The 4th RSI International Conference on

Robotics & Mechatronics

ORAL Presentation

Control I

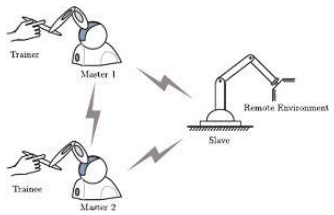
Chairs: Hamidreza Koofigar, University of Isfahan
Gholam Reza Vosoughi, Sharif University of Technology

11:00-11:20 | 91 | WeA1.1

Adaptive Control for Force-Reflecting Dual User Teleoperation Systems

Sara Abkhofte, Mohammad Motaharifar, Hamid D. Taghirad
Advanced Robotics and Automated Systems (ARAS) Lab., Faculty of Electrical Engineering, K. N. Toosi University of Technology, Tehran, Iran

• The aim of this study is to develop an adaptive force reflection control scheme for dual master nonlinear teleoperation systems.
• The proposed method addresses dynamic uncertainty of the system and an adaptive controller is designed in order to deal with this issue.
• As it is desired to have a sense of the environment and other user's forces in each master side in the application of surgery training, a force-reflecting algorithm has been used.
• Experimental results verify the effectiveness of the proposed approach.

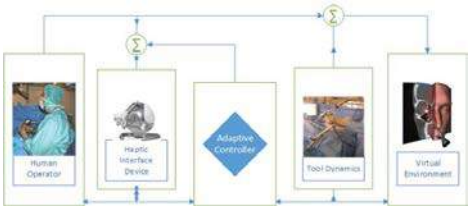


11:20-11:40 | 25 | WeA1.2

Nonlinear Adaptive Impedance Control of Virtual Tool-Tissue Interaction for Use in Endoscopic Sinus Surgery Simulation System

Ali Ebrahimi, Soroush Sadeghnejad, Gholamreza Vossoughi, Hamed Moradi, Farzam Farahmand
School of Mechanical Engineering, Sharif University of Technology, Iran

• In this article, a nonlinear adaptive impedance control strategy is proposed to adjust the impedance of a one-degree of freedom Falcon robot to a pre-defined nonlinear impedance which is an approximate mathematical representation of the sino-nasal tissue.
• The stability of the proposed control strategy and convergence of tracking error are proved by using Lyapunov Stability Theorem.
• The proposed controller requires less computational efforts and consequently lower time to accomplish the relevant simulations.

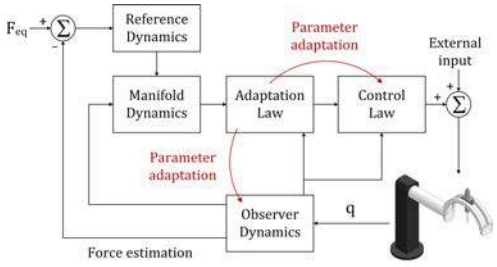


11:40-12:00 | 21 | WeA1.3

An Observer-Based Adaptive Impedance-Control for Robotic Arms: Case Study in SMOS Robot

Soheil Gholami, Arash Arjmandi, Hamid D. Taghirad
Advanced Robotics and Automated Systems (ARAS), Industrial Control Center of Excellence (ICCE), Faculty of Electrical Engineering, K. N. Toosi University of Technology, Tehran, Iran

• An adaptive output-feedback impedance control is proposed to be used in environment-machine interaction applications.
• The proposed control is designed to achieve a desired robot impedance in the presence of possible dynamical parameter uncertainties.
• Stability of the overall system is analyzed through input to state stability analysis.



Parallel Robot I

Chairs: Payam Zarafshan, University of Tehran
Mehdi Tale Masouleh, University of Tehran

11:00-11:20 157 WeA2.1

Sensory Feedback Performance Improvement on RoboCab: An Experimental Approach to Wire–Driven Parallel Robot

Mohammadreza Mousavi[1], Masoud Ghanbari[1], Ali Nasr[1], S. Ali A. Moosavian[1], Payam Zarafshan[2]
[1] *Center of Excellence in Robotics and Control, Advanced Robotics and Automated Systems (ARAS) Lab., Faculty of Mechanical Engineering, K. N. Toosi University of Technology, Tehran, Iran*
[2] *Department of Agro-Technology, College of Aburaihan, University of Tehran, Pakdasht, Tehran, Iran*

• This study investigates a method to improve the feedback accuracy in cable-driven parallel robots using multisensor data fusion
• Cable flexibility, unmodeled rotation of feeder pulley and sagging in cables leads to unreliability in encoder data.
• This paper proposes an effective scheme based on fusion of camera, load cell and inertial measurement unit data to provide more reliable posture information in presence of data accuracy challenges.
• Experimental results demonstrate the merits of the proposed approach.

11:20-11:40 106 WeA2.2

Fuzzy Logic Trajectory Tracking Control of a 3-RRS Ball and Plate Parallel Manipulator

Roya Khaje Pour, Hassan Khajvand, S. Ali A. Moosavian
K. N. Toosi University of Technology

• This paper focuses on modeling and fuzzy control of a 3-RRS ball and plate parallel manipulator.
• In addition to forward and inverse kinematic, dynamic equations of motion are derived by use of lagrangian method.
• Mamdani max-product method is used to control the position of the ball on the moving platform.
• Consequently, according to simulation study, it leads to a more accurate kinematic and dynamic model and precise trajectory tracking control of the ball.

11:40-12:00 162 WeA2.3

Type Synthesis of 2R-T Parallel Mechanisms Based on the Screw Theory for Haptic Applications

Nahid Khajeh Ahmadi, Fateme Zarei, Hamid D. Taghirad
Advanced Robotics and Automated Systems (ARAS) Lab., Faculty of Electrical Engineering, K. N. Toosi University of Technology, Tehran, Iran

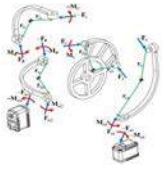
• This study investigates type synthesis of 2R-T parallel mechanisms as haptic devices.
• Different structural factors that affect the haptic device performance are discussed
• This paper pursues a stepwise algorithm for mechanism synthesis based on concepts such as wrench and twist system and virtual chain
• Several 2R-T parallel mechanisms are synthesized using screw theory.

12:00-12:20 54 WeA2.4

Kinematics and Dynamics Analysis of a 2-DOF Spherical Parallel Robot

Alaleh Arian, Behzad Danaei, Mehdi Tale Masouleh
Human & Robot Interaction Laboratory, Faculty of New Sciences & Technologies, University of Tehran

• The mobility and motion pattern of the manipulator are analyzed using screw theory, which resulted in obtaining the direct and inverse Jacobian matrices.
• Position, velocity and acceleration relations between different parts of the manipulator and the actuated joint angles are obtained.
• Since the manipulator, belongs to a class of parallel mechanism known as over-constrained mechanism, thus to obtain a dynamical model, a modification should be applied in its kinematic arrangement by preserving the performed motion pattern.
• Finally, accuracy of the dynamical model is verified by comparing the results obtained from the formulated model with results obtained from a SimMechanics model of the under study manipulator.



Mechatronics I

Chairs: Mohammad Mahjoob, University of Tehran
Ali Najafi, K. N. Toosi University of Technology

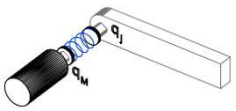
11:00-11:20 | 70 | WeA3.1

Feed-Forward Learning with Frequency Adaptation towards the Control of Series Elastic Actuators

Soroush Maleki, Atoosa Parsa, Majid Nili Ahmadabadi

Cognitive robotics lab., School of ECE., University of Tehran

• In this paper, a novel method towards approaching perfect tracking performance in periodic motions for robotic joints with serial elastic actuators, is proposed.
• The method is in an adaptive feed-forward scheme which has the ability to learn the required controlling signal, leading to reduced tracking error.
• The results for two cases of tracking linear and circular periodic trajectories of end-effector prove satisfactory.



11:20-11:40 | 152 | WeA3.2

Design and Fabrication of a Gripper Actuated by Shape Memory Alloy Spring

Nafise Faridi Rad, Aghil Yousefi-Koma, Hanie Rezaei, Mohammad Ali Bazrafshani

Center of Advanced Systems and Technologies (CAST), School of Mechanical Engineering, College of Engineering, University of Tehran, Tehran, Iran

• Shape Memory Alloy (SMA) can be used as actuators in different robotic systems.
• In this paper, a novel gripper actuated by SMA springs is designed and fabricated.
• Both closing and opening of the gripper's jaws is produced by a SMA spring which is actuates by applying voltage.
• A Fan is also considered in the gripper's design for increasing the low rate of operating frequency of SMA springs.

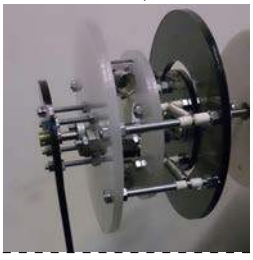
11:40-12:00 | 16 | WeA3.3

Design & Modeling of a Novel Mult-Functional Elastic Actuator(MFEA)

Sajjad Mozaffari, Elham Rekabi, Rezvan Nasiri, Majid Nili Ahmadabadi

Cognitive Systems Laboratory, Control and Intelligent Processing Center of Excellence (CIPCE), School of Electrical and Computer Engineering, College of Engineering, University of Tehran, Iran.

• This paper presents the design and modeling of a soft actuator with a novel arrangement of linear tension springs (MFEA).
• This arrangement of linear springs enables us to create a wide variety of compliance force-deection proles (including nonlinear and linear).
• The design is very easy to fabricate, it easily can be compacted and its deflection range can be tuned with respect to application (upto 90 degree).



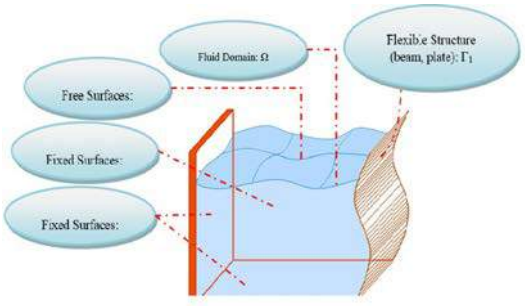
12:00-12:20 | 88 | WeA3.4

Vibrations Stabilization of a Euler-Bernoulli Beam in Contact With a Fluid Using Piezoelectric Actuators

Ali Najafi Ardekany, Amin Mehrvarz

Faculty of Mechanical Engineering, K. N. Toosi University of Technology, Tehran, Iran

• In this article the vibration suppression of a beam under heavy fluid loading will be addressed.
• The piezoelectric sensors and actuators are attached to the beam and utilized to suppress the beam vibrations.



Wheeled Mobile Robots

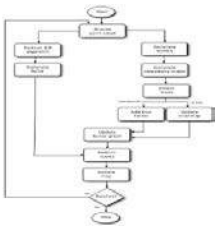
Chairs: Majid M. Moghaddam, Tarbiat Modares University
Subir Kumar Saha, Indian Institute of Technology Delhi

11:00-11:20 | 14 | WeA4.1

NURBS-based Representation of Urban Environments for Mobile Robots

AliReza Norouzzadeh Ravari, Hamid D. Taghirad
Advanced Robotics and Automated Systems (ARAS) Lab.,Faculty of Electrical Engineering, K. N. Toosi University of Technology, Tehran, Iran

• This study investigates a method to represent the 3d environment of a mobile robot in a continuous space.
• Conventional environment representation methods suffer from storing huge amount of data and computational complexity.
• This paper proposes an effective scheme based on Non Uniform Rational Spline (NURBS) surface for representation of urban environments.
• Consequently, Experimental results demonstrate the applicability of the proposed approach in challenging environments.



11:20-11:40 | 185 | WeA4.2

Dynamic Identification and Model based Control of an Omni-wheeled Mobile Robot

Vishal Abhishek, S. K. Saha
Department of Mechanical Engineering, Indian Institute of Technology, Delhi, India

• This paper provides dynamic identification of an omni-wheeled mobile robot.
• A Natural Orthogonal Complement based method is used for dynamic modeling of the robot in a linear in parameter form.
• The identified dynamic model is used for model based control of the robot.
• Experimental results are provided for a four omni-wheeled mobile robot

11:40-12:00 | 119 | WeA4.3

Experimental Study on Optimal Motion Planning of Wheeled Mobile Robot Using Convex Optimization and Receding Horizon Concept

Mojtaba Zarei[1], Mehdi Tale Masouleh[2]
[1]*Human and Robot Interaction Laboratory, Faculty of New Sciences and Technologies, University of Tehran, Iran*
[2]*School of Electrical and Computer Engineering, Human and Robot Interaction Laboratory, University of Tehran, Iran*

• In this paper, a novel algorithm for collision-free motion planning of two wheeled mobile robots is presented.
• The proposed approach is based on discrete motion planning, convex optimization and model-based control.
• CVX package benefited by the Gurobi solver is employed to solve the optimization problem.
• The reported results reveal that by considering the maximum velocity of the E-puck, obtained computational time is less than 0.2 seconds in each stage.

12:00-12:20 | 15 | WeA4.4

WeeMiK: A low-cost omnidirectional swarm platform for outreach, research and education

Mojtaba Karimi, Alireza Ahmadi, Parinaz Kavandi, Saeed Shiry Ghidary
Amirkabir Robotic Research Institute (ARRI) Lab., Amirkabir University of Technology (Tehran polytechnic), Tehran, Iran

• In This study we develop a low-cost and robust but extensible platform for research and educational purpose especially in swarm robotics.
• Cable flexibility, unmodeled rotation of feeder pulley and sagging in cables leads to unreliability in encoder data.
• This paper introduce WeeMiK platform, which offers a balance between capabilities, accessibility, cost and an open-design with open source programming SDK.
• electrical structure include sensors, motor drive, wireless communication system and device communication manager (DCM), are designed based on a 8-Bit AVR microcontroller that runs under Real-Time Operating System (freeRTOS).

Social Robotics

Chairs: Ali Meghdari, Sharif University of Technology
Hadi Moradi, University of Tehran

11:00-11:20 | 67 | WeA5.1

A Gait Pattern Generator for the Alice Mina Humanoid Robot

Ali Meghdari, Saeed Behzadipour, Majid Abedi
Center of Excellence in Design, Robotics, and Automation (CEDRA), Sharif University of Technology, Tehran, Iran

• The purpose of this research was to generate a gait pattern for the humanoid robot Alice for which no walking pattern has been designed thus far.
• The construction of this robot is such that a non-negligible offset exists at the hip, so no analytic inverse kinematics solution exists for the robot's legs.
• Using the definition of the kinematic equations of the robot in the joints Cartesian coordinates and the static stability condition, the inverse kinematics of the lower-body, i.e. a 12-DOF chain, was solved numerically.
• Results of the simulations and the real experiments with an Alice humanoid robot were acceptable indicating the suitability of the kinematic modeling; However, the stability of the robot was not acceptable.

11:20-11:40 | 170 | WeA5.2

The Real-Time Facial Imitation by a SocialHumanoid Robot

Ali Meghdari, Saeed Bagheri Shouraki, Alireza Siyami, Azadeh Shariati
Social & Cognitive Robotics Laboratory, Center of Excellence in Design, Robotics and Automation (CEDRA), Sharif University of Technology, Tehran, Iran

• This paper contributes to the real-time facial expression imitation of a human, by the humanoid robot, Alice.
• The key points of the user are extracted with the Kinect sensor and Microsoft Software Development Kit (SDK).
• The human facial expressions are recognized and classified using Artificial Neural Networks (ANN).
• Simulations and experimental results showed a satisfying reaction time and appropriate accuracy in gesture recognition and imitation by the social humanoid Alice.

11:40-12:00 | 133 | WeA5.3

RoboParrot 2.0: A Multi-Purpose Social Robot

Amir Mehdi Shayan[1], Alireza Sarmadi[1], Armin Pirastehzad[1], Hadi Moradi[1,2], Pegah Soleiman[1]
[1] *Advanced Robotics and Intelligent Systems Laboratory, School of ECE, College of Engineering, University of Tehran*
[2] *Intelligent Systems Research Institute, SKKU, South Korea*

• This research presents RoboParrot 2.0, an intelligent socially interactive parrot-like robot.
• The new platform is capable of adding further features to increase autonomy and to expand applicable fields, so it can be widely used in homes of independent-living elderly people, nursing home, hospitals, and for home based ASD therapy.
• The current prototype of RoboParrot 2.0 is ready to be utilized in clinical centers for assisted ASD therapy, nursing homes, and in homes of independent-living older adults.

12:00-12:20 | 85 | WeA5.4

System and method for recognizing human emotion state based on analysis of speech and facial feature extraction; Applications to Human-Robot Interaction

Mohammad Rabiei[1], Alessandro Gasparetto[2]
[1] *Faculty of Electronics and Computer Engineering, Eyvanekey University*
[2] *Department of Electrical and Mechanical Engineering, University di Udine*

• This paper focuses on report the results obtained from an exploratory study on software which automatically recognizes and classifies basic emotional states.
• The study consists of generating and analyzing the graphs of speech signals with using: pitch, intensity and formant properties of speech.
• In this experiment, the accuracy of the proposed system with training stage was 98.6% for all of six basic emotions.

Arial Robots

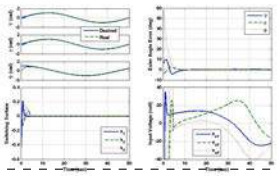
Chairs: Hamid D. Taghirad, K. N. Toosi University of Technology
Hami Tourajizadeh, University of Kharazmi

15:00-15:20 56 WeB1.1

Inertia-Free Nonlinear Attitude Tracking with Disturbance Compensation Using Adaptive-Sliding Control Based on Quaternion Algebra

Mohammadreza Alipour S.[1], Mansour Kabganian[1], Farhad Fani Saberi[2]
[1] *Department of Mechanical Engineering, Amirkabir University of Technology (Tehran Polytechnics)*
[2] *Space Science and Technology Institute, Amirkabir University of Technology (Tehran Polytechnics)*

• In this paper, a nonlinear tracking control algorithm is developted.
• The control objective in this research is to track a desired time varying attitude of a satellite in the presence of inertia uncertainties and external disturbances.
• In this investigation, actuators are reaction wheels and the actuators dynamics are modeled.
• The global stability of both methods are investigated.



15:20-15:40 79 WeB1.2

Autonomous Flight and Obstacle Avoidance of a Quadrotor By Monocular SLAM

Omid Esrafilian, Hamid D. Taghirad
Advanced Robotics and Automated Systems (ARAS) Lab., Faculty of Electrical Engineering, K. N. Toosi University of Technology, Tehran, Iran

• This study presents an algorithm which enables the Quad-Rotor robot flies autonomously using Monocular SLAM.
• Sparse reconstructed environment map and inaccurate estimated robot position obtained by Monocular SLAM lead to unreliability in visual odometry and mapping data for any autonomous missions by mobile robots in unknown environments.
• This paper proposes an effective algorithm for map enrichment and data correction by utilizing Kalman filter, clustering and classifying methods.
• Consequently, experimental verifications of the proposed algorithms are reported.

15:40-16:00 101 WeB1.3

theta-D Based Nonlinear Tracking control of Quadcopter

M. Navabi, Hamidreza Mirzaei
Faculty of New Technologies Engineering, Shahid Beheshti University, Tehran, Iran

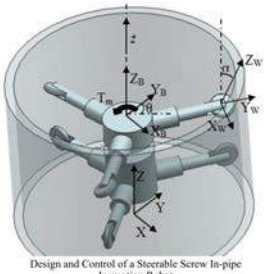
• This study investigates two methods to control attitude and altitude of quadrotor.
• In this paper, nonlinear dynamic of quadrotor is considered.
• Due to nonlinear and uncertain dynamic of quadrotor, two semioptimal control method are applied.
• proposed methods guarantee stability of closed-loop system, force the states to follow desired reference signals and compensate nonlinear terms.

16:00-16:20 36 WeB1.4

Design and Control of a Steerable Screw In-pipe Inspection Robot

H. Tourajizadeh, M. Rezaei
Mechanical Engineering Department, Faculty of Engineering, Kharazmi University,Tehran, Iran

• This study is about a screw in-pipe inspection robot which its pitch rate is controllable.
• Obstacle avoidance problem is considered in this paper.
• The controller robustness against uncertainties is discussed.
• A robust control is designed and tested with exerted disturbance.



Serial Robots

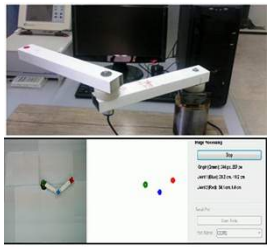
Chairs: Heidar Ali Talebi, Amirkabir University of Technology
Adrian Olaru, University Politehnica of Bucharest

15:00-15:20 | 5 | WeB2.1

Control of flexible-joint underactuated manipulators in task space

S. Reza Naghibi[1], Ali. A Pirmohamadi[1], S. Ali A. Moosavian[2]
[1] *Department of Mechanical Engineering, University of Zanjan, Zanjan, Iran*
[2] *Department of Mechanical Engineering, K. N. Toosi University of Technology, Tehran, Iran*

- Dynamics of flexible joint underactuated manipulators is reviewed.
- A controller is introduced to control flexible joint underactuated manipulators in task space.
- The controller robustness against uncertainties is discussed.
- Efficiency of this new control approach is ensured using experimental results for a two-link underactuated flexible joint robot.

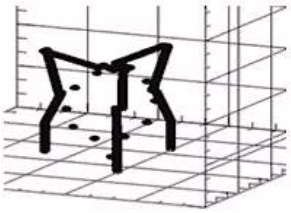


15:20-15:40 | 8 | WeB2.2

Achieving Extreme Precisions for Multiple Manipulators Using a Proper Coupled Neural Network Matrix Method and LabVIEW Instrumentation

Adrian Olaru[1], Ellips Masehian[2], Serban Olaru[3], Niculae Mihai[4]
[1] *University Politehnica of Bucharest, Bucharest, Romania*
[2] *Tarbiat Modares University, Tehran, Iran*
[3] *RomSys SA, Bucharest, Romania*
[4] *Technoaccord Company, Quebec, Canada*

- This paper proposes a solution to the Inverse Kinematics problem in robots with redundant chains through a hybrid method that combines the convergence process through proper Iterative Pseudo Inverse Jacobian Matrix Method.
- Computational errors are filtered by a Bipolar Sigmoid Hyperbolic Tangent Neural Network Method with Time Delay and Recurrent Links.
- Tracking spatial conventional and unconventional curves in different Euler planes by three robots moving simultaneously is achieved with extreme end-effector precision.



15:40-16:00 | 24 | WeB2.3

Visual Servoing Control of Robot Manipulator in 3D Space Using Fuzzy Hybrid Controller

Fatemeh Abadianzadeh, Vali Derhami, Mehdi Rezaeian
Computer Engineering Department, Faculty of Engineering, Yazd University, Yazd, Iran

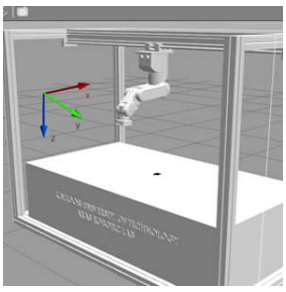
- This study investigates a method for visual servoing of a robot manipulator in 3D space.
- Since model of robot and camera calibration parameters are not available, a fuzzy hybrid controller proposes. This fuzzy controller includes a fuzzy inverse model and a fuzzy expert system.
- Experimental results in a real robot manipulator demonstrate the efficiency of the proposed approach.

16:00-16:20 | 93 | WeB2.4

Visual Servoing Simulator by Using ROS and Gazebo

Parisa Masnadi Khiabani, Babak Sistanizadeh Aghdam, Javad Ramezanzadeh, Hamid D. Taghirad
Advanced Robotics and Automated Systems (ARAS), Industrial Control Center of Excellence (ICCE), Faculty of Electrical Engineering, K. N. Toosi University of Technology, Iran

- this study presents five degree of freedom (DOF) visual servoing robot with eye-in-hand configuration.
- The simulator has been developed in Robot Operating System (ROS) and Gazebo environment.
- The designed simulator eases the process of testing and debugging visual servoing schemes, and robot controllers
- Image-moment based visual servoing has been implemented to verify the functionality and performance of it.



System Identification

Chairs: Alireza Akbarzadeh, Ferdowsi University of Mashhad
Mahdi Aliyari Shoorehdeli, K. N. Toosi University of Technology

15:00-15:20 169 WeB3.1

Dynamic Identification of the Novint Falcon Haptic Device

Nima Karbasizadeh[1], Ali Aflakiyan[1], Mojtaba Zarei[1], Mehdi Tale Masouleh[2], Ahmad Kalhor[3]
[1] *Human and Robot Interaction Laboratory, Faculty of New Sciences and Technologies, University of Tehran, Iran.*
[2] *School of Electrical and Computer Engineering, Human and Robot Interaction Laboratory, University of Tehran, Iran.*
[3] *Control and Intelligent Processing Center of Excellence, School of Electrical and Computer Engineering, University of Tehran, Iran.*

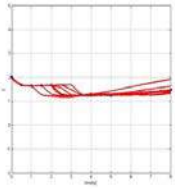
• The main concern of this paper consists in dynamic identification of the "Novint Falcon" parallel haptic device.
• The unknown parameters in closed-form dynamic model of the robot is identified.

15:20-15:40 110 WeB3.2

Time-Delay Estimation Of Nonlinear Systems With Delay In States And Outputs

Mohammad Ali Abooshahab, Mohsen Ekramian, Mohammad Ataei
Department of Electrical Engineering, University of Isfahan, Isfahan, Iran

• This paper develops a method based on gradient to estimate time delays in nonlinear dynamic systems with unknown time-delays in both state and output equation
• The gradient of cost function cannot be computed analytically by standard differentiation rules; thus, the computational method based on the variational method is proposed to compute gradient.
• In this study, the common gradient-based optimization method which is sequential quadratic programming will be used to minimize the cost function
• Finally,The effectiveness of proposed algorithm is demonstrated by simulation results



15:40-16:00 156 WeB3.3

EMG-Based Estimation of Shoulder Kinematic Using Neural Network and Quadratic Discriminant Analysis

Armin Ehrampoosh[1], Aghil Yousefi-Koma[1], Seyed Saied Mohtasebi[1], Moosa Ayati[2]
[1] *Center of Advanced Systems and Technologies (CAST), School of Mechanical Engineering, College of Engineering, University of Tehran, Tehran, Iran*
[2] *Advanced Instrumentation Lab., School of Mechanical Engineering, College of Engineering, University of Tehran, Tehran, Iran*

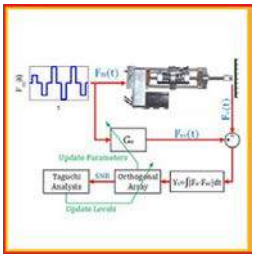
• The aim of this research is to create a mapping between electrical activities of muscles and kinematics of joint.
• This paper proposes a two phase strategy in myoelectric control of upper limb.

16:00-16:20 158 WeB3.4

System Identification of a Linear Series Elastic Actuator using a Recursive Taguchi-based Algorithm

Somayeh Norouzi, Alireza Akbarzadeh, Iman Kardan
Center of Excellence on Soft Computing and Intelligent Information Processing, Mechanical Engineering Department, Ferdowsi University of Mashhad

• This paper addressed a new system identification method which is simply applicable to identify both of the linear and nonlinear models.
• The purposed method is implemented on a custom made linear series elastic actuator.
• The presented method significantly reduced the system identification time process.
• Using the presented method, estimation of both of the structure and the model is possible.



Legged Robots

Chairs: Aghil Yousefi-Koma, University of Tehran
Vahid Johari Majd, Tarbiat Modares University

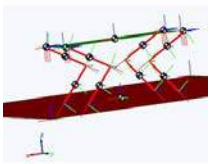
15:00-15:20 | 23 | WeB4.1

Modifying the Attitude of Quadruped Robot Body against Disturbances via Data Fusion

Farid Edrisi, Vahid Johari Majd, Mehran Attar, Navid Dini

Intelligent Control Systems (ICS) Lab., Faculty of Electrical Engineering, Tarbiat Modares University, Tehran, Iran

• The purpose of this paper is modifying the attitude of quadruped robot body against disturbances via sensory feedback.
• In this filter, switching rule is used to separate the measurement model of EKF in the accelerated or non-accelerated motion of the robot body.
• The body deviation is compensated using support legs based on the outputs of observer.
• Through numerical simulations, SEKF is compared with a nonlinear observer and its efficiency is shown and finally, the robot body attitude is modified on a platform under ramp disturbances.



15:20-15:40 | 45 | WeB4.2

Stepping Stabilization Using a Combination of DCM Tracking and Step Adjustment

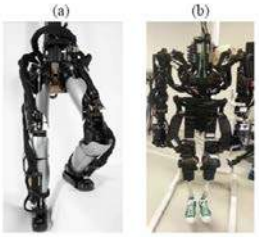
Majid Khadiv[1,2], Sebastien Kleff[2], Alexander Herzog[2], S. Ali A. Moosavian[1], Stefan Schaal[3], Ludovic Righetti[2]

[1] *Faculty of Mechanical Engineering, K. N. Toosi University of Technology, Tehran, Iran*

[2] *Autonomous Motion Department, Max-Planck Institute for Intelligent Systems, Germany*

[3] *CLMC Lab, University of Southern California, USA*

• This paper proposes a method for stabilizing biped robots.
• A swing foot trajectory modification strategy is proposed to adapt the landing point, using DCM measurement.
• In order to apply the generated trajectories to the full robot, a Hierarchical Inverse Dynamics (HID) is employed.
• Simulation experiments on two scenarios for two different simulated robots, one with active ankles and the other with passive ankles, are carried out.



15:40-16:00 | 123 | WeB4.3

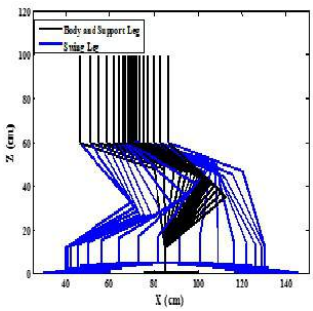
A Novel Three-Mass Inverted Pendulum Model for Real-Time Trajectory Generation of Biped Robots

Mostafa Eslami[1], Aghil Yousefi-Koma[1], Majid Khadiv[2]

[1] *Center of Advanced Systems and Technologies (CAST), School of Mechanical Engineering,College of Engineering, University of Tehran, Iran*

[2] *Center of Excellence in Robotics and Control, Advanced Robotics & Automated Systems (ARAS), Faculty of Mechanical Engineering, K. N. Toosi University of Technology, Iran*

• In this paper, a new model is proposed based on the three-mass inverted pendulum for generating real-time walking pattern for biped robots.
• Simulations showed that the proposed model has less error in comparison with one-mass and three-mass models.



16:00-16:20 | 27 | WeB4.4

Estimation of External Forces Acting on the Legs of a Quadruped Robot using Two Nonlinear Disturbance Observers

Navid Dini, Vahid Johari Majd, Farid Edrisi, Mehran Attar

Intelligent Control Systems (ICS) Lab., Faculty of Electrical and Computer Engineering, Tarbiat Modares University, Tehran, Iran

• This study addresses the sensor-less estimation of external forces exerted on the legs of a quadruped from the environment.
• For this purpose, two nonlinear disturbance observers have been used.
• The first disturbance observer, estimates the torques applied to the legs through the legs' couplings with the body, while the second one uses the data from this observer to derive an estimation of the external torques applied to the tips of the robot legs.
• The results of the simulation, have been compared with the results derived from another disturbance observer.

Medical Robotics I

Chairs: Khalil Alipour, University of Tehran
Ali Doustmohammadi, Amirkabir University of Technology

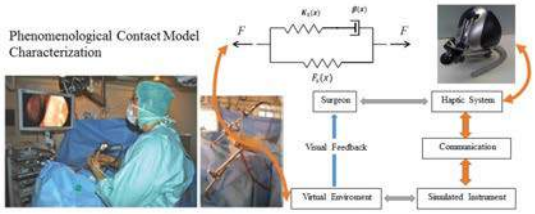
15:00-15:20 29 WeB5.1

Phenomenological Contact Model Characterization and Haptic Simulation of an Endoscopic Sinus and Skull Base Surgery Virtual System

Soroush Sadeghnejad, Mojtaba Esfandiari, Farzam Farahmand, Gholamreza Vossoughi

School of Mechanical Engineering,Sharif University of Technology, Iran

• This research studies the interactions between surgical tools and simultaneous soft and hard tissue deformation in the sinonasal region.
• In this article, ex-vivo indentation and relaxation experiments are presented.
• The estimated parameters of the modified Kelvin-Voigt model are then used to provide a realistic dynamic model.
• Finally, the principle of a virtual reality simulation scheme that would allow better haptic discrimination of tool-tissue interaction is proposed and illustrated.



15:20-15:40 154 WeB5.2

Simplifying user interaction solutions for the FUM Bionic Hand-I

Saeed Bahrami Moqadam[1], Hamed Jafarzadeh[2], Sadra Naddaf[3], Sina Darvishi[4], Seyyed Alireza Esfehani[5], Pouya Pishbin[6], Farsad Babazadeh[7], Aryan Makhdoumi[8], Alireza Akbarzadeh[9], Ahmad Hajipour[10]

[1,10] *Electrical and computer Dept., Hakim Sabzevari University of Sabzevar, Iran*
[2,3,4,5] *Computer Dept. of Ferdowsi University of Mashhad, Iran*
[6,7] *Mechanical Dept. of Azad University Mashhad branch, Iran*
[8] *Electrical Dept. of Ferdowsi University of Mashhad, Iran*
[9] *Center of Excellence on Soft Computing and Intelligent Information Processing, Ferdowsi University of Mashhad, Iran*

• This paper discussed the various aspects of the FUM Bionic Hand-I.
• Finally, the paper discusses the force control capability.

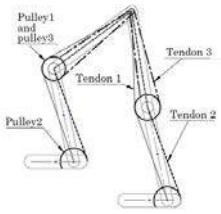
15:40-16:00 171 WeB5.3

Conceptual Design of a Lower Limb Exoskeleton Actuated by Shape Memory Alloys for Assisting Elderly People in Stair Climbing

Payman Joudzadeh, Alireza Hadi, Khalil Alipour

Department of Mechatronics Engineering, Faculty of New Sciences and Technologies, University of Tehran, Tehran, Iran

• Assistive lower limb exoskeletons are a group of devices that are designed to improve/augment the user movement.
• Weight reduction and wearability of such systems have always been serious concerns of medical robotics research community.
• This paper proposes a conceptual design of a tendon driven lower limb exoskeleton for assisting elderly people to climb the stairs, utilizing shape memory alloy wires.
• The response of the suggested system has been examined via Matlab and Adams simulation softwares.



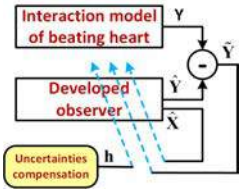
16:00-16:20 51 WeB5.4

Model-Based Online Estimation of Interaction Force in Beating Heart Robotic-Assisted Surgery

Elaheh Arefinia, Heidar Ali Talebi, Ali Doustmohammadi

Department of Electrical Engineering, Amirkabir University of Technology, Tehran, Iran

• The main contribution of this paper is to develop a model of beating heart tissues on the basis of anisotropic viscoelastic Boltzmann model.
• In the proposed approach, most the unrealistic assumptions adopted in the previous studies has been relaxed.
• A continuous nonlinear adaptive robust estimator is proposed to estimation of interaction force online, as well as to overcome model uncertainties, i.e. Lipchitz with unknown Lipchitz constant, and constant and unknown upper bounds on uncertainties. To this end, three parameters are defined to compensate uncertainties.
• Analysis are carried out on vivo samples which approve the satisfactory performance of the proposed approach.



Control II

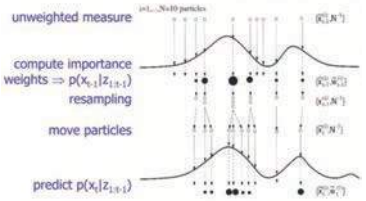
Chairs: Ali Khaki-Sedigh, K. N. Toosi University of Technology
Mohammed Reza Zakerzadeh, University of Tehran

9:50-10:10 167 ThA1.1

Particle Filters for Non-Gaussian Hunt-Crossley Model of Environment in Bilateral Teleoperation

Pedram Agand, Hamid D. Taghirad, Ali Khaki-Sedigh
Advanced Robotics and Automated Systems (ARAS) Lab., Faculty of Electrical Engineering, K. N. Toosi University of Technology, Tehran, Iran

• This study investigates a method to estimate signals flow of environment in a force-reflecting Teleoperation system.
• The estimation includes filtering of position signal asd prediction of force signals in a nonlinear non-Gaussion framework.
• This paper proposes an effective scheme based on Bayesian inference by cooperating of all available information to obtain the most knowledge from system.
• Consequently, simulation results on a full teleoperation scenario with Hunt-Croossley model for environment illustarte priority of this method.

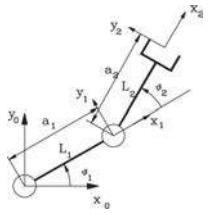


10:10-10:30 41 ThA1.2

Estimation of Decenteralized Unknown Dynamics for a 2DOF Manipulator Using a Time Varying Extended State Observer

Mehran Attar, Vahid Johari Majd, Navid Dini, Farid Edrisi
Intelligent Control Systems Laboratory, School of Electrical and Computer Engineering, Tarbiat Modares University, Tehran, Iran.

• In this paper, an estimation of the dynamics of a 2 degrees of freedom robot manipulator with uncertainties, is derived, using an extended state observer.
• Decentralizing approach in multivariable systems, is an methodolgy used in an increasing number of practical systems to simplify the controller design.
• On the other hand, these systems usually contain uncertainties, and also parts of the system's dynamics are unknown.
• As shown in the simulations, the estimation error pick phenomena reduces drastically.



10:30-10:50 142 ThA1.3

Design Improvement of a 2-DOF Ankle Joint Actuation Mechanism for a Humanoid Robot

Mahyar Ashkvari[1], Aghil Yousefi-Koma[1], Hossein Keshavarz[1], Masoud Shariat-Panahi[2]
[1] *Center of Advanced Systems and Technologies (CAST), School of Mechanical Engineering, University of Tehran, Tehran, Iran*
[2] *School of Mechanical Engineering, College of Engineering, University of Tehran, Tehran, Iran*

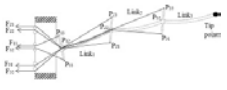
• In this article, a novel mechanism to actuate ankle joint of a humanoid robot SURENA III is presented.
• The proposed power transmission mechanism is based on raising center of mass of robots' legs which may lead to lighten the feet.
• In this mechanism, a combined timing belt-pulley, harmonic drive module and also a roller screw mechanism are exploited for power transmission of pitching and rolling movements of the ankle joints, respectively.
• Consequently, Simulation results demonstrate the merits of the proposed mechanism.

10:50-11:10 173 ThA1.4

Computational Dynamic Modeling and Sequential PID Controlling of a Tendon-Based Manipulator with Highly Slender Flexible Arms

Arman Mardani, Saeed Ebrahimi
Faculty of Mechanical Engineering, Yazd University, Yazd, Iran

• The effect of a sequential PID controller for a long-thin flexible manipulator with low-weight arms is investigated.
• The main idea and novelty is to control each link of slender manipulator and to lock other links at each stage of control by means of flexible tendons.
• The controlling process deals with the force of flexible tendons which are motivated by means of motors located in the manipulator base.
• The idea of sequential PID controlling would be real by means of some mechanical lockers in each joint.



Parallel Robot II

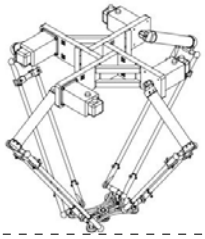
Chairs: S. Ali A. Moosavian, K. N. Toosi University of Technology
Mahdi Bamdad, Shahrood University of Technology

9:50-10:10 | 172 | ThA2.1

Weighted Kinematic Sensitivity of a 4-DOF Robot

Mohsen Mohammadi[1], Behzad Mehrafrooz[1], Mehdi Tale Masouleh[2]
[1] *Human and Robot Interaction Lab., University of Tehran, Iran.*
[2] *School of Electrical and Computer Engineering, Human and Robot Interaction Laboratory, University of Tehran, Iran*

• In this paper, kinematic modeling and weighted kinematic sensitivity of a 4-DOF parallel robot called Tesseraataar is investigated.
• The conventional kinematic sensitivity index has the drawback of ignoring different sensitivity to the active joints uncertainty.
• In the proposed approach, different sensitivity of actuators by implementation of Sobols sensitivity analysis method is obtained.
• Consequently, a new index refer to as weighted kinematic sensitivity is obtained.



10:10-10:30 | 63 | ThA2.2

Experimental Identification of Friction and Dynamics of an Overconstrained 3-DOF Decoupled Parallel Mechanism

Mohammad Sharifzadeh[1], Azadeh Doroudchi[2], Mehdi Tale Masouleh[3], Ahmad Kalhor[4]
[1,2] *Human and Robot Interaction Laboratory, Faculty of New Sciences and Technologies, University of Tehran*
[3] *Human and Robot Interaction Laboratory, School of Electrical and Computer Engineering, University of Tehran*
[4] *Control and Intelligent Processing Center of Excellence, School of Electrical and Computer Engineering, University of Tehran*

• An experimental investigation on the dynamic identification of an over constraint 3-DOF decoupled parallel mechanism is carried out.
• In order to circumvent the problem of being over constraint, a model based on 105 polynomial regressors is proposed.

10:30-10:50 | 46 | ThA2.3

Robust H_∞ Control of a 2RT Parallel Robot For Eye Surgery

Abbas Bataleblu, Mohammad Motaharifar, Ebrahim Abedlu, Hamid D. Taghirad
Advanced Robotics and Automated Systems (ARAS), Industrial Control Center of Excellence, Faculty of Electrical Engineering, K. N. Toosi University of Technology, Tehran, Iran

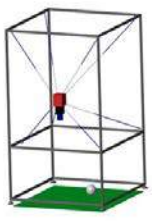
• This paper investigates the problem of robust controller design for a 2RT parallel robot for eye telesurgery.
• The nonlinear model of the robot is encapsulated with a linear model and multiplicative uncertainty using linear fractional transformations (LFT).
• Two different robust control namely, H_∞ and mu-synthesis are used and implemented.
• Simulation results are presented to show that effectiveness of the controllers compared to that of conventional controller designs.

10:50-11:10 | 177 | ThA2.4

Visual Servoing in a Cable Robot Using Microsoft Kinect v2 Sensor

Maryam Sadat Nabipour, Nima Arteghzadeh, S. Ali A. Moosavian, Ali Nasr
Advanced Robotics and Automated Systems (ARAS) Lab., Faculty of Mechanical Engineering, K. N. Toosi University of Technology, Tehran, Iran

• In this paper, a simulator of a parallel cable robot's moving platform follows an object by using the 3D pose of the object provided by the Kinect sensor.
• In this work, two tracking methods by using Kinect sensor are introduced and validated. The 3D tracking method is experimentally implemented to generate the desired path for the parallel cable robot simulator.
• Consequently, it was decided to use the 3D tracking method for applying to the actual parallel cable robot in the future.



Mechatronics II

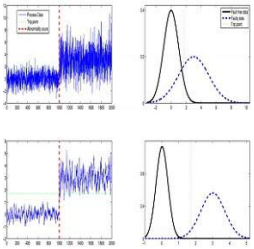
Chairs: Faruk Kececi, Istanbul Technical University
Ariya Alasti, Sharif University of Technology

9:50-10:10 | 108 | ThA3.1

Alarm Management based Fault Diagnosis of V94.2 Gas Turbines by Applying Linear Filters

Hamid Alikhani[1], Mahdi Aliyari Shoorehdeli[1], Mostafa Yari[2]
[1]*FDI Lab. (APAC Group), Faculty of Electrical Engineering, K. N. Toosi University of Technology, Tehran, Iran*
[2]*MAPNA Electric and Control Engineering and Manufacturing Company MECO, Karaj, Iran*

• This paper focuses on linear filtering as a simple and effective method for the fault detection.
• A simple approach is proposed for the calculation of the false and missed alarm rates of the linear filters.
• An analytical method for the linear optimal filter design is proposed
• Finally, the performance of the proposed analytical method is tested by deposition fault detection of the V94.2 gas turbine.

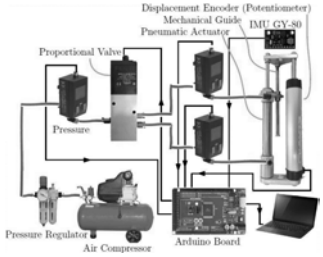


10:10-10:30 | 57 | ThA3.2

An Experimental Study on Friction Identification of a Pneumatic Actuator and Dynamic Modeling of a Proportional Valve

Amir Salimi Lafmejani[1], Mehdi Tale Masouleh[2], Ahmad Kalhor[3]
[1]*Human and Robot Interaction Laboratory (TaarLab), Faculty of New Sciences and Technologies, University of Tehran*
[2]*Human & Robot Interaction Laboratory (TaarLab), School of Electrical and Computer Engineering, University of Tehran*
[3]*Control and Intelligent Processing Center of Excellence, School of Electrical and Computer Engineering, University of Tehran*

• This paper focuses on deriving dynamic model of a pneumatic system.
• Friction force and viscous coefficient in dynamic equation of the actuator and mass flow rate in dynamic equations of electrical proportional valve are unknown parameters.
• Viscous coefficient has been calculated in such a way that pneumatic force is not exerted.
• Validation of the identified model has been revealed.

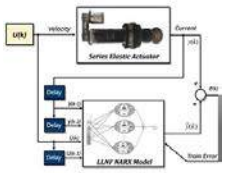


10:30-10:50 | 122 | ThA3.3

Achiving Transparency in Series Elastic Actuator of Sharif Lower Limb Exoskeleton using LLNF-NARX Model

Ahmad Zibafar[1], Sahand Ghaffari[2], Gholamreza Vossoughi[3]
[1,3]*Sharif University of Technology*
[2]*K. N.Toosi University of Technology*

• This paper focuses on providing a method for dynamic modeling and identifying the actuator of Sharif exoskeleton.
• This model is used in the control loop as a feed-forward term to eliminate the actuator's dynamics.
• Obtained experimental results show that the major part of the torque produced in robot is spent on the actuator's dynamics.
• The LLNF-NARX data-based method is used in this study for actuator identification and utilization in control.



Medical Robotics II

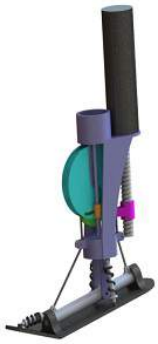
Chairs: Hannes Bleuler, École Polytechnique Fédérale de Lausanne
Moosa Ayati, University of Tehran

9:50-10:10 | 138 | ThA4.1

Design of a Novel Three Degrees of Freedom Ankle Prosthesis Inspired by Human Anatomy

Nafise Faridi Rad[1], Aghil Yousefi-Koma[1], Farzam Tajdari[2], Moosa Ayati[3]
[1] *Center of Advanced Systems and Technologies (CAST), School of Mechanical Engineering, College of Engineering, University of Tehran, Tehran, Iran*
[2] *School of Mechanical Engineering, Amirkabir Univesity of Technology, Tehran, Iran.*
[3] *Advanced Instrumentation Lab, School of Mechanical Engineering, College of Engineering, University of Tehran, Tehran, Iran.*

• In this paper, a powered cable driven ankle-foot prosthesis is presented that overcomes these design challenges.

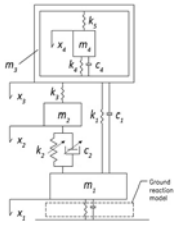


10:10-10:30 | 117 | ThA4.2

An active model for gastrocnemius muscle activity to predict the impact force during running

Peyman Jalali, M-R Sayyed Noorani, Reza Hassannejad, Mir Mohammad Ettefagh
University of Tabriz

• This paper aims at presenting a new active biomechanical model for the musculoskeletal system of the human leg to predict the impact force during running.
• This idea is established on the LNZN model with replacing the passive package of lower soft-tissue in an active Kelvin-Voigt type model of the gastrocnemius muscle.
• Tuning parameters included in the gastrocnemius muscle model are determined using the least square error (LSE) method.
• The results, obtained by numerical simulations, show a good agreement with the data reported in literature.

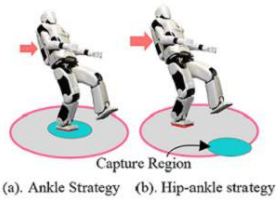


10:30-10:50 | 139 | ThA4.3

Push Recovery of a Humanoid Robot Based on Model Predictive Control and Capture Point

Milad Shafiee-Ashtiani[1], Aghil Yousefi-Koma[1], Masoud Shariat-Panahi[2], Majid Khadiv[3]
[1] *Center of Advanced Systems and Technologies (CAST), School of Mechanical Engineering, College of Engineering, University of Tehran, Tehran, Iran.*
[2] *School of Mechanical Engineering, College of Engineering, University of Tehran, Tehran, Iran.*
[3] *Department of Mechanical Engineering, K. N. Toosi University of Technology, Tehran, Iran.*

• This study presents a push recovery controller for humanoid robots.
• This paper proposes an effective scheme to provide more robust push recovery controller especially in situation that stepping is not possible or contact surface is small.
• Consequently, simulation results demonstrate the merits of the proposed approach.



(a). Ankle Strategy (b). Hip-ankle strategy

10:50-11:10 | 179 | ThA4.4

Conceptual Design of a Social Robot for Pediatric Hospitals

Ali Meghdari[1], Minoo Alemi[1,2], Mobin Khamooshi[1], Ali Amoozandeh[1], Azadeh Shariati[1], Behrad Mozaffari[1]
[1] *Social & Cognitive Robotics Laboratory, Center of Excellence in Design, Robotics and Automation (CEDRA), Sharif University of Technology, Tehran, Iran*
[2] *Islamic Azad University, Tehran-west Branch*

• This work presents the conceptual design features of a social robot for educational-therapeutic interventions for children with cancer in a hospital environment.
• We selected the holonomic Omni drive system since it was more accurate and controllable than other systems.
• A 7-inch monitor is selected for facial expressions, and several faces have been designed for the social robot.
• The design process has been completed and briefly reported in this paper.