



Browse

My Settings

Help

Institutional Sign In

Institutional Sign In

All



ADVANCED SEARCH

Journals & Magazines > IEEE Transactions on Human-Ma... > Volume: 53 Issue: 6

# PC-GNN: Pearson Correlation-Based Graph Neural Network for Recognition of Human Lower Limb Activity Using sEMG Signal

Publisher: IEEE

Cite This

PDF

Ankit Vijayvargiya ; Rajesh Kumar ; Parul Sharma

All Authors



5 Cites in Papers

707 Full Text Views

## Alerts

Manage Content Alerts  
Add to Citation Alerts

### Abstract

#### Document Sections

- I. Introduction
- II. Dataset
- III. Proposed Methodology
- IV. Experimentation
- V. Conclusion

### Authors

- Figures
- References
- Citations
- Keywords
- Metrics
- More Like This



Downl  
PDF

#### Abstract:

Artificial intelligence has a plethora of applications in the realm of biomedical sciences, such as pattern recognition, diagnosis of disease, human-machine interaction, ... **View more**

#### Metadata

##### Abstract:

Artificial intelligence has a plethora of applications in the realm of biomedical sciences, such as pattern recognition, diagnosis of disease, human-machine interaction, medical image processing, robotic limbs, or exoskeletons. Robotic limbs, or exoskeletons, are widely employed to assist with lower limb movement. To increase the exoskeleton's flexibility in the lower extremities, it is critical to recognize the diverse motion intents of the lower limbs of the human body. In this investigation, sEMG signals from lower limb muscles are used for a computer-aided recognition system to correctly identify the lower limb activities because these signals can identify movement ahead of time and enable faster detection of signal fluctuation than other wearable sensors. Several types of noise are introduced into the signal during collection. A multistage classification strategy is proposed to overcome the processing challenges associated with these sEMG signals. Initially, nine time-domain handcrafted features are retrieved using a hybrid of wavelet denoising and ensemble empirical mode decomposition approach with a sliding window of 256 ms and a 25% overlap. Next, a Pearson correlation-based graph neural network (PC-GNN) not only captures the temporal dependencies between the sEMG signals, but also captures the spatial dependencies. The combination of a Pearson correlation-based graph neural network (PC-GNN) and a graph neural network (GNN) not only captures the temporal dependencies between the sEMG signals, but also captures the spatial dependencies. The observation states for the walking, sitting, knee abnormalities, res

Published in: IEEE Tr

Page(s): 945 - 954

Date of Publication: 1

## Access to this document requires a subscription.

IEEE offers both personal and institutional subscriptions. Whether you are an academic, a practitioner, or a student, IEEE offers a range of individual and institutional subscription options that can meet your needs.

LEARN MORE

Close



---

 ▼ ISSN Information:
 

---



Ankit Vijayvargiya  
 Department of Electrical Engineering, Swami Keshvanand Institute of  
 Technology, Management and Gramothan, Jaipur, India

Ankit Vijayvargiya (Senior Member, IEEE) received the B.Tech. (Hons.) degree in electrical engineering from Rajasthan Technical University, Kota, India, in 2010, the M.Tech. degree in instrumentation from Devi Ahilya University, Indore, India, in 2014, and the Ph.D. degree in electrical engineering from the Malaviya National Institute of Technology, Jaipur, India.

He is an Associate Professor with the Department of Electri... [Show More](#)

Ankit Vijayvargiya (Senior Member, IEEE) received the B.Tech. (Hons.) degree in electrical engineering from Rajasthan Technical University, Kota, India, in 2010, the M.Tech. degree in instrumentation from Devi Ahilya University, Indore, India, in 2014, and the Ph.D. degree in electrical engineering from the Malaviya National Institute of Technology, Jaipur, India.

He is an Associate Professor with the Department of Electri... [View more](#)

---



Rajesh Kumar  
 Department of Electrical Engineering, Malaviya National Institute of  
 Technology, Jaipur, India

Rajesh Kumar (Senior Member, IEEE) received the B.Tech. (Hons.) degree in electrical engineering from the National Institute of Technology, Kurukshetra, India, in 1994, the M.E. (Hons.) degree in power systems from the Malaviya National Institute of Technology (MNIT) Jaipur, Jaipur, India, in 1997, and the Ph.D. degree in intelligent systems from the University of Rajasthan, Jaipur, in 2005.

Since 1995, he has been a Facul... [Show More](#)

Rajesh Kumar (Senior Member, IEEE) received the B.Tech. (Hons.) degree in electrical engineering from the National Institute of Technology, Kurukshetra, India, in 1994, the M.E. (Hons.) degree in power systems from the Malaviya National Institute of Technology (MNIT) Jaipur, Jaipur, India, in 1997, and the Ph.D. degree in intelligent systems from the University of Rajasthan, Jaipur, in 2005.

Since 1995, he has been a Facul... [View more](#)

---



Parul Sharma  
 Department of Electrical Engineering, Malaviya National Institute of  
 Technology, Jaipur, India

Parul Sharma received the B.E. degree in electrical and electronics engineering from Mugneeram Bangur Memorial Engineering College, Jodhpur, India, in 2018, and the M.Tech. degree in power electronics and drives engineering from the Malaviya National Institute of Technology, Jaipur, India.

She is currently a Product Design Engineer with Mercedes-Benz. Her research interests include power electronics and machine learning ap... [Show More](#)

Parul Sharma received the B.E. degree in electrical and electronics engineering from Mugneeram Bangur Memorial Engineering College, Jodhpur, India, in 2018, and the M.Tech. degree in power electronics and drives engineering from the Malaviya National Institute of Technology, Jaipur, India.

She is currently a Product Design Engineer with Mercedes-Benz. Her research interests include power electronics and machine learning ap... [View more](#)

---

## I. Introduction

The research on monitoring human activities using sensor devices has been attention-grabbing for the past decade. Human activities recognition (HAR) uses sensors to monitor data that has been learned and performed in the relevant context to detect a person's activity. There are several uses for HAR in various fields, including teleimmersion, healthcare monitoring, and smart homes with aided surveillance [1]. Usually, the HAR procedure is attainable by employing various steps, from working on the recorded data, utilizing various sensors, to finally classifying the activity to be performed. An HAR system using various sensory devices can track the lower limb activities of humans. To identify human posture, physical activity state, and behavioral activities, HAR technology often uses multiple multimodal data originating from numerous hardware sensors. Currently, HAR research can be broadly categorized into several situations supported by various technologies, including video, wearable, mobile phone sensors, social networks, and wireless signal [2], [3], [4].

## Authors



Ankit Vijayvargiya  
Department of Electrical Engineering, Swami Keshvanand Institute of Technology, Management and Gramothan, Jaipur, India

Ankit Vijayvargiya (Senior Member, IEEE) received the B.Tech. (Hons.) degree in electrical engineering from Rajasthan Technical University, Kota, India, in 2010, the M.Tech. degree in instrumentation from Devi Ahilya University, Indore, India, in 2014, and the Ph.D. degree in electrical engineering from the Malaviya National Institute of Technology, Jaipur, India.

He is an Associate Professor with the Department of Electrical Engineering, Swami Keshvanand Institute of Technology, Management and Gramothan, Jaipur, India. His research interests include biomedical signal processing, pattern recognition, and machine learning.

Ankit Vijayvargiya (Senior Member, IEEE) received the B.Tech. (Hons.) degree in electrical engineering from Rajasthan Technical University, Kota, India, in 2010, the M.Tech. degree in instrumentation from Devi Ahilya University, Indore, India, in 2014, and the Ph.D. degree in electrical engineering from the Malaviya National Institute of Technology, Jaipur, India.

He is an Associate Professor with the Department of Electrical Engineering, Swami Keshvanand Institute of Technology, Management and Gramothan, Jaipur, India. His research interests include biomedical signal processing, pattern recognition, and machine learning. **View more**



Rajesh Kumar  
Department of Electrical Engineering, Malaviya National Institute of Technology, Jaipur, India

Rajesh Kumar (Senior Member, IEEE) received the B.Tech. (Hons.) degree in electrical engineering from the National Institute of Technology, Kurukshetra, India, in 1994, the M.E. (Hons.) degree in power systems from the Malaviya National Institute of Technology (MNIT) Jaipur, Jaipur, India, in 1997, and the Ph.D. degree in intelligent systems from the University of Rajasthan, Jaipur, in 2005.

Since 1995, he has been a Faculty Member of the Department of Electrical Engineering, MNIT Jaipur, where he is currently a Professor. From 2009 to 2011, he was a Postdoctoral Research Fellow with the Department of Electrical and Computer Engineering, National University of Singapore, Singapore. His research interests include the theory and practice of intelligent systems, computational intelligence and analytics, electric transportation, smart grid, and robotics.

Rajesh Kumar (Senior Member, IEEE) received the B.Tech. (Hons.) degree in electrical engineering from the National Institute of Technology, Kurukshetra, India, in 1994, the M.E. (Hons.) degree in power systems from the

Malaviya National Institute of Technology (MNIT) Jaipur, Jaipur, India, in 1997, and the Ph.D. degree in intelligent systems from the University of Rajasthan, Jaipur, in 2005.

Since 1995, he has been a Faculty Member of the Department of Electrical Engineering, MNIT Jaipur, where he is currently a Professor. From 2009 to 2011, he was a Postdoctoral Research Fellow with the Department of Electrical and Computer Engineering, National University of Singapore, Singapore. His research interests include the theory and practice of intelligent systems, computational intelligence and analytics, electric transportation, smart grid, and robotics. **View more**



Parul Sharma  
Department of Electrical Engineering, Malaviya National Institute of  
Technology, Jaipur, India

Parul Sharma received the B.E. degree in electrical and electronics engineering from Mugneeram Bangur Memorial Engineering College, Jodhpur, India, in 2018, and the M.Tech. degree in power electronics and drives engineering from the Malaviya National Institute of Technology, Jaipur, India.

She is currently a Product Design Engineer with Mercedes-Benz. Her research interests include power electronics and machine learning applications.

Parul Sharma received the B.E. degree in electrical and electronics engineering from Mugneeram Bangur Memorial Engineering College, Jodhpur, India, in 2018, and the M.Tech. degree in power electronics and drives engineering from the Malaviya National Institute of Technology, Jaipur, India.

She is currently a Product Design Engineer with Mercedes-Benz. Her research interests include power electronics and machine learning applications. **View more**

Figures	▼
References	▼
Citations	▼
Keywords	▼
Metrics	▼

#### More Like This

MhaGNN: A Novel Framework for Wearable Sensor-Based Human Activity Recognition Combining Multi-Head Attention and Graph Neural Networks  
IEEE Transactions on Instrumentation and Measurement  
Published: 2023

Multi-STMT: Multi-Level Network for Human Activity Recognition Based on Wearable Sensors  
IEEE Transactions on Instrumentation and Measurement

Published: 2024

Show More

**IEEE Personal Account**

CHANGE USERNAME/PASSWORD

**Purchase Details**

PAYMENT OPTIONS  
VIEW PURCHASED DOCUMENTS

**Profile Information**


COMMUNICATIONS PREFERENCES  
PROFESSION AND EDUCATION  
TECHNICAL INTERESTS

**Need Help?**

US & CANADA: +1 800 678 4333  
WORLDWIDE: +1 732 981 0060  
CONTACT & SUPPORT

**Follow**

f @ in v

About IEEE *Xplore* | Contact Us | Help | Accessibility | Terms of Use | Nondiscrimination Policy | IEEE Ethics Reporting  | Sitemap | IEEE Privacy Policy

A public charity, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved, including rights for text and data mining and training of artificial intelligence and similar technologies.

**IEEE Account**

- » Change Username/Password
- » Update Address

**Purchase Details**

- » Payment Options
- » Order History
- » View Purchased Documents

**Profile Information**

- » Communications Preferences
- » Profession and Education
- » Technical Interests

**Need Help?**

» **US & Canada:** +1 800 678 4333

» **Worldwide:** +1 732 981 0060

» **Contact & Support**

[About IEEE Xplore](#) | [Contact Us](#) | [Help](#) | [Accessibility](#) | [Terms of Use](#) | [Nondiscrimination Policy](#) | [Sitemap](#) | [Privacy & Opting Out of Cookies](#)

A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

© Copyright 2024 IEEE - All rights reserved. Use of this web site signifies your agreement to the terms and conditions.