Tilendra Choudhary, Ph.D.

CONTACT INFORMATION

1501 Snow Crest Trl, Durham, North Carolina-27707, USA
Mobile: +1-4046675618
Email: tilendrachoudhary@gmail.com, tilendra.choudhary@duke.edu
URLs: LinkedIn GoogleScholar (h-index: 11) ResearchGate

RESEARCH INTERESTS

- Digital signal processing and analysis of physiological waveform data, such as ECG, ABP, photophethysmogram and seismocardiogram (SCG), for various applications
- Artificial intelligence and machine learning for healthcare
- Data science on electronic health records (EHR) data of critical ill patients
- Development of electronic circuits for wearables

CURRENT AREAS OF RESEARCH

- Development of smart ML-based algorithms for ICU patients using lab values, vital signs and physiological waveforms for analyzing various sepsis-induced complications (e.g., respiratory failure, multi-organ failure) and therapies (e.g., blood transfusion)
- Phenotyping of RBC transfused non-traumatic ICU patients
- ML-based sepsis phenotyping with multimodal biosignal-derived physiomarkers
- Prediction of volume responsiveness for fluid-resuscitation in septic-shock patients
- Physiological waveform-based and behavioral analysis of distress and PTSD related disorders during neuromodulation treatments.

EDUCATION

Ph.D, Electronics and Electrical Engineering, 2020
Indian Institute of Technology Guwahati (IIT G), Assam
Degree awarded in March 2021

M.Tech., Electronics and Communication Engineering, 2015
Indian Institute of Technology Bhubaneswar (IIT BBS), Odisha
CGPA: 8.93/10

B.E., Electronics and Telecommunication Engineering, 2012
Chhattisgarh Swami Vivekanand Technical University (State Govt.), Bhilai, Chhattisgarh
CPI: 8.21/10

RESEARCH EXPERIENCE (FULL TIME)

Post-doctoral Research Fellow, **2024 Mar. - Present**
Dept. of Surgery, Duke University, Durham, NC-27707, USA
Advisers: Dr. Rishikesan Kamaleswaran

Post-doctoral Research Fellow, **2022 Apr. - 2024 Feb.**
Dept. of Biomedical Informatics, Emory University, Atlanta, GA-30322, USA
[Jointly with] Georgia Institute of Technology (Georgia Tech), Atlanta, USA
Advisers: Dr. Rishikesan Kamaleswaran, Dr. Omer T. Inan, Dr. J. D. Bremner
Domains: **(a)** To develop signal processing and machine learning-based intelligent methods to analyze multimodal physiological waveforms and EHR-derived clinical data from ICU for assessing critical complications such as sepsis and ARDS,
(b) To analyze the longitudinal effect of VNS neuromodulation on patients with PTSD using physiological and behavioral analysis.

Post-doctoral Industrial Experience:
Research Consultant **2021 Nov. - 2022 Mar.**
Research Engineer **2021 Feb. - 2021 Oct.**
Brigosha Technologies Pvt. Ltd. (R&D), VCR Cornerstone, #780, HSR Layout, Bangalore, Karnataka-560102, India
Domain: Autonomous driving and machine learning: Developed a deep learning-based traffic scene perception from LiDAR 3-D sensor-data and assisted tracking, *Tools:* Python, MATLAB

Ph.D. Research Scholar **2015 July - 2020 Oct.**
Department of EEE, IIT Guwahati, Guwahati, Assam-781039, India

Dissertation: Waveform Delineation and Analysis of Seismocardiographic Signals
Advisers: Prof. M. K. Bhuyan, Dr. L. N. Sharma, *Tools:* MATLAB, Python, NI Multisim, BIOPAC physiological data acquisition system, Arduino

M.Tech. Scholar **2013 July - 2015 July**
School of Electrical Sciences, IIT Bhubaneswar, Argul, Khordha, Odisha-752050, India
Dissertation: Delineation Frameworks for Photoplethysmogram and Electrocardiogram Signals
Adviser: Dr. M. S. Manikandan, *Tools:* MATLAB

Project: Hardware circuit design for SCG and ViCG signals acquisition [*during PhD*]
Advisers: Prof. M. K. Bhuyan and Dr. L. N. Sharma, *Tools:* NI Multisim, BIOPAC system, Arduino, sensor node and other electronic components

Project: Design of Biometric Recognition Systems using ECG/PPG Signals [*during MTech*]
Adviser: Dr. M. S. Manikandan, *Tools:* MATLAB

PUBLICATIONS, PATENTS, & PREPRINTS

JOURNAL PUBLICATIONS (PEER-REVIEWED):

1. M. Das, **Tilendra Choudhary**, L.N. Sharma, and M.K. Bhuyan, "Analyzing SCG Methodology for Identification of Ventricular Depolarization Events," *Biomedical Signal Processing and Control, Elsevier*, Sep. 2024. https://doi.org/10.1016/j.bspc.2024.106940.

2. A. Rafiei, R. Moore, **Tilendra Choudhary**, C. Marshall, G. Smith, J. D. Roback, R. M. Patel, C. D. Josephson, R. Kamaleswaran, "Robust Meta-Model for Predicting the Likelihood of Receiving Blood Transfusion in Non-traumatic ICU Patients," *Health Data Science*, Sep. 2024. DOI: 10.34133/hds.0197.

3. **Tilendra Choudhary**, P. Upadhyaya, C.M. Davis, P. Yang, S. Tallowin, F.A. Lisboa, S.A. Schobel, C.M. Coopersmith, E.A. Elster, T.G. Buchman, C.J. Dente, R. Kamaleswaran, "Derivation and Validation of Generalized Sepsis-induced Acute Respiratory Failure Phenotypes Among Critically Ill Patients: A Retrospective Study," *BMC Critical Care*, vol. 28, no. 1, pp. 321, Oct. 2024. (#citations:0, IF: 8.8) [Link].

4. M. M Soliman, C. Marshall, J. P Kimball, **Tilendra Choudhary**, G. Clermont, M.R. Pinsky, T.G. Buchman, C.M. Coopersmith, O.T. Inan, R. Kamaleswaran, "Parsimonious waveform-derived features consisting of pulse arrival time and heart rate variability predicts the onset of septic shock," *Biomedical Signal Processing and Control, Elsevier*, vol. 92, pp. 105974, 2024. (#citations:0, IF:4.9)

5. **Tilendra Choudhary**, M. Elliott, N. R. Euliano, N. Z. Gurel, A. G. Rivas, M. T. Wittbrodt, V. Vaccarino, A. J. Shah, O. T. Inan, J. D. Bremner, "Effect of transcutaneous cervical vagus nerve stimulation on declarative and working memory in patients with Posttraumatic Stress Disorder (PTSD): A pilot study," *Journal of Affective Disorders*, vol. 339, pp. 418-425, 2023. (#citations:3, IF:4.9)

6. M. Das, **Tilendra Choudhary**, M.K. Bhuyan, and L.N. Sharma, "Non-Contact Heart Rate Measurement from Facial Video Data Using a 2D-VMD Scheme," *IEEE Sensors Journal*, vol. 22, no. 11, pp. 11153-11161, 2022. (#citations:19, IF:4.3)

7. M. Das, **Tilendra Choudhary**, L.N. Sharma, and M.K. Bhuyan, "Noninvasive Accelerometric Approach for Cuffless Continuous Blood Pressure Measurement," *IEEE Trans on Instrumentation and Measurement*, vol. 70, Art no. 4008109, pp. 1-9, 2021. (#citations:8, IF:5.6)

8. **Tilendra Choudhary**, M. Das, M.K. Bhuyan, and L.N. Sharma, "Vibrocarotidography: A Novel Measurement Technique to Quantify Pulsations at Common Carotid Arteries," *IEEE Trans on Instrumentation and Measurement*, vol. 70, pp. 1-8, Art no. 4007208, 2021. (#citations:0, IF:5.6)

9. **Tilendra Choudhary**, M. Das, L.N. Sharma, and M.K. Bhuyan, “Analyzing Seismocardiographic Approach for Heart Rate Variability Measurement," *Biomedical Signal Processing and Control, Elsevier*, vol. 68, pp. 102793, 2021. (#citations:19, IF:4.9)

10. **Tilendra Choudhary**, L.N. Sharma, M.K. Bhuyan, and K. Bora, “Identification of Human Breathing-States Using Cardiac-Vibrational Signal for m-Health Applications," *IEEE Sensors Journal*, vol. 21, no. 3, pp. 3463-3470, 2021. DOI: 10.1109/JSEN.2020.3025384. (#citations:17, IF:4.3)

11. **Tilendra Choudhary**, M.K. Bhuyan, and L.N. Sharma, “Delineation and Analysis of Seismocardiographic Systole and Diastole Profiles," *IEEE Transactions on Instrumentation and Measurement*, vol. 70, Art no. 4000108, pp. 1-8, 2021. (#citations:10, IF:5.6)

12. **Tilendra Choudhary**, M.K. Bhuyan, and L.N. Sharma, “A Novel Method for Aortic Valve Opening Phase Detection Using SCG Signal," *IEEE Sensors Journal*, vol. 20, no. 2, pp. 899-908, 2020. (#citations:27, IF:4.3)

13. **Tilendra Choudhary**, L.N. Sharma, and M.K. Bhuyan, “Automatic Detection of Aortic Valve Opening using Seismocardiography in Healthy Individuals," *IEEE Journal of Biomedical and Health Informatics*, vol. 23, no. 3, pp. 1032-1040, 2019. (#citations:65, IF:7.7, **This work was featured on the cover of the journal’s sub-column, and as an “Editor’s Pick" for the May 2019 issue.**)

14. **Tilendra Choudhary**, L.N. Sharma, and M.K. Bhuyan, “Heart Sound Extraction from Sternal Seismocardiographic Signal," *IEEE Signal Processing Letters*, vol. 25, no. 4, pp. 482-486, 2018. (#citations:36, IF:3.2)

15. **Tilendra Choudhary**, M.K. Bhuyan, and L.N. Sharma, “Orthogonal Subspace Projection based Framework to Extract Heart Cycles from SCG Signal," *Biomedical Signal Processing and Control, Elsevier*, vol. 50, pp. 45-51, 2019. (#citations:15, IF:4.9)

16. M. S. Manikandan, B. Ramkumar, P. S. Deshpande, and **Tilendra Choudhary**, “Robust Detection of Premature Ventricular Contractions using Sparse Signal Decomposition and Temporal Features," *IET Healthcare Technology Letters*, vol. 2, no. 6, pp. 141-148, 2015. (#citations:15, IF:2.5)

CONFERENCE PUBLICATIONS (PEER-REVIEWED):

1. **Tilendra Choudhary**, P. Upadhyaya, C. Davis, P. Yang, C. Coopersmith, R. Kamaleswarsan, “A Multicenter Study on Deriving and Validating Data-driven Phenotypes for Sepsis-induced Acute Respiratory Failure in ICU Patients," in *American Thoracic Society (ATS) Conference, San Diego*, pp. A6629-A6629, 2024. (#citations:0)

2. P. Upadhyaya, **Tilendra Choudhary**, C. Davis, P. Yang, C. Coopersmith, R. Kamaleswarsan, “A Retrospective Causal Inference-based Study Using Machine Learning for Identifying Treatment Effects of Various Therapies in Sepsis-induced Acute Respiratory Failure Phenotypes," in *American Thoracic Society (ATS) Conference, San Diego*, pp. A5071-A5071, 2024. (#citations:0)

3. M. Das, **T. Choudhary**, M. K. Bhuyan, L. N. Sharma, and P. J. Dutta H., “A Multiresolution Method for Non-Contact Heart Rate Estimation Using Facial Video Frames," in *Proc. IEEE Intr. Conf. on Wireless Communications, Signal Processing and Networking (WiSPNET)*, 2022. (#citations:4)

4. **Tilendra Choudhary**, M. Das, L. N. Sharma, and M. K. Bhuyan, “A Non-Fiducial Noise Robust VMD-based Framework for ECG-based Biometric Recognition," in *Proc. IEEE Intr. Conf. INDICON*, 2021. (#citations:2)

5. **Tilendra Choudhary**, M.K. Bhuyan, and L.N. Sharma, “Effect of Respiratory Effort Levels on SCG Signals," in *Proc. IEEE Intr. Conf. TENSYMP*, 2019. (#citations:8)

6. **Tilendra Choudhary**, L.N. Sharma, and M.K. Bhuyan, “Suppression of Artifacts from Seismocardiogram Signal using Two-Stage Kalman Filtering Model," in *Proc. IEEE Intr. Conf. SPCOM, IISc Bangalore*, 2018. (#citations:2)

7. **Tilendra Choudhary**, L.N. Sharma, and M.K. Bhuyan, “Standalone Heartbeat Extraction in SCG signal using Variational Mode Decomposition," in *Proc. IEEE Intr. Conf. Wireless Communications, Signal Processing and Networking (WiSPNET)*, 2018. (#citations:16)

8. **Tilendra Choudhary**, L.N. Sharma, and M.K. Bhuyan, “SPECTRACENTROGRAM : A Time-Frequency Distribution for Signal Processing Applications," in *Proc. IEEE Intr. Conf. Intelligent Informatics and BioMedical Sciences (ICIIBMS), Thailand*, 2018. (#citations:4)

9. M. Kumar, **Tilendra Choudhary**, and M. K. Bhuyan, “Small Motion Magnification Using Automated RoI Selection and Spatial Co-ordinate Approach," in *Proc. IEEE Intr. Conf. on Wireless Communications, Signal Processing and Networking (WiSPNET)*, 2018, pp. 1-4. (#citations:2)

10. **Tilendra Choudhary** and M. S. Manikandan, “Robust Photoplethysmographic (PPG) based Biometric Authentication for Wireless Body Area Networks and m-Health Applications," in *Proc. IEEE National Conference on Communication (NCC)*, 2016, pp. 1-6. (#citations:46)

11. D. Sarma, M. K. Tarafder, **Tilendra Choudhary**, and K. K. Sarma, “An Energy Efficient Image Communication Framework for Bandlimited Wireless Sensor Networks," in *Proc. IEEE Intr. Conf. on Accessibility to Digital World (ICADW)*, 2016, pp. 197-201. (#citations:1)

12. **Tilendra Choudhary** and M. S. Manikandan,“A novel unified framework for noise-robust ECG-based biometric authentication," in *Proc. IEEE Intr. Conf. on Signal Processing and Integrated Networks (SPIN)*, 2015, pp. 186-191. (#citations:35)

PATENTS FILED:

1. “Method and Technology for Accelerometric Signal Recording of a Novel Vibrocarotidogram (ViCG) with Seismocardiogram (SCG)," in *Indian Patent*, 2020. Ref. No.: 202031026802

2. “Device and Method for Seismocardiography Recording and Monitoring in Mobile Device for Healthcare Applications," in *Indian Patent*, 2020. Ref. No.: 202031027314

PREPRINTS:

1. A. Wu, **Tilendra Choudhary**, P. Upadhyaya, A. Ali, P. Yang, and R. Kamaleswaran, “Deep Representation Learning-Based Dynamic Trajectory Phenotyping for Acute Respiratory Failure in Medical Intensive Care Units," *arXiv Preprint*, May 2024.

2. **Tilendra Choudhary**, G. Smith, J.D. Roback, R.M. Patel, C.D. Josephson, and R. Kamaleswaran, “SpO2/FiO2 Ratio as a Better Metric for Assessment of RBC Transfusion Effectiveness in Non-traumatic Critically Ill Patients with Physiologic Derangements," *medRxiv*, Oct. 2024.

Achievements & Other Experiences

- EPIC system deployment of the sepsis-induced ARF phenotyping model is currently under process at Emory University for its prospective use in ICU.
- Administered brain imaging and physiological waveform data acquisition of acute stressed and PTSD patients at Emory University Hospital.
- Was the part of a working group to standardize the physiological waveforms format in the Bridge2AI for Clinical Care Project [zenodo link].
- Worked in collaboration with Evren Technologies Inc., GeorgiaTech, University of Pittsburgh, MIT, Altanta VA medical center
- Mentored many PhD, MS and undergraduate students.
- MHRD, Govt. of India Scholarship for my PhD (2015-20) & MTech (2013-15).
- Young Researcher Award 2021 by Institute of Scholars (InSc), 2021.
- **Invited talks:**

  - Speaker, Research Friday Duke University, “ML-derived Unique Phenotypes for Sepsis-induced Acute Respiratory Failure (ARF) in ICU", Oct. 18, 2024.
  - Speaker, Workshop on AI in Healthcare Eng., IIT Guwahati, March 28-30, 2019.
  - Speaker, Workshop on MATLAB, RSF-EEE, IIT Guwahati, March 09-10 2019.
- Reviewer of many IEEE, Elsevier, Nature, npj and ACM, journals and conferences.
- **Grant proposal development experience:** assisted the development of one **NIH R01** submission, July 2023.
- Contributed for book-preparation, “Computer Vision and Image Processing: Fundamentals and Applications," CRC Press, 2019.
- Attended workshop on “Tutorial Series on Deep Learning using Tensorflow (TSDLT)," IEEE Branch, IIT Guwahati, Oct. 2018.
- Participated in, “Algorithms and Architectures for High Efficiency Video Coding," TEQIP, KIC, IIT Guwahati, Sept. 05-09, 2016.
- Member, Organizing Committee, ISHAN VIKAS Program at IIT Guwahati, by MHRD, Govt. of India, Dec. 6-17, 2015.
- Winner of “SCIENCE EXHIBITION" with my model DCS at SSCET Bhilai, 2009.
- Attended workshop on “BOT-VIRTUAL"(ROBOTICS) at VNIT Nagpur.

Media Coverage

- **Physician’s Weekly:** Sepsis-Induced ARF Phenotypes Show Special Organ Injury Characteristics & Clinical Outcomes Differences, Oct 2024. [Link]
- **MedScape:** Transcranial VNS Tied to Improved Cognition in PTSD, Jul 2023. [Link]
- **GLOBE NEWSWIRE:** gammaCore (Non-Invasive Vagus Nerve Stimulation; nVNS) Improves Attention and Memory in Patients with PTSD, Jul 2023. [Link]
- **GLOBE NEWSWIRE:** gammaCore nVNS Improves Attention and Working Memory in Patients with Post Traumatic Stress Disorder (PTSD), Sept 2023. [Link]

Skills

Coding skills : MATLAB, Python, Pytorch, Tensorflow, basic C/C++
Software editor tools : Spyder, Pycharm, Cloudcompare, JupyterLab, Dataiku
Simulation skills : NI Multisim, MATLAB, Simulink, PSpice
Type-setting skills : LaTeX, MS Office
Embedded programming skills : Arduino
Lab-equipments handled : CRO, DSO, FG, BIOPAC physiological data recording system (MP36, 45, 150, 160), CNAP 500 BP monitor

Teaching Assistance

Digital Electronics Circuit Lab, Analog Electronics Lab, Signal & System Lab, and its Tutorial, Design Laboratory, Basic Electronics Tutorial, Probability and Randam Processes Tutorial

---

Editorial Experience and Other Professional Services

- Review Editor, Biomedical Signal Processing, Frontiers in Signal Processing (SP)
- Topic Editor, Smart Biomedical Signal Analysis with Machine Intelligence, Frontiers in SP
- Journal Reviewer for Nature Scientific Data, npj Cardiovascular Health, IEEE Journal of Biomedical and Health Informatics, IEEE Sensors Journal, IEEE Sensors Letters, IEEE Transactions on Instrumentation and Measurement, Biomedical Signal Processing and Control, ACM Transactions on Computing for Healthcare, Measurement, Artificial Intelligence in Medicine

Professional Memberships

- IEEE Member, 2019
- IEEE Graduate Student Member, 2015–2019

REFERENCES AVAILABLE TO CONTACT

Dr. Rishikesan Kamaleswaran [e-mail: r.kamaleswaran@duke.edu]
Associate Professor, Dept. of Surgery, and of Anesthesiology, Duke University[1],
Associate Professor, Dept. of Biomedical Engineering, and of Electrical & Computer Engineering, Duke University[2], Durham, NC, USA-27710.
url: https://www.kamaleswaran.com/team

Prof. M.K. Bhuyan [e-mail: mkb@iitg.ac.in; phone: +91-361-258-2523]
Professor, Dept. of Electronics and Electrical Engineering,
Indian Institute of Technology (IIT) Guwahati; Guwahati, Assam, India-781039.
url: http://www.iitg.ac.in/mkb/

Prof. Shaik Rafi Ahamed [e-mail: rafiahamed@iitg.ac.in; phone: +91-361-258-2520]
Professor, Dept. of Electronics and Electrical Engineering,
Indian Institute of Technology (IIT) Guwahati; Guwahati, Assam, India-781039.
url: https://www.iitg.ac.in/eee/rafi.html