

Dr. ASHUTOSH TIWARI

Ph. No: (+1)7086210581/ (+91)7999519166

Email ID: ashutoshtiwari666@gmail.com/atiwari8@uic.edu

Webpage: <https://ashutoshtiwari666.github.io/>

Current appointment: Postdoctoral fellow, University of Illinois (UIC) at Chicago, USA

Broad Area of Specialization

Biomedical Instrumentation; Biomedical Signal Processing; Human Movement Biomechanics; Assistive Wearable Technologies, Prosthesis, and orthosis

Current Area of Research

Gait analysis and lower limb rehabilitation

- Development of wearable sensing devices for human movement assessment
 - Development of assistive technology (Active/passive prosthesis, orthosis, biofeedback systems) for gait training and rehabilitation in clinical populations
 - Data-driven human-in-loop optimization
-

Education

- **PhD., Biomedical Engineering** [Dec. 2021]
Indian Institute of Technology (IIT) Delhi, New Delhi, India
(Jointly with AIIMS New Delhi)
Thesis title: Development of Center of pressure-Based visual feedback system for improved minimum toe clearance (mTC): Validation in transfemoral amputees.
Supervisor: Prof. Deepak Joshi
Coursework CPI (/10): 9.0
 - **M.Tech., Biomedical Engineering** [Aug. 2015]
Indian Institute of Technology (IIT) Bombay, Mumbai, India
Supervisor: Prof. Soumyo Mukherji
CPI (/10): 9.12
 - **B.Tech., Biomedical Engineering (With minors in Instrumentation Engg.)** [Aug. 2013]
Vellore Institute of Technology (VIT University), Vellore, India
CPI (/10): 8.14
 - **Higher secondary school (12th), Math's background** [Aug. 2008]
Madhya Pradesh Board of Secondary Education
Percentage (/100): 74.20
 - **High school (10th), Science, Math, English** [Aug. 2006]
Central Board of Secondary Education
Percentage (/100): 72.40
-

Post PhD Research Experience

- **Postdoctoral Research Associate** [Feb. 2023-Present]
Rehabilitation Robotics Laboratory (RRL)
Supervisor: Prof. Myunghee Kim
University of Illinois Chicago, IL, USA
Responsibilities: Human-in-loop optimization of the ankle-foot prosthesis using the Bayesian cost function minimization of stump socket interaction pressure for enhanced performance
- **Research Associate** [Dec. 2021-Jan. 2023]
Neuromechanics Research Laboratory (NRL)
Supervisor: Prof. Deepak Joshi
Indian Institute of Technology Delhi, New Delhi, India
Responsibility: Development of wearable instrumentation for gait analysis in Parkinson's and Cerebral Ataxia patients

Industry Experience

- **Internship Trainee**

Bhagwan Mahavir Vikalang Sahayata Samiti (BMVSS), Jaipur Foot, Jaipur, India

Hands on experience in the design and development of the lower limb passive prosthetic limb and assistive devices for human locomotion

Teaching experience

- Teaching assistant for the course on “Biosensor (BS601)” for M. Tech students in the department of Biosciences and Biomedical Engineering at IIT Bombay
 - Teaching assistant for the course on “Biomedical Instrumentation (BML740)” for B. Tech and M. Tech students in the Centre for Biomedical Engineering at IIT Delhi
 - Teaching assistant for the course on “Research Techniques in Biomedical Engineering (BML800)” for B. Tech and M. Tech students in the Centre for Biomedical Engineering at IIT Delhi
Responsibilities: Prepare materials, deliver tutorials in person and conduct semester exams
 - M. Tech Laboratory instructor for the “Biomedical Instrumentation Lab (BMP743)” for five consecutive semesters of PhD at IIT Delhi
Responsibilities: Design experiments and conduct lab session/exams
-

Administrative Experience

- Actively coordinated 03 days MHRD-GIAN course sponsored by the Govt. of India titled ‘Prosthetic and Motor Learning’ during 5th -7th Dec 2017 at IIT Delhi
Responsibility: Organization of the expert talks/lectures/demos and logistics
 - Organized international hybrid workshop on “Human-Device Symbiosis: State of the Art and Future Directions” during 18th international Intelligent Autonomous Systems conference 2023 at Seoul, South Korea
Responsibility: Development of the workshop website for outreach and registration, organization of the expert talks/lectures/demos and logistics
 - Organized Open House (Popular event to showcase innovations) 2017 in Centre for Biomedical Engineering at IIT Delhi
 - Guest Lecture on “Lower limb prosthetic control strategies” at the University of Illinois at Chicago, USA.
 - Reviewer for *IOP Journal of Neural Engineering*
 - Reviewer for *IOP Measurement science and technology*
 - Reviewer for *IEEE Transaction in Medical Robotics and Bionics, IEEE sensors letters*
-

Invited talks, Seminars and Exhibitions

- Invited expert talk on “Wearable assistive tools for gait rehabilitation in patients with movement disability” at IAS workshop 2023 at Seoul, South Korea.
 - Invited seminar Talk on the “Wearable sensing technologies for gait application” at IIT Delhi, Sonipat campus.
 - Invited hands on live demonstration of the EEG (from Brain products, USA) and EMG (Delsys, USA) device on the patients during IEEE international conferences at NIT Trichy 4 oct 2019
 - Demonstration of the instrumented shoe for gait analysis at the exhibition organized by ministry of Govt. of India at Pragati maidan, New Delhi
 - Show cased our innovations Instrumented shoe and pressure insole during ‘AIIMS research day 2022’ at AIIMS Delhi
-

Peer-reviewed Journals (Journal papers: (I.F. = Impact Factor)) [Google scholar](#)

Published

1. Rohan Khatavkar, *Ashutosh Tiwari*, Priyanka Bhat and D. Joshi, " A Novel Kinematic Gait Parameter-Based Vibrotactile Cue for Freezing of Gait Mitigation Among Parkinson's Patients: A Pilot Study," in ***IEEE Transactions on Haptics*** [I.F. = 2.9] – Accepted (In press).
2. *Ashutosh Tiwari* and D. Joshi, "An Infrared Sensor-Based Instrumented Shoe for Gait Events Detection on Different Terrains and Transitions," in ***IEEE Sensors Journal***, vol. 20, no. 18, pp. 10779-10791, 15 Sept. 2020. [I.F. = 4.3] [Link](#)
3. *Ashutosh Tiwari* and D. Joshi, "Template-Based Insoles for the Center of Pressure Estimation in Different Foot Sizes," in ***IEEE Sensors Letters***, vol. 4, no. 8, pp. 1-4, Aug. 2020. [I.F. = 2.8] [Link](#)

4. Ashutosh Tiwari and D. Joshi, "Design and Validation of a Real-Time Visual Feedback System to Improve Minimum Toe Clearance (mTC) in Transfemoral Amputees," in **IEEE Transactions on Neural Systems and Rehabilitation Engineering**, vol. 29, pp. 1711-1722, 2021. [I.F. = 4.9] [Link](#)
5. R. Bajpai, Ashutosh Tiwari, A. Jain and D. Joshi, "A Novel Instrumented Outsole for Real-Time Foot Kinematic Measurements: Validation Across Different Speeds and Simulated Foot Landing," in **IEEE Transactions on Instrumentation and Measurement**, vol. 71, pp. 1-10, 2022. [I.F. = 5.6] [Link](#)
6. D. Mehra, Ashutosh Tiwari, and D. Joshi, 2021, "Investigating neural correlates of locomotion transition via temporal relation of EEG and EOG-recorded eye movements", **Elsevier, Computers in Biology and Medicine**, p.104350, 2021. [I.F. = 7.7] [Link](#)
7. Ashutosh Tiwari, A. Pai, and D. Joshi, "A shoe-mounted infrared sensor-based instrumentation for locomotion identification using machine learning methods". **Elsevier, Measurement**, p.108458, Jan. 2020. [I.F. = 5.6] [Link](#)
8. R. Sharma, D. Singh, Ashutosh Tiwari and D. Joshi, "User-feedback based robust and simplified damping control for affordable transfemoral prosthesis," **IET Electronics Letters**, vol. 56, no. 8, pp. 366-367, 16 4 2020. [I.F. = 1.1] [Link](#)
9. Ashutosh Tiwari, Deepak Joshi, "Investigating the effect of real-time center of pressure (CoP) feedback training on the swing phase of lower limb kinematics in transfemoral prostheses with SACH foot" in **ASME Journal of Biomechanical Engineering**, Dec. 2021. [I.F. = 1.7] [Link](#)

Under revision/review (preprints-TechRxiv)

10. Ashutosh Tiwari, and Deepak Joshi (2022): Wearable Haptic Feedback System for Training Propulsion Force in Individuals with Solid Ankle Foot Orthosis: Development and Validation. TechRxiv. Preprint. (Under revision in **IEEE Sensors Journal**). [Link](#)
11. Rohan Khatavkar, Ashutosh Tiwari and Deepak Joshi (2022), "Effect of spatial gait parameter-based cueing on toe clearance in a patient with Parkinson's disease" (Under revision in **Annals of Biomedical Engineering**) [Link](#)
12. Atharva Deshpande, Ashutosh Tiwari, James L. Patton, Adith Srivastava, Myunghee Kim, "Customizing a passive hip exosuit for efficient walking" (Under review in Science Robotics)

Manuscript under preparation

13. Ashutosh Tiwari et al. "Investigation the effect of the varying plantarflexion stiffness of ankle foot orthosis on the lower limb kinetic and kinematic changes: A pilot study on the Able-bodied individuals"
14. Ashutosh Tiwari et al. "Steady state and transition step length intent prediction using force myography for lower limb prosthetic application."
15. Ashutosh Tiwari et a. "Understanding the mechanics of the propulsion force generation and dynamic stability in the idiopathic toe walking children via mathematical modelling approach".

Peer reviewed conference proceedings

1. Ashutosh Tiwari, S. Saxena and D. Joshi, "Instrumented shoe-based foot clearance and foot-to-ground angle measurement system for the gait analysis," 2019 **28th IEEE International Conference on Robot and Human Interactive Communication (RO-MAN)**, New Delhi, India, 2019, pp. 1-6. [Link](#)
2. Rishabh Bajpai, Ashutosh Tiwari, Deepak Joshi, "AbnormNet: A Neural Network Based Suggestive Tool for Identifying Gait Abnormalities in Cerebral Palsy Children," **IEEE International conference on Advancement in Technology**, Goa, 2022. [Link](#)
3. Ashutosh Tiwari, Rishabh Bajpai, Deepak Joshi, "Exploring the center of pressure shift feedback at heel strike to modulate the step length," **IEEE International conference on Advancement in Technology (ICONAT)**, Goa, 2022. [Link](#)
4. Rohan Khatavkar, Ashutosh Tiwari, Deepak Joshi, "Gait Step Length Classification Using Force Myography," **IEEE International conference on Advancement in Technology**, Goa, 2022. [Link](#)
5. Ashutosh Tiwari, Rishabh Srivastava, Kush Arora, Bhaskar Mohan Morari "Low-Cost Augmentative Technology to Assist People with Communicative Disorder," **International conference on Applied Mechanics 2013 (INCAM)** held at IIT Madras, Tamil Nadu, India.
6. Hyeognkeun Jeong, Ashutosh Tiwari, Myunghee Kim, "EMG Based Optimization for Squat Assistance with Ankle-Foot Exoskeleton" **American Society of Biomechanics 2023 Annual Meeting**, Knoxville, USA
7. Daehyun Kim, Sangeun Lee, Ashutosh Tiwari, Minsam Ko, Myunghee Kim, "The effect of visual guidance on the squat posture", **18th International Conference on Intelligent Autonomous Systems (IAS 2023)**, Seoul, South Korea.

8. Ashutosh Tiwari, James Patton, Myunghee,” Gait Adaptation in Resistance Training for Gait Asymmetry using Passive Hip Exosuit”, **second Progress in Clinical Motor Control: Movement and Rehabilitation Sciences (PCMC II) 2023**, Chicago, IL, USA
 9. Mounika Pasavula, Inigo Sanz-Pena, Atharva Deshpande, Ashutosh Tiwari, Julius P.A. Dewald, M. Hongchul Sohn, Myunghee Kim,” Impact of abnormal hip extension and adduction torque coupling on gait initiation after stroke: Feasibility case study in a healthy individual”, **second Progress in Clinical Motor Control: Movement and Rehabilitation Sciences (PCMC II) 2023**, Chicago, IL, USA.
 10. Prakyath Kantharaju, Inigo Sanz-Pena, Vakacherla Sai Siddarth, Hyeonkeun Jeong, Ashutosh Tiwari, Meet Nikunj Mevada, Cortney Bradford, Courtney Haynes, Myunghee Kim, “Human-In-The-Loop Optimization of Ankle Exoskeleton for Walking with Meta-Learning Algorithm”, **2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)**
-

List of Patents

1. Soumyo Mukherji, Ashutosh Tiwari et al., Indian Patent Application No.: 6624/CHE/2015, entitled “SINGLE SNAPSHOT MICROARRAY READER”, filed on December 2015. **[Patent Granted]**
 2. Arnab Chandra, Ashutosh Tiwari et al., Indian Patent Application No.: 202011029409, entitled “CUSTOMIZABLE AND FLEXIBLE FORCESENSING RESISTOR”, filed on July 2020. **[Published]**
 3. Deepak Joshi, Ashutosh Tiwari, Indian Patent Application No.: 201911034729, entitled “INSOLE-BASED FOOT PRESSURE MEASUREMENT SYSTEM”, filed on August 2019. **[Published]**
 4. Deepak Joshi, Ashutosh Tiwari, Indian Patent Application No.: 201811034806, entitled “WEARABLE GAIT ANALYSIS SYSTEM”, filed on September 2018 **[Later funded by Department of Science and Technology (DST), Government of India (Project no. RP04110G)]. [Patent Granted]**
-

Awards and Recognitions

1. University of Illinois (UIC) **Postdoctoral Travel Award 2023**
 2. **Gandhian young technological innovation (GYTI) award 2021**, BIRAC, Department of Science and Technology (DST), Government of India
 3. Best innovation award during **Industry Day 2018** organized at IIT Delhi
 4. Qualified **University Grant Commission-National Eligibility Test (UGC-NET)** exam for the entry to the Assistant Professor in the year 2017
 5. Qualified **Graduate aptitude test in Engineering (GATE)** exam 2016 (99 percentile) in Electronics and communication organized by IISc Bangalore.
 6. Second prize in Poster presentation during Nation Biomedical Research Competition organized (**NBRC**) at AIIMS Rishikesh in 2018
 7. Third prize in a Poster presentation during Nation Biomedical Research Competition (**NBRC**) organized at PGI Chandigarh in 2019.
 8. My innovation on intelligent prosthetic leg (IPL) development published in the most popular “Times of India” newspaper
-

Research grants

The research grant of INR 1 lakh for developing the working prototype of the instrumented insole was received from the Department of Science and Technology (DST), Government of India. Grant award no. BT/BIRAC/SITARE-GYTI-0663

Professional membership

Holds membership of American Society of Biomechanics (ASB)

Key projects

- **Lab on a chip reader and software analysis using MATLAB.**
Supervisor: Prof. Soumyo Mukherji, IIT Bombay. [May '14- June' 15]
 - Development of microarray reader, a system that can read microarray (DNA/Protein) based on its fluorescence properties providing high resolution combined with seamless data analysis and extended dynamic range as well as higher sensitivity
 - Imaging of large number of fluorochromes without photo bleaching
 - Cost reduction to many folds as compared to the existing available products in the market

- **Augmentative device to assist people with vocal cord dysfunction.**
Supervisor: Prof. Bhaskar Mohan Morari, VIT University. [November '12-May '13]
 - A device to mimic the act of non- functioning or paralyzed vocal folds with a speaker driven by an electronic oscillator which produces vibration at the frequency of desired range was developed
 - This technology is inexpensive, reliable and advanced
- **Auto ranging measurement of capacitance.**
Supervisor: Prof. P.C. Pandey, IIT Bombay [July' 13-December' 13]
 - A circuit for the measurement of capacitance with auto ranging was developed
 - The capacitance measurement was carried out using all pass filter and arduino based microcontroller
 - Circuit can measure the capacitance in the range of picofarad to microfarad.
- **Design and fabrication of a biocompatible microgripper for manipulation and handling of microscopic cells.**
Supervisor: Prof. R.S. Shrivastava, IIT Bombay [January' 14- April' 14]
 - It is based on micro-electro-mechanical system (MEMS) technique which allows holding of cells without imposing any structural deformation and biocompatibility issues with online feedback to help automate the system
 - Low cost and efficient

Research Advising and Mentoring

- Mr. Saurya Bhatt, Project associate, IIT Delhi [Jan. 2018- Dec. 2018]
- Mr. Dhruv Mehra, Summer intern, IIT Delhi [April 2019- Aug. 2019]
- Mr. Aditya Arora, Summer intern, IIT Delhi [March 2018- July 2018]
- Mr. Shreyas Sanghvi, Summer intern, IIT Delhi [May 2018- Aug. 2018]
- Mr. Ajey Pai, Project associate, IIT Delhi [July 2018- Jan. 2019]
- Mr. Arijit Dey, Masters student, IIT Delhi [July 2018- April 2019]
- Mr. Atharva Deshpandey, University of Illinois Chicago, US [May 2023- Sep 2023]

Technical skills

- **Data acquisition experience:** Marker-based motion capture system (12 IR camera-based system, BTS Bioengineering, Vicon and three camera-based systems by Noraxon), EEG (64 channel wireless, Brain Products, Germany), EMG (12 channel wireless, Delsys, USA), Wireless digital goniometer by Biometrics
- **Programming Languages:** C, C++, Matlab, R-Software
- **Tools:** Corel Draw, Solid Works, Unity (3D game development), Opensim
- **Microcontroller:** Raspberry pie, All Arduino platform

Language Proficiency

- English
- Hindi