International Journal of Computer Science and Engineering (IJCSE)
ISSN (P): 2278–9960; ISSN (E): 2278–9979
Vol. 11, Issue 2, Jul–Dec 2022; 147–178

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

MACHINE LEARNING FOR MUSCLE DYNAMICS IN SPINAL CORD REHAB

Nishit Agarwal[1], Sowmith Daram[2], Aditya Mehra[3], Om Goel[4] & Shalu Jain[5]

[1]Independent Researcher, Rikab Gunj, Hyderabad, Telangana, India

[2]Independent Researcher, Nakrekal, Nalgonda, Telangana, India

[3]Independent Researcher, Haldwani, Nainital, Uttarakhand, India

[4]Independent Researcher, Abes Engineering College, Ghaziabad, India

[5]Reserach Scholar, Maharaja Agrasen Himalayan Garhwal University, Pauri Garhwal, Uttarakhand, India

ABSTRACT

Spinal cord injuries (SCI) often result in significant loss of motor function, necessitating specialized rehabilitation to restore muscle strength, coordination, and control. Recent advancements in machine learning (ML) offer new avenues for enhancing the effectiveness of spinal cord rehabilitation, particularly by improving the analysis and understanding of muscle dynamics. This paper reviews the current applications of ML in spinal cord rehabilitation, focusing on the integration of wearable biosensors, predictive modeling, and functional electrical stimulation (FES) systems. Wearable devices, in combination with machine learning algorithms, provide real-time monitoring of muscle activity, enabling personalized rehabilitation plans that adjust dynamically to a patient's progress. Predictive models have shown great promise in forecasting recovery trajectories, allowing for more tailored therapy strategies that optimize patient outcomes. Machine learning also improves the performance of FES systems by automatically adjusting stimulation levels, thereby enhancing muscle engagement without causing fatigue. However, challenges related to data variability and the need for large, high-quality datasets limit the generalizability of some ML models. Despite these obstacles, the potential for machine learning to revolutionize spinal cord rehabilitation is evident, with emerging technologies continuing to refine predictive accuracy and real-time adaptability. This paper explores these advancements, highlighting the transformative role of ML in personalizing and optimizing rehabilitation protocols, thus improving recovery outcomes for patients with spinal cord injuries.

Despite the significant potential of ML, there are challenges in applying it to spinal cord rehabilitation. One major challenge is data variability—differences in patient conditions, sensor placement, and data quality can affect the accuracy of ML models. Additionally, machine learning models often require large, high-quality datasets for training. Acquiring such datasets in the context of spinal cord rehabilitation is difficult due to the diversity of injury types and patient responses. These challenges limit the generalizability of ML models, making it difficult to develop solutions that work universally across different patient populations.

***KEYWORDS**: Spinal Cord Injury, Machine Learning, Muscle Dynamics, Rehabilitation, Wearable Biosensors, Predictive Modeling, Functional Electrical Stimulation, Personalized Therapy, Real-Time Monitoring, Recovery Optimization*

Article History

Received: 10 Sep 2022 | Revised: 16 Sep 2022 | Accepted: 28 Sep 2022