycles
- combining Au with a flexible substrate is an excellent way to prepare flexible electrode



- 15:45~16:00

Personalized Assistance Learning for Soft Wearable Robot

Ning Li, Wenyuan Chen, Yang Yang, Tie Yang, Peng Yu, Wenxue Wang, and Liangqiang Liu
Shenyang Institute of Automation, Chinese Academy of Sciences, China
Ning Xi
University of Hong Kong

- Uncertainty of model for soft structure and the diversity of motion parameters restrict the application in exoskeleton robots
- Personalized control can adapt to different characters and improve control performance
- Model based meta learning to adapt new individuals more quickly based on the prior knowledge of learned individuals



TuC II: Vision II

Session Chair:

Online : July 18, 16:15 - 18:00, Tuesday

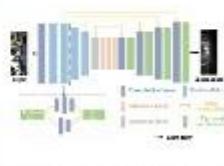
- 16:15~16:30

- 16:30~16:45

Attention Mechanism-based Monocular Depth Estimation and Visual Odometry

Qieshi Zhang, Dian Lin, Ziliang Ren, Yuhang Kang, Fuxiang Wu,
Jun Cheng
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences,
China

- Propose a depth estimation network encoder based on attention mechanism for predicting the spatial features of the adjacent frames.
- Improve the depthwise separable convolution to replace the convolution layers in the main architecture for improving efficiency.
- Validate the performance of our algorithm on a public dataset and real world experiments with our mobile robot, including outdoor and indoor with ground truth.



- 16:45~17:00

Bidirectional Weighted Loss with Feature Perception for Self-supervised Learning of Consistent Depth-pose

Fei Wang, Jun Cheng and Penglei Liu
CAS Key Laboratory of Human-machine Intelligent-Syntax Systems, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

- Take full advantage of limited data by using the bidirectional photometric loss.
- Deal with moving objects and occlusions by reweighting the bidirectional photometric loss.
- Improve the robustness for textureless regions by employing the bidirectional feature perception loss.
- Enforce consistency between depths by employing the bidirectional depth structure consistency loss.

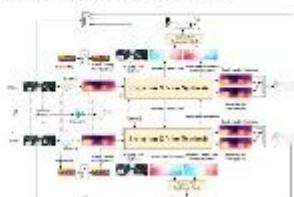


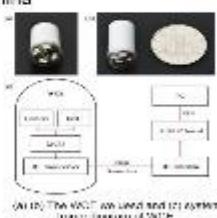
Diagram of the general framework

- 17:15~17:30

Real-time Attitude Tracking of Capsule Endoscope Based on MEMS IMU and Error Analysis

Zhuokang Huang and Chengzhi Hu
Department of Mechanical and Energy Engineering, Southern University of Science and Technology, China

- A method for calculating the attitude of WCE based on MEMS IMU is implemented.
- The accuracy of attitude tracking is measured by a series of experiments.
- The experimental results show that the method meets the requirements in about six minutes.
- Additionally, we propose a method to improve the attitude accuracy by reciprocating the rotational motion.



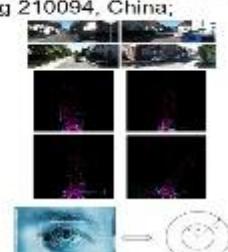
- 17:45~18:00

3D LiDAR Point Cloud Loop Detection Based on Dynamic Object Removal

Pan-Yun Ding, Zhi-Hui Wang

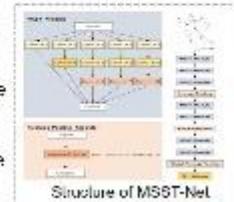
School of Computer Science and Engineering, Nanjing University of Science and Technology, Nanjing 210094, China;

- 3D object detection model OpenPCDet is employed to detect dynamic objects in the outdoor scene, such as vehicles, pedestrians, etc.
- We use the bounding box detected by the model to perform cube filtering on the original data to remove dynamic objects.
- The preprocessed data is utilized to extract scene descriptors for loop detection. In the road scene, experimental results demonstrate that our approach yields superior performance against the traditional methods.

**Skeleton-based Action Recognition with Multi-scale Spatial-temporal Convolutional Neural Network**

Qin Cheng, Ziliang Ren, Jun Cheng, Qieshi Zhang, Hao Yan and Jianming Liu
Guilin University of Electronic Technology, Guilin, China

- Action recognition based on skeleton data needs comprehensive spatial-temporal features.
- A novel MSST-Module is established to capture robust spatial temporal features.
- The MSS1-Net constructed by MSS1-Module achieved remarkable performance on two large dataset.

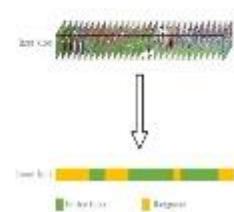


- 17:00~17:15

Two Stream Dynamic Threshold Network for Weakly-Supervised Temporal Action Localization

Hao Yan, Jun Cheng, Qieshi Zhang, Ziliang Ren, Shijie Sun, Qin Cheng
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

- Weakly-supervised methods only require video level labels to train the models.
- The proposed DI-L-WTAL features a dynamic attention threshold decision for the attention.
- Our model further adjust the extreme values of the attention mechanism for different videos accordingly.

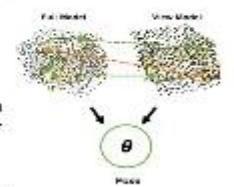


- 17:30~17:45

Unseen Object Pose Estimation via Registration

Jun Wu, Yue Wang and Rong Xiong
Control Science and Technology, Zhejiang University, China

- Current object pose estimation methods mostly rely on instance specific features, which limits their ability to generalize to unseen objects.
- 3D geometrical construction is embedded in observation, yet commonly neglected.
- We reconstruct full model and view model from reference and query observation, then seek for probabilistic correspondence between them to solve registration problem.
- Our method achieves comparable performance with SOTA, with accuracy and efficiency.



TuD II:Learning

Session Chair:

Online : July 18, 16:15 - 18:00, Tuesday

- 16:15~16:30

TactCapsNet: Tactile Capsule Network for Object Hardness Recognition

Senlin Fang¹, Tingting Mi¹, Zhenning Zhou¹, Chaohang Ye¹, Chengliang Liu¹, Hancheng Wu¹, Zhengkun Yi^{1,2} and Xinyu Wu^{2,3}

¹Shenzhen Institutes of Advanced Technology

²Guangdong Provincial Key Lab of Robotics and Intelligent System
³Shenzhen Key Laboratory of Smart Sensing and Intelligent Systems

^{1,2}SIAAT Branch, Shenzhen Institute of Artificial Intelligence and Robotics for Society

- Develop a method of constructing the tactile image which could make full use of the spatio-temporal information.
- Introduce a TactCapsNet for object hardness recognition.
- Collect the tactile hardness dataset by using the Barrett Hand to press three shapes of silicone samples with 13 hardness levels.



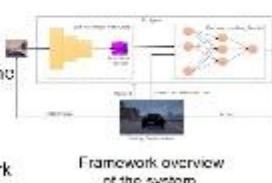
- 16:45~17:00

Towards Autonomous Driving Decision by Combining Self-attention and Deep Reinforcement Learning

Meiling Chen, Yanjie Li, Qi Liu, Shaohua Lv,
Yunhong Xu, Yuecheng Liu

Department of Control Science and Engineering,
Harbin Institute of Technology (Shenzhen), Shenzhen

- We proposed an framework based on self-attention model and DRL for autonomous driving.
- We used the self-attention model to reduce the dimension of image.
- we used DDPC algorithm to complete the autonomous driving task.
- The results show that the proposed framework performs better than existing methods.

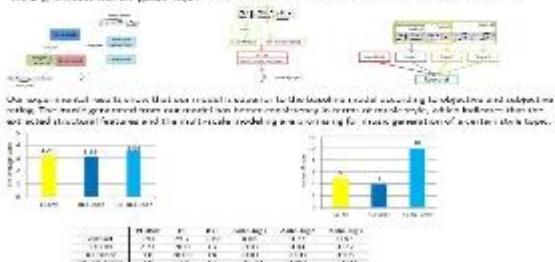


Framework overview of the system.

- 17:15~17:30

RE-RLTuner: A topic-based music generation method

This paper proposes a topic-based music generation method. The proposed method can generate music with specific topics, and detect the music's topics based on the topic words in the generated music. This method can also find the topic and emotion of the provided text, and then generate a new song through the combination of the provided text and the music generated from the global music.

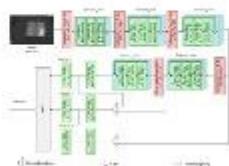


- 17:45~18:00

ToF 3D Vision Detection and Localization of Soft Packaging Bags Based on Deep Learning

Chengyang Shen and Weldong Chen
Department of Automation, Shanghai Jiao Tong University, China

- ToF 3D Vision
- Detection and Localization of Soft Packaging Bags
- deep learning

**A Traffic Scene Object Detection Method Combining Deep Learning and Stereo Vision Algorithm**

Linhui Li, Minhang Fang, Yuhang Yin, Jing Lian, and

Zhenghao Wang

Vehicle Engineering and Mechanics, School of Automotive Engineering, Dalian University of Technology, Dalian

- A method combining depth information with YOLOv5s object detection algorithm is proposed.
- The depth information is obtained by the disparity images which generated by the PSMNet.
- Add Attention Feature Fusion Module to YOLOv5s to improve the accuracy of small object detection
- The depth information is fused with the object detection to obtain distance information

- 17:00~17:15

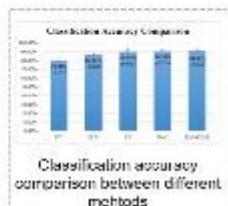
Gesture Recognition by Rotation Forest-Based Extreme Learning Machine

Fulai Peng, Cai Chen, Xikun Zhang, Xingwei Wang, Changpeng Wang
Shandong Institute of Advanced Technology, Chinese Academy of Sciences

Lin Wang

Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences

- This paper proposes a rotation forest-based extreme learning machine method (RoF-ELM).
- The proposed method enhanced the stability and accuracy of ELM in recognizing gestures from sEMG signals across different subjects.
- Results show that the RoF-ELM method have the highest accuracy across different subjects with relatively short runtime compared with decision tree (DT), ELM, random forest (RF), and RoF methods.



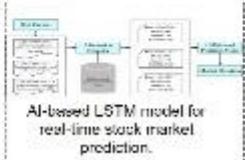
- 17:30~17:45

LSTM based Model for Real-time Stock Market Prediction on Unexpected Incidents

Saba Aslam¹, Abdur Rasool², Qingshan Jiang², Qiang Qu²

¹Computer Science, Fazl NULCFS Chiniot-Faisalabad, Pakistan.
²Shenzhen Key Lab for High Performance Data Mining, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China.

- Build an AI-based LSTM model to predict the stock market direction for unexpected incidents
- Find the impact of terrorist attacks, floods and earthquakes incidents on Stock market direction
- Web crawler crawls unexpected data → Information extractor → LSTM prediction Model → Market direction



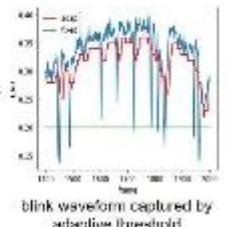
- 18:00~18:15

Blink Detection and Duration Estimation by Using Adaptive Threshold with Considering Individual Difference

Ruitao Liang and Qi Song

the School of Electronic and Information Engineering, Beijing Jiaotong University, China

- Dual functions for blink detection and duration estimation.
- Real-time blink detection which can adapt to future changes in individuals and periods.
- The blink detection performances on two public datasets are better than the real-time methods compared.
- For the estimation of duration, MAE of below 2.5 frames(30fps) can be achieved.



WeA I: Vision III

Session Chair:

Online : July 19, 8:30 - 10:15, Wednesday

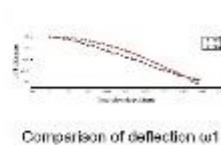
- 8:30~8:45

- 8:45~9:00

Research on Mechanical Properties of Bevel-Tip Needle Based on Image Guidance

Linze Wang*, Dedong Gao*, Yan Zhao and Juntao Zhang
the School of Mechanical Engineering, Qinghai University, Xining
Jiali Cui
Department of Computer Technology and Application, Qinghai University, Xining

- The flexible needle is a minimally invasive medical device mainly used for human biopsy.
- the mechanical model between the needle holder and the force sensor is established.
- A quasi static cantilever beam model is established
- The results show that the cantilever beam model can predict the insertion trajectory.



Comparison of deflection w_1 and w_2

- 9:00~9:15

Switching fluctuation compensation of the multi-view optical positioning system under camera occlusion

Zhengjun Yu, Shibo Li*, Ying Hu
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China
Haizhong Jin*
Shenzhen Broadband medical robotics co. Ltd., China
Gang Yu
Harbin Institute of Technology (Shenzhen), China

- Positioning system measurement model and System switching fluctuation under camera occlusion
- Vanished image point prediction based on neural network
- Simulation of system switching fluctuation and compensation based on neural network
- System switching fluctuation compensation in real environment



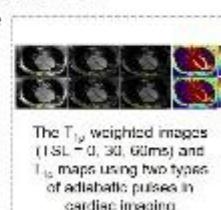
System switching fluctuation compensation for four view optical positioning system

- 9:30~9:45

The Optimization of Adiabatic Pulses with Constant Amplitude Spin-lock for MR $T_{1\rho}$ Imaging

Yuxin Yang, Xi Xu and Zhongmin Chen
Biomedical Engineering, Chongqing University of Technology, China
Yuanyuan Liu, Yanjie Zhu and Dong Liang
SIAT, Chinese Academy of Sciences, China

- HS and HSEsp adiabatic spin-lock pulses were optimized using a duration of 4ms.
- Images with higher SNR were obtained compared with those using pulses of 8ms.
- Almost equivalent mapping quality was achieved compared with that using pulses of 8ms.



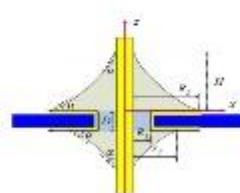
The $T_{1\rho}$ weighted images ($TSL = 0, 30, 60$ ms) and $T_{1\rho}$ maps using two types of adiabatic pulses in cardiac imaging

- 10:00~10:15

Vision-based soldering process parameters calculation for Robotic soldering

Hao Ren, Xinyu Wu and Wanfeng Shang
Center for Intelligent and Biomimetic Systems, SIAT and CAS, CHINA

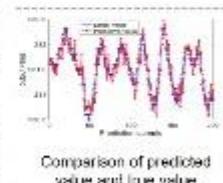
- Automatic soldering for THT Components
- Vision-based automatic soldering process parameters decision.
- High quality soldering result



Research on Diameter Prediction of Silicon Single Crystal Based on Data Driven

Xiya Zhang, Shan Wang*, Dedong Gao, Yan Zhao,
Guangwei Lin and Xin Peng
The School of Mechanical Engineering, Qinghai University, Xining

- In this paper, based on the long-term and massive crystal growth data of the crystal pulling workshop of the single crystal furnace, a crystal diameter prediction model based on the BP neural network is constructed.
- The model prediction results are verified by actual crystal pulling data, and the results show that for 6 groups of randomly selected crystal pulling data, the average relative percentage error is 0.08355%.



Comparison of predicted value and true value

- 9:15~9:30

Rapid identification method of fresh tea leaves based on lightweight model

Zhonghui Chen, Dengzhun Wang, Hongbo Fang, Guang Wang, and Benliang Xie
College of Big Data and Information Engineering, Guizhou University, China
e-mail: bjxie@gzhu.edu.cn

- By improving the MobileNetV2 network, the MobileNetV2 tea model has obtained
- Depth-separable convolutional structure has less the computation of parameters
- Using attention optimization module
- building a new average pooling layer and a new fully connected layer



MobileNetV2- Tea model

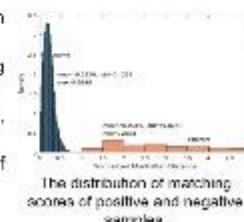
Model Comparison

- 9:45~10:00

Gun Model Recognition Using Geometric Features of Contour Image

Zhisheng Zhou, Jun Han, Jiaxin Chen and Yuming Dong
Shenzhen Institute of Advanced Technology, CAS, China

- A method to recognize a gun's model based on image classification is presented
- The procedure involves contour image acquiring and classification based on geometric features
- Geometric features include area, circumference, maximum distance and Hu moment.
- Experimental results show a high accuracy of larger than 99%.



The distribution of matching scores of positive and negative samples.

WeB I:Advanced Control II

Session Chair:

Online : July 19, 8:30 - 10:15, Wednesday

- 8:30~8:45

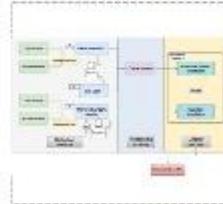
A Preliminary Study on an IMU-Based Surgery Assisting Method for Minimally Invasive Puncture of Intracranial Hematoma

Tianqi Shao¹, Ye Wang¹, Peng Jiang¹, Chong Wu², Guanglin Li¹, Lin Wang¹, and Shiwei Du²

¹Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences

²Department of Neurosurgery, Shenzhen University General Hospital

- A real-time processing navigation system for assisting minimally invasive puncture and drainage (MIPD) of intracranial hematoma (ICH).
- Initial Measurement Units(IMU)-based method for tracking puncture path and surgery needle.
- A data fusion method fusing IMUs and CT data.



- 9:00~9:15

Theoretical and Experimental Study of Adaptive Control for Fixed-wing UAV Arrested Recovery on the USV

Lingling Chu and Feng Gu

Shenyang Institute of Automation, Chinese Academy of Sciences, China

Yaqing He

Shenyang Institute of Automation, Chinese Academy of Sciences, China

- Shipborne recovery of fixed wing UAV is an important technology for UAV.
- An adaptive control method combined with LPV model and $\alpha - \beta$ filter for fixed-wing UAV arrested recovery.
- Flight experiments under different conditions are completed to verify the performance of the controller.
- The UAV with the proposed method can satisfy the requirements of recovery on the USV.



Recovery of UAV on USV in real environment

- 9:30~9:45

Cloud-based Robot Path Planning in Dynamic Environments

Xinquan Chen, Lujia Wang and Xitong Gao
SIAT, Chinese Academy of Sciences, China

Cheng-Zhong
the University of Macau, China

- Cloud-base framework for multi-agent path planning under dynamic environments.
- Modified A* global planner to make plans safer and more reasonable.
- Improved A* local planner to make obstacle avoidance more simple and effective.



- 10:00~10:15

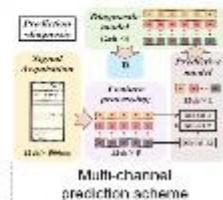
A Novel Method for Predicting Action Switching in Continuous Motion based on sEMG Signals

Xin Shi, Jiaqiang Zhu and Pengjie Qin
School of Automation, Chongqing University, China

Haoyang Cui

Provincial Key Lab of Robotics and Intelligent System, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China

- This paper proposes a predictive classification method based on multi channel sEMG signals.
- Selects the most suitable model from several traditional prediction models through experiments.
- Through online simulation testing the data of 8 objects, the average switching delay is 145ms.



Algorithm for the Detection of Thin Strip Shaped Structural Small Diseases on Airport Pavement based on improved pyramid and feature fusion

Haiteng Li, Hongyang Han, Jianping Zong, and Jilin Li

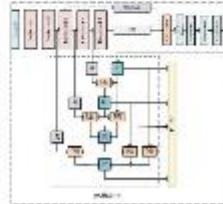
College of Computer Science and Technology, Civil Aviation

University of China, China

Zhongcheng Gui

Shanghai Guimu Co., Ltd, China

- This paper proposes a deep Neural Network algorithm, named as DFAMNet, based on improved pyramid and feature fusion.
- The method improves the detection accuracy of small target diseases in the thin strip shape on the airport pavement.
- Experimental results have verified the efficacy of the proposed method.

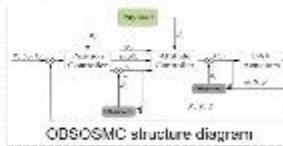


- 9:15~9:30

IEEE RCAR 2020 Digest Observer-based Second Order Sliding Mode Control for Tethered Quadrotor Transportation

Jiale Gao, Fan Zhang, Panfeng Huang and Ya Liu
the Research Center for Intelligent Robotics, School of Astronautics, Northwestern Polytechnical University, China

- Precise control: the disturbance can be compensated in proposed controller via the signed observer.
- Comparative test verification: two different experiments were conducted by hovering test and circling test.
- A double loops observer-based second order sliding mode control scheme is proposed for tethered quadrotor transportation.

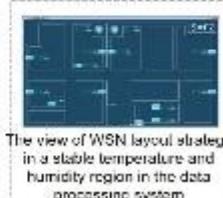


- 9:45~10:00

A Study on Wireless Sensor Network Layout Strategy in the Stable Temperature and Humidity Region

Ying Zhao, Weiren Shi, Pengjie Qin, Wenbin
Automation, Chongqing University, China

- The stable temperature and humidity region is obtained by CHI, K Means, and mathematical statistics.
- The WSN is laid out in the stable temperature and humidity region.
- The WSN is used to design a data processing system.
- This study focuses on the tobacco production industry.



WeC I:Robotic Control II

Session Chair:

Online : July 19, 10:45 - 12:30, Wednesday

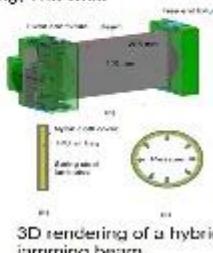
- 10:45~11:00

Hybrid Jamming Variable-Stiffness Link for Safe Co-Robots

Yitong Zhou

Shien-Ming Wu School of Intelligent Engineering, South China University of Technology, China
Leon M. Headings and Marcelo J. Dapino
Mechanical and Aerospace Engineering, The Ohio State University, USA

- We propose a tunable stiffness mechanism for co-robot links based on hybrid jamming
- It is made of multiple thin layers of spring steel and cloth, and an air bladder
- Bending stiffness and cross-section area increases with air pressure
- Around 66 times bending stiffness change is achieved (0.26 to 17.42 N/mm)



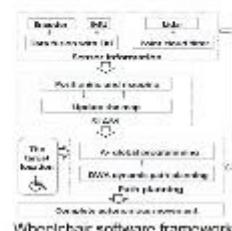
3D rendering of a hybrid jamming beam

- 11:15~11:30

Research on Autonomous Movement of Nursing Wheelchair Based on Multi-sensor Fusion

Yingbing Su, Huarui Zhu, Zhou Zhou, Bingshan Hu, Hongliu Yu
School of Medical Instrument and Food Engineering, University of Shanghai for Science and Technology, China

- According to the mobile needs of semi-disabled patients, an intelligent nursing wheelchair was designed.
- Fusion of multiple sensor information to improve positioning accuracy.
- Realize the autonomous movement of wheelchair and improve its intelligence and interactivity.



- 11:45~12:00

Monocular Object SLAM using Quadrics and Landmark Reference Map for Outdoor UAV Applications

Pengtao Shao, Fan Mo, Yaqian Chen, Ning Ding, and Rui Huang
Shenzhen Institute of Artificial Intelligence and Robotics for Society, and Institute

of Robotics and Intelligent Manufacturing, The Chinese University of Hong Kong, Shenzhen, Shenzhen, Guangdong, 518172, China.

- We propose geolocalization method based on object-level SLAM using visual input only
- We use buildings as the landmark objects to match with offline reference maps.
- Keywords:
GPS-denied, Object SLAM
UAV geolocalization

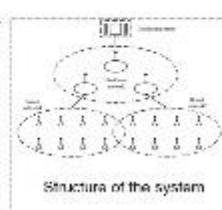


- 12:15~12:30

Environmental Monitoring System Based on Hybrid Mode Network

Zhishuo Li^{1,2}, Guodong Yang^{1,2}, En Li¹, Zize Liang¹
¹State Key Laboratory of Management and Control for Complex Systems,
Institute of Automation, Chinese Academy of Sciences, China
²University of Chinese Academy of Sciences, China

- This paper proposes a hybrid network structure based on the Zigbee and Mesh
- It consists of the backbone network, branch network, and monitoring center
- It has the advantage of long transmission distance, large bandwidth, and low cost.



Structure of the system

Robot-Assisted Haptic Rendering of Bilateral Physical Tasks via Physical Engine

Yudong Liu, Kaiya Chu and Qing Miao

Department of Biomedical Engineering, SUSTech, China

Mingming Zhang

Department of Biomedical Engineering, SUSTech, China

- This study developed a haptic-integrated robotic system capable of delivering bilateral physical training that resembles ADLs
- The system is implemented with robotic motion control and a physical engine
- The system showed satisfying motion control and haptic transparency in terms of position tracing during bimanual tasks



- 11:30~11:45

An Intelligent Speed-Suggestion Planner for Coverage Path with Multiple Constraints

Xinbo Ma and Guolai Jiang and Yuanzhe Peng and Tingchen Ma and Chao Liu and Yongsheng Ou
Shenzhen Institutes of Advanced Technology (SIAT), Chinese Academy of Sciences (CAS), China.

- We introduce the commonly used traffic regulations in daily life into the generation of speed profiles
- We construct a cost function to evaluate the safety performance of the trajectory, which can better evaluate different experimental results
- Our proposed method achieves not only high safety but also efficiency in the tracking of coverage paths.



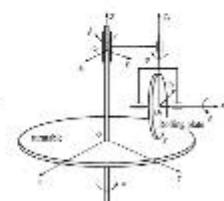
Introduce the traffic regulations into the generation of speed profile

- 12:00~12:15

Simplification of Dynamic Equations of a Nonholonomic Motion Transfer Mechanism

Wang Yong, Cui Jinchao, Xiao Jing and Zhang Huailing
School of Biomedical Engineering, Guangdong Medical University, China

- The simplification of the dynamic equations may be realized by simplifying the configuration space.
- The dynamic equations of first-order linear nonholonomic systems can be given by quasi-Newton's law.
- The dynamic equations of the motion transfer mechanism is reduced to the simplest form by quasi-coordinates.



WeD I:Robot Mechanism

Session Chair:

Online : July 19, 10:45 - 12:30, Wednesday

- 10:45~11:00

- 11:00~11:15

A Non-zero-sum-based Neural-optimal control method for Modular and Reconfigurable Robot Systems

Tianjiao An, Xinye Zhu, Yuanchun Li and Bo Dong
Department of Control Science and Engineering,
Changchun University of Technology, Changchun, China

- Using non-zero-sum neural-optimal control on modular and reconfigurable robot
- Extending ADP to non-zero-sum algorithm complete trajectory tracking task
- Each module is regarded as one player in the game theory.



- 11:15~11:30

Lower Limb Exoskeleton Design Based on Knee Joint Assistance

Peng Jiang, Ye Wang, Tianqi Shao, Lin Wang, Guanglin Li
Institute of Advanced Integration Technology, Shenzhen Institute of Advanced
Technology, Chinese Academy of Sciences, P.R.China

- Propose a passive lower limb exoskeleton to benefit patients with knee dysfunction
- The effectiveness of the exoskeleton in assisting patients with walking dysfunction was verified using OpenSim simulation software.
- It can help to regain the ability to walk with a natural gait by wearing this exoskeleton. Ultimately, it is hoped to improve the physical and mental health of patients.

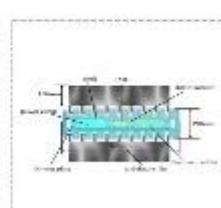


- 11:45~12:00

Kinetic Analysis and Design of a Bio-Inspired Amphibious Robot with Two Undulatory Fins

Shenglin Yin, Qiao Hu*, Yangbin Zeng, Chang Wei, Zhenhan Chen
School of Mechanical Engineering, Xi'an Jiaotong University, China

- A bio-inspired amphibious robot featuring with two undulatory fins
- The kinetic analysis of the undulatory fin propulsion both underwater and on the ground
- The prototype design are presented in detail.
- Three-dimensional movements test as well as ground propulsion test are introduced.

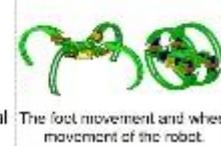


- 12:15~12:30

Simulation Study of a Spider-like Robot Based on Leg Reorganization

ShuQi Wang and JiZhuang Fan and Kuan Zhang
and GangFeng Liu and Jie Zhao
State Key Laboratory of Robotics and System,
Harbin Institute of Technology, China
Wei Zhang
College of Mechanical and Power Engineering,
Harbin University of Science and Technology , China

- A four-legged bionic robot with wheel-foot integrated is designed.
- The principle of wheel-foot conversion was analyzed.
- The bionic motion simulation of the robot virtual prototype is realized.



The Ground Motion Dynamics Analysis of a Bionic Amphibious Robot with Undulatory Fins

Yangbin Zeng, Qiao Hu*, Shenglin Yin
Baocheng Tong and Tangjia Zhang
Department of Mechanical Engineering, Xi'an Jiaotong University, China

- A novel type of bionic undulatory fin robot is designed.
- The kinematics of undulatory fin is modeled based on the ruled surface model.
- The ground dynamics of undulatory fin is analyzed based on wheel dynamics
- The research focus is verified through experiments



- 11:30~11:45

Robot-assisted quantitative assessment of axis misalignment of wrist joint

Dong Xu, Han Xu, Yibin Li, Xu Zhang, Xiaolong Li,
ATM& RFRG, Tangji Zhejiang College, China
Jianming Fu

the Second Affiliated Hospital of Jiaxing University, Jiaxing, China

- proposed a quantitative assessment method of axis misalignment of wrist joint by introducing a self-aligning mechanism based on the rehab-robot.
- the axis variation of wrist joint can be mimicked naturally and quantitative values can be recorded to assess axis misalignment.
- Experiments were conducted and ICC (2, 1) ≥ 0.866 , and SEM ≤ 1.34 mm.



- 12:00~12:15

Dexterous Origami-inspired Soft (DOIS) Robot for Objects Reorientation and Overturn

Zhi Chen, ShiPan Siu, Sinyee Tin, Yukhei Liu, Hanwen Cao, Yuan Gao, Jianshu Zhou, and Yunhui Liu,
Mechanical Automation Engineering, The Chinese University of Hong Kong,
Hong Kong

- A novel dexterous origami-inspired soft (DOIS) robot is proposed with bi-lateral bending and linear extension/contraction in a compact structure.
- Design, modeling, control of DOIS robot are introduced for versatile customization
- two challenging tasks, egg reorientation and envelop flipping, are performed by DOIS robot, which shows the promising practical application potential of DOIS robot.



WeA II: Vision IV

Session Chair:

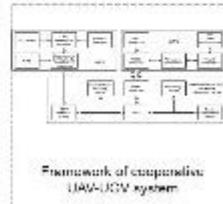
Online : July 19, 14:00 - 15:45, Wednesday

- 14:00~14:15

A Framework of Cooperative UAV-UGV System for Target Tracking

Zhilong Hu, Can Wang, Xinyu Wu, Yan Dong, Jiangpeng Ni, Haolin He
Guangdong Provincial Key Lab of Robotics and Intelligent System, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen 518055, China

- UAV is composed of an airborne processor, navigation module, perception module, and data transmission module.
- The UGV is composed of a navigation module and a perception module
- The ground station control is installed on the UGV



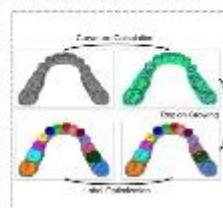
- 14:30~14:45

Tooth Segmentation of Dental Mesh Based on Improved Region Growing

Chenlan Gu and Hesheng Wang

Department of Automation, Shanghai Jiaotong University, China
Ning Zhao
Department of Orthodontics, Shanghai Ninth People's Hospital, China

- Improved region growing algorithm with extended region similarity description
- Multi-level label optimization algorithm based on label consistency
- Parameter adaptive method



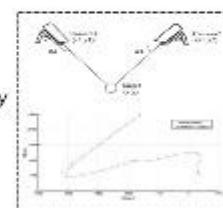
- 15:00~15:15

An Invasive Target Detection and Localization Strategy Using Pan-tilt-zoom Cameras for Security ApplicationsJia Hu, Chuanshen Zhang^{1*}, Sheng Xu^{2*}, Chunjie Chen^{2,4}

¹Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen 518055, China
²School of Physics Science and Information Technology, Liaocheng University, Liaocheng, 252000, China
³Guangdong Provincial Key Lab of Robotics and Intelligent System, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen 518055, China

*CAS Key Laboratory of Human-Machine Intelligence Synergy Systems, Shenzhen Institute of Advanced Technology, Shenzhen 518055, China

- This paper designs a practical security monitoring system to quickly detect and localize the invasive animals.
- To resolve the inaccurate and time-lag problems in the target recognition, a strategy combined with YOLOv5 and DeepSOFT is developed.
- Furthermore, an improved PID controller using particle swarm optimization (PSO) is proposed to control the PTZ for target localization.

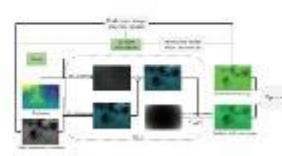


- 15:30~15:45

A Novel Underwater Image Synthesis Method Based on a Pixel-Level Self-Supervised Training Strategy

Zhiheng Wu, Zhengxing Wu, Yue Lu, Jian Wang and Junzhi Yu
State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

- An underwater image synthesis method is proposed to generate various underwater images
- Pixel level supervision is designed to make sure the authenticity of the synthetic underwater image
- A self-supervised training strategy is proposed to reduce the difficulty of data preparation and also improve the training performance



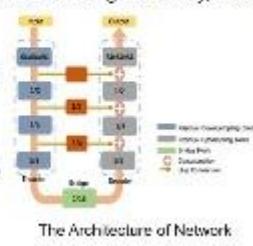
Architecture of the synthesis model

Attention Residual Network with 3D convolutional neural network for 3D Human Pose Estimation

Jianyu Yan and Kuiwei Mei

Institute of Artificial Intelligence and Robotics, Xi'an Jiaotong University, China

- We proposed a method estimate 3D pose from voxelized grid data. Our method output the heat map, which contains per-voxel likelihood for each joint.
- We evaluated our method on public dataset, ITOP dataset; and collect a 3D human pose estimation dataset to evaluate our method
- We design a attention block to help network focus on more important information



- 14:45~15:00

Measuring Method of Involute Profile Error Based on Machine Vision

ZHI Shan

College of Mechanical Engineering
Liaoning Institute of Science and Technology
China

- A new algorithm for measuring involute tooth profile error based on machine vision with gear local image is proposed
- The gray image of gear is acquired by gear visual measuring instrument
- The center of gear positioning is determined by fitting the circle based on fixed radius least square method with constraints



- 15:15~15:30

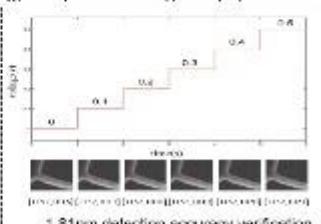
Nano Robotic Manipulator Positioning Accuracy Measurement By Secondary Electron Image

Litao Yang, Lue Zhang, Zhi Qu, Zengsheng Li, Zhan Yang
Robotics and Microsystems Center, School of Mechanical and Electric Engineering, Soochow University, Suzhou, China

Zengsheng Li

School of Mechanical Engineering, Tianjin University, Tianjin, China

- The mapping relationship between SEM image pixel and actual displacement is established
- Construct characteristic areas to track displacements at the nanometer scale
- The operation machine outputs a displacement of 2nm to verify the effectiveness of the displacement monitoring method



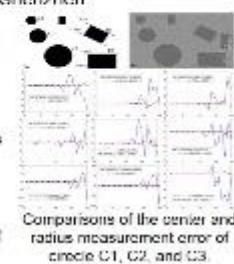
- 15:45~16:00

Stable Line and Circle Detection Method in Noise Image for Machine Vision

Xiaojun Wu and Xinhuan Wang

School of Mechanical Engineering and Automation, Harbin Institute of Technology, Shenzhen

- A region of interest (ROI) of line or circle is detected using a template matching method of the stable feature
- A 2D feature detection problem can be converted to 1D. Then, the local noise scale and filtering variance are computed from pixels along the sample line
- The edge point is detected from the first order derivative and the outliers are rejected
- The line or circle is fitted by using a linear least square method



WeB II:Robotic Control III

Session Chair:

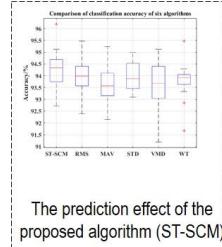
Online : July 19, 14:00 - 15:45, Wednesday

- 14:00~14:15

A new sEMG signal feature extraction method based on S transform

Xin Shi, Maqiang Zhai, Pengjie Qin, Keqi Yu, and Wenbo Zhou
College of Automation, Chongqing University, China

- sEMG signal can reflect the state of human movement.
- The combination of SVD and concentration measurement can reduce the dimensionality of S transformation's result.
- Compared with RMS、MAV、STD、VMD and WT, the algorithm has higher prediction accuracy.



- 14:30~14:45

Design and Energy Consumption Optimization of an Automatic Hybrid Sailboat

Rong Ou

Central South University, China

Cheng Liang, Xiaoqiang Ji, Huihuan Qian
Shenzhen Institute of Artificial Intelligence and Robotics for Society,
The Chinese University of Hong Kong, Shenzhen, China

- Hybrid Sailboat-III, an energy-saving ASV which can make use of both wind and electricity.
- It solves the problem of tacking when the sailboat is making a zig-zag path.
- Experiments show that new design can significantly decrease energy cost and enhance the course stability of hybrid sailboat.

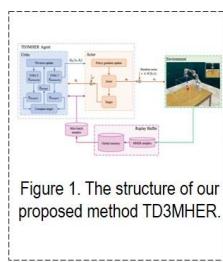


- 15:00~15:15

Data-efficient Deep Reinforcement Learning Method Toward Scaling Continuous Robotic Task with Sparse Rewards

Junkai Ren, Yichuan Zhang, Yujun Zeng and Yixing Lan
College of Intelligence Science and Technology,
National University of Defense Technology, China

- A model-free, off-policy RL algorithm TD3MHER is proposed to solve continuous tasks with sparse rewards.
- TD3MHER motivates the agent to learn the potential physical model of the robot.
- TD3MHER uses the previously collected samples to train the agent.
- TD3MHER is convenient to be applied because it requires no extra exploration.



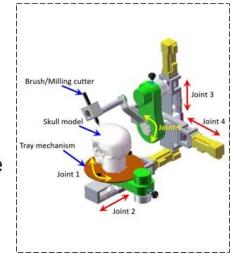
- 14:15~14:30

Kinematics Modeling and Trajectory Planning for the Skull Reconstruction Robot

Weiqun Wang¹, Xiru Wang², Zeng-Guang Hou¹, Zhijie Fang¹,
Yuze Jiao¹, Yangyu Luo¹ and Jian Gong³

1.the State Key Laboratory for Management and Control of Complex Systems,
Institute of Automation Chinese Academy of Sciences, China
2.Department of Electronics, Polytech Nice Sophia, France
3. Department of Pediatric Neurosurgery, Beijing Tiantan Hospital, Capital Medical University, China

- A skull reconstruction robot has been developed firstly in the world
- The contour data for cutting are obtained based on the laser scanning sensor
- A PCA based method is designed to ensure the end tools perpendicular to the skull surface
- A polynomial interpolation based method is designed to construct the curves between adjacent key points.



- 14:45~15:00

Design of a Battery Carrying Barge for Enhancing Autonomous Sailboat's Endurance Capacity

Cheng Liang

Shenzhen Institute of Artificial Intelligence and Robotics for Society, China
Rong Ou, Bairun Lin, Xiaoqiang Ji, Ray C. C. Cheung and
Huihuan Qian

Department of Electronic Engineering, City University of Hong Kong, China
Shenzhen Institute of Artificial Intelligence and Robotics for Society, China

- Autonomous mono-hull sailboat is reformed to tow a battery carrying barge.
- The angles of the two sails are optimized to produce maximum lift.
- The batteries in the barge provide more energy for the sailboat.
- Autopilot tests show greater endurance.

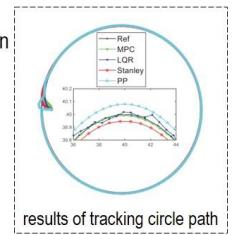


- 15:15~15:30

Simulation Performance Evaluation of Pure Pursuit, Stanley, LQR, MPC Controller for Autonomous Vehicles

Jia Liu, Zhiheng Yang, Zhejun Huang, Wenfei Li, Shaobo Dang,
and Huiyun Li
Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences,
China

- Build geometry path tracking methods based on Ackerman steering model
- Build optimal path tracking methods based on Ackerman steering model
- Carry on simulation experiments on different paths



WeC II:Robotic Control IV

Session Chair:

Online : July 19, 16:15 - 18:00, Wednesday

- 16:15~16:30

SongBot: An Interactive Music Generation Robotic System for Non-musicians Learning from A Song

Kaiwen Xue, Zhixuan Liu, Jiaying Li, Xiaoqiang Ji, Huihuan Qian
 Shenzhen Institute of Artificial Intelligence and Robotics for Society (AIRS)
 The Chinese University of Hong Kong, Shenzhen, China

- An interactive music generation robotic system
- Unify the analysis of notes and phrases in a general form with music theory
- Enhance the detail-capture ability with tunable parameter k
- Optimize the system with the users crowd sourcing data



- 16:45~17:00

Active Vibration Control of the Cantilever Beam Using a Manipulator

Pengyu Jie, Guangzeng Chen, Ke Li, Yuhao Meng,
 Jiangtao Ran and Yunjiang Lou
 Harbin Institute of Technology (Shenzhen), Shenzhen, China

- Used for vibration suppression of cantilever beam under large deformation.
- Structural dynamics is used to predict deformation without terminal deformation or acceleration feedback and a manipulator is used for force output to control vibration.
- Active vibration control algorithm is designed based on zero strain expectation.



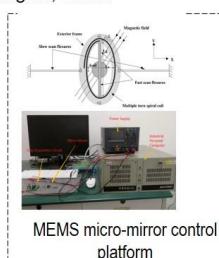
Vibration Control Equivalent Experimental Platform

- 17:15~17:30

A Predictive Control Scheme for Electromagnetic Scanning Micro-mirrors

Peijun Zheng¹, Ruili Dong¹, Yonghong Tan² and Huiyu Wang¹
 1. Donghua University, Shanghai China
 2. Shanghai Normal University, Shanghai, China

- MEMS electromagnetic scanning micro-mirror (ESMM) is an optical actuator used in optical-electro-mechanical instrument.
- The ESMM is a micro-opto-electro-mechanical system with complex characteristics.
- A predictive control scheme is proposed for angular control of electromagnetic scanning micro-mirrors.

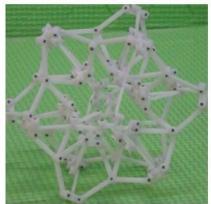


- 16:30~16:45

Deployable Polyhedral Mechanisms with Radially Reciprocating Motion Based on Non-crossing Angulated Structural Element

Tao Yang and Peng Li
 Harbin Institute of Technology Shenzhen, China
 Qing Shi
 Being Institute of Technology, China
 Yunhui Liu
 The Chinese University of Hong Kong, China

- Propose a non-crossing angulated element with a constant subtended angle.
- Construct a family of deployable polyhedral mechanisms with radially reciprocating motion but no singularity.
- Build 3D model both in computer and prototypes to demonstrate the feasibility of the proposed mechanisms.

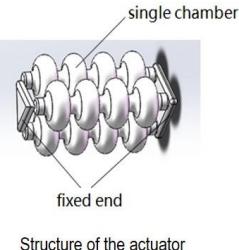


- 17:00~17:15

Multi-chamber Pneumatic Actuator for Peristaltic Soft Robot

Sheng GAO, Yue WANG, Rong XIONG, Zhefeng GONG,
 Nenggan ZHENG, and HaoJian LU
 Zhejiang University,China

- Designed and fabrication the pneumatic corrugated structure driver for squirmly soft robots
- Built a set of controller systems to control actuator deformation
- Completed the action of forwarding and turning with the actuator on experiments



Structure of the actuator