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Guest Editorial

Special Issue on Rehabilitation Robots, Devices, and Methodologies

Most of the developed countries are encountering an aging society, which brings an increasing morbidity of neuromuscular disabilities and diseases, such as stroke, Alzheimer, etc. Rehabilitation has proven to be an effective therapy, and this calls for the development of assisting devices and methodologies for limb/body and cognitive rehabilitation. In the recent decades, the kinematic/dynamic analysis and control of rehabilitation robots and design of rehabilitation methodologies have engaged researchers in mechanical and biomedical engineering to help propose novel engineering solutions to such problems.

This Special Issue of the *ASME Journal of Engineering and Science in Medical Diagnostics and Therapy* highlights original research and high-quality technical briefs on rehabilitation robots, devices, and methodologies, with a special focus on dynamics, control, kinematics, and sensing/actuation. Recent research achievements in theoretical, experimental, or computational aspect of rehabilitation robotics, devices, and methods as well as practical applications are presented in this issue.

As one of the most popular study in rehabilitation research and application, advances in limb rehabilitation devices, and robots are reflected in five papers of this special issue. Ghosh, McCarthy, and Robson introduced a 6-bar knee angle foot orthosis design that involves the systematic model design and preliminary kinematic evaluation. Loya, Deshpande, and Purwar presented a machine learning-based approach for conditional synthesis of single-degree-of-freedom linkage mechanisms for gait rehabilitation based on different individuals. Yihun, Adhikari, Majidirad, et al. designed and implemented a novel task-based knee rehabilitation strategy through kinematic synthesis, assist-as-needed control strategy, and recovery tracking system. To realize an active rehabilitation method based on the pneumatic control system, Li, Xu, Zhang, et al. developed a pneumatic upper limb rehabilitation robot. Lastly, Kamel, Harraz, Azab, et al. presented the results of an investigative study on the development of an affordable and functional prosthetic foot for below knee amputees.

In the area of medical and wearable technologies, four papers have contributed to this special issue to explore the fundamental topics of surgical robots and wearable devices. Wang, Cao, and Yu presented a closed-form solution of inverse kinematics method for a minimally invasive surgical robot slave manipulator similar to da Vinci robot system. Aiming at improving the performance of positioning of surgical robot, Jing, Jin, Shi, et al. aimed to optimize the size of the device based on multipopulation genetic algorithm. Baca and Martinez showed a monitoring human body joint rotations based on wearable magnetic strap modules and the Jacobian Matrix of magnetic fields, while Kokkoni, Liu, and Karydis presented a soft wearable robot to assist infant reaching using pneumatic actuators.

Studies and developments in rehabilitation wheelchairs continue to thrive along with the trend of data-driven and intelligent design. Two papers in this issue explore the advances in this topic. Xu, Lv, Zhu, et al. proposed a user-driven design framework to design a customized wheelchair for disabled. Nandikolla and Van Leeuwen presented the groundwork of a hybrid BCI controller for a smart wheelchair and identifies that there are areas of improvement in the design.

This Special Issue also features four papers on cognitive rehabilitation as well as rehabilitation design methodologies. Chen, Dong, et al. described a motion tracking method suitable for designing the rehabilitation robot with few degree-of-freedom. By capturing the relationship between the force interaction and the sEMG, Yihun, MajidiRad and Cure analyzed the interaction between the robot and the user's upper arm muscles. Baca, Martinez, and King introduced a novel framework that combines Bayesian Statistics for motor control with a Probabilistic Graphical Model to estimate sensorimotor problems. To assist patients with mild cognitive impairment in block design test rehabilitation training, Chen, Zhu, Teng, et al. developed a robotic cognitive rehabilitation therapy system.

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