University of Bridgeport

School of Engineering,
Department of Computer Science and Engineering

Review of the thesis titled "Synthesis of Leg Mechanism and Optimal Design of Walking Robot" by the PhD candidate of the Department of Mechanics, Faculty of Mechanical Mathematics, Al-Farabi Kazakh National University, Arman Ibrayeva Sayatqyzy

Recent military technology trends show a rising interest in walking mobility as an alternative to wheeled and tracked robots. Walking robots (WR) offer enhanced maneuverability by effortlessly stepping over obstacles and experiencing minimal resistance from the terrain, reducing the risk of getting stuck. They also exert lower ground pressure compared to tracked or wheeled vehicles. The growing appeal of walking robots extends to agricultural applications due to their minimal surface damage. Their discrete track minimizes soil erosion and virtually eliminates gully formation, highlighting their environmentally friendly nature. The objective of this study is to devise synthesis techniques for a leg mechanism and optimize the parameters of the WR using the functional decomposition method. This approach aims to streamline the control system and enable efficient movement across rugged terrain while minimizing energy consumption.

The research conducted by Arman represents a significant advancement in the field of adaptive walking robots. Departing from conventional insectomorphic designs, the study focuses on optimizing operational characteristics in mechanics and control. Through meticulous synthesis of support and locomotion mechanisms, coupled with the functional separation of structural modules and their corresponding motors, the investigation has led to streamlined control systems and minimized energy consumption, particularly notable during movement across uneven terrain.

The developed synthesis methods have facilitated the determination of optimal structural-metric parameters for the Support-Locomotion System (SLM) by decomposing the robot's movement and functionally separating the motors. This approach not only simplifies leg coordination, resulting in movement with minimal motor usage and reduced energy consumption, but also addresses critical challenges such as individual leg adaptation to support surface irregularities and the elimination of redundant connections and parasitic loads on motors due to multiple static indeterminacies. Furthermore, the study has successfully mitigated additional energy consumption associated with leg slippage and reduced reactions in leg joints during turns.

The research findings lead to the manufacturing of prototypes and the development of an experimental laboratory model of adaptive walking robots, underscoring the practical implications of the study. Through the demonstration of the full functionality of the design and the validation of the main hypotheses, Arman's work represents a significant contribution to the advancement of adaptive walking robots, with implications for various fields requiring mobility over challenging terrains.

Sarosh Patel, Ph.D.
Assistant Professor
Computer Science & Engineering.

Director, Interdisciplinary RISC Laboratory

School of Engineering,
University of Bridgeport, CT, USA 06604