Woosong Kang

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Research Interests

Legged Robot Locomotion Locomotion of both bipedal and quadrupedal robots, especially focus on achieving agile and stable movement.

Actuator Passionate about developing various types of actuators, with a particular interest in high-torque variants

Reinforcement Learning Enthusiastic about employing reinforcement learning for the acquisition of locomotion patterns.

Manipulator Control Interested in manipulator position control using both 6-DOF manipulators and redundant manipulators.

Education

Daegu Gyeongbuk Institute of Science and Technology(DGIST) *Daegu, Republic of Korea*

M.S in Robotics Engineering *2019 - 2021*

- Motion Control Lab (MCL), *Prof. Sehoon Oh*
- **Thesis title**: *Development and Control of High Driving-Force Quadruped Robot*
- Focus : Quadruped Robot, Leg Locomotion, Series Elastic Actuator(SEA), Torque Control

Daegu Gyeongbuk Institute of Science and Technology(DGIST) *Daegu, Republic of Korea*

B.S. in Engineering *2015 - 2019*

University of California, Berkeley *Berkeley, CA*

Visiting Student *July. 2016 - Aug. 2016*

Publications

Journal Articles

Iterative Periodic Running Control through Swept Angle Adjustment with Modified SLIP Model
Woosong Kang, Jeil Jeong, Dongil Park, Sehoon Oh
IEEE Robotics and Automation Letters (Accepted). IEEE, Accepted

Conference Proceedings

Development of Rotating Workspace Ground Contact Force Observer for Legged Robot
Woosong Kang, Chan Lee, Sehoon Oh
2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (*IROS*), 2021

Transparent Torque Sensor-less Impedance Rendering for Low-cost Direct Drive Motor
Chan Lee, Sangjin Bae, Woosong Kang, Sehoon Oh
2020 IEEE 16th International Workshop on Advanced Motion Control (*AMC*), 2020

Ripple Minimization for Harmonic-geared Series Elastic Actuator under Force Control
Woosong Kang, Chan Lee, Sangjin Bae, Sehoon Oh
2020 IEEE 16th International Workshop on Advanced Motion Control (*AMC*), 2020

Implementation of Integrated Dual SLIP Dynamics for Sagittal plane motion of Quadruped Robot
Woosong Kang, Chan Lee, Sehoon Oh
International Conference on Control, Automation and Systems (*ICCAS*) (2020) pp. 280–283. 2020

Poster Presentation

Developing a Jumping Algorithm for Overcoming Obstacle in a Wheeled Bipedal Robot
Woosong Kang, Younghun Lee, Jongcheon Park, Chanhoon Park, Dongil Park
The Korean Society of Manufacturing Technology Engineers(*KSMTE*) *Annual Autumn Conference*, 2023

Torque Ripple Estimation, Characterization and Compensation for High Torque BLDC Motor based on Multi-sine Function
Woosong Kang, Chan Lee, Sehoon Oh
19th International Conference on Control, Automation and Systems (*ICCAS*), 2019

Research Experience

Korea Institue of Machinery and Materials(KIMM)

Full-time Researcher(Technical Research Personnel) *2021 - current*

- **Project : Wheeled-Leg Robot Development and Locomtion Control:**
- Designed a robot leg incorporating topology optimization to achieve desired linear trajectory
- Analyzed the jumping conditions of a robot and developed a control algorithm to enable it to jump to desired heights
- Developed a control algorithm enabling a robot to maintain balance and navigate through changing external environments
- Trained a locomotion algorithm using reinforcement learning techniques
- **Technical Skills:** Linear Quadratic Control(LQR), Spring-Loaded Inverted Pendulum(SLIP), ROS-based real-time simulation/experiments, Reinforcement Learning Algorithm, etc.

- **Project : Dual Arm Robot Development and Control :**
- Conducted manufacturing and validation experiments for a novel actuator
- Developed a Dual Arm Robot and implemented robot control to grasp cups and pour water by integrating grippers
- Exhibited at RobotWorld 2022
- **Technical Skills:** Dynamometer test, Inverse Kinematics Control, ROS-based real-time experiments, MATLAB simulation, etc.

Daegu Gyeongbuk Institue of Science and Technology(DGIST)

Graduate Student Researcher(Advisor : Sehoon Oh) *2021*

- **Project : Quadrupedal Robot high-speed running locomotion algorithm :**
- Developed hopping and gait pattern generation algorithms for a quadruped robot
- Proposed new control algorithms for achieving high-speed running with estimated ground reaction forces
- **Technical Skills:** Sensorless Force Estimation Algorithm, LabVIEW based real-time experiments, MATLAB Simscape simulation , etc.

Daegu Gyeongbuk Institue of Science and Technology(DGIST)

Research Assistant *2019 - 2020*

- **Project :Development of High-Speed Running Multi-Legged Robot Using Back-Driveable Actuator System :**
- Designed a quadruped robot platform with a waist actuator
- Proposed a novel running control algorithm for robot legs based on the SLIP model
- Enhanced force control performance algorithm for Series Elastic Actuators
- **Technical Skills:** Spring-Loaded Inverted Pendulum(SLIP) algorithm, Solidworks , LabVIEW based real-time experiments, MATLAB Simscape simulation , etc.

- **Project :Developing a variable exercise machine with the Tension Control Module :**
- Designed an affordable high torque actuator module enabling force control to adapt to dynamic load changes during exercise
- Developed a control algorithm capable of adjusting load in response to user intent
- **Technical Skills:** High-Torque Actuator Development, Force Control Algorithm, etc.

- **Project : Development of interworking modular exo-suit technology for strength support :**
- Devised an auxiliary force control algorithm for enhancing the precision strength of SEA integrated into exosuits
- **Technical Skills:** Impedance Control, Harmonic Drive Ripple Compensation , Cogging Torque Compensation, etc.

Undergraduated Group Research Program(UGRP) *DGIST*

Junior Student *Mar. 2017 - Dec. 2017*

- **Project : Probabilistic Inference of Emotion in Text by Using Deep Learning Technology**
- Developed a deep learning algorithm for emotion analysis based on a seven-step emotion classification
- **Technical Skills:** Recurrent Neural Network(RNN) , Caffe Framework, etc.

Undergraduated Group Research Program(UGRP) *DGIST*

Senior Student *Mar. 2018 - Dec. 2018*

- **Project : Beginning and Significance of Scientific Skepticism**
- Analyzed case studies of pseudoscience and proposed methodologies for distinguishing pseudoscience
- **Technical Skills:** Writing Skill

Honors & Awards

Full Scholarship *DGIST*

Received national scholarship includes full tuition and stipend. *Mar. 2015 - Feb. 2019*

DGIST Best Research Award *DGIST*

Won Best Topic Research Award in Undergraduate Group Research Program (received 10 teams among 58 prgrams) *2017*

Internship

Company-University Cooperation Program(CUOP)

WINITECH *July. 2017 - Aug. 2017*

- To devise a solution for swiftly assessing situations during disasters, incorporating active monitoring and response mechanisms

Daegu Gyeongbuk Institue of Science and Technology(DGIST)

Communication & Signal Processing Lab *Jan. 2016 - Feb. 2016*

- advisor : Ji-Woong Choi
- Researching brainwave activity measurement through the use of the fNIRS device attached to the brain
- Conducting research to assess brain activity in response to various sounds and analyze associated emotions to identify emotion-specific brain activations

Teaching & Mentoring Experience

Teaching Assistant, Introduction to Control Engineering *DGIST*

Mar.2020 - Aug. 2020

Mentor, DGIST Graduate Job Fair *DGIST*

Oct.2022

Mentor, Mathematics *Hwanseo Middle School*

July.2015

Extracurricular Activities

Student Council *DGIST*

As the Director of External Cooperation in the Student Council, overseeing external programs and facilitating agreements with external vendors *Mar. 2017 - Dec. 2017*

Club Activitity *DGIST*

Organized new busking club and performed as a singer *Mar. 2015 - Feb. 2019*

Voluntary Mentor *DGIST*

Organized and participated in a reading mentoring program for middle school students *2015*

Skills

Programming	Python, C/C++, ROS, Matlab, LabVIEW
Simulator	Matlab/Simulink,Simscape, Nvidia Issac Gym, Gazebo, Raisim
Miscellaneous	Linux, Git, Solid Works