

# ASHUTOSH SINGH

Boston, MA | [singh.ashu@northeastern.edu](mailto:singh.ashu@northeastern.edu) | +1 857-588-2464  
[ashutosh17dec.github.io](https://github.com/ashutosh17dec) | [linkedin.com/in/ashutosh-singh-8b034070](https://www.linkedin.com/in/ashutosh-singh-8b034070)

## SUMMARY

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PhD researcher in machine learning specializing in **dynamical systems, state estimation, data assimilation, and physics-informed modeling for healthcare sensing and human biomechanics**. Developed recursive learning frameworks for nonlinear forecasting, system identification, physiological event prediction, and physically grounded human motion modeling from noisy multimodal measurements. Research experience spans **Sony AI, MERL, Amgen, and Ford**, with first-author publications at **ICLR, ICASSP, and CVPR**. Seeking research scientist / research engineer roles in dynamical modeling, human-centered sensing, and physics-informed ML.

## TECHNICAL SKILLS

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**Languages:** Python, C++, MATLAB, R

**ML / DL:** PyTorch, TensorFlow, JAX, Hugging Face, scikit-learn

**Core Methods:** State estimation, data assimilation, dynamical systems, system identification, Koopman modeling, temporal point processes, neural operators, self-supervised learning, diffusion models, VAEs, masked autoencoders

**Infrastructure:** GCP, Docker, SLURM, Git, W&B, MLflow

**Application Areas:** Healthcare sensing, physiological time series, human biomechanics, 3D human motion, spatiotemporal forecasting, multimodal ML

**Tools:** OpenCV, Blender, SMPL/SMPLX, Carla, ROS, MediaPipe

## RESEARCH EXPERTISE

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State Estimation • Data Assimilation • Spatio Temporal Modeling • Physics-Informed Machine Learning • System Identification • Human Biomechanics • Generative AI • Healthcare Sensing • Multimodal Modeling

## INDUSTRY EXPERIENCE

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### Research Intern, Amgen

May 2025 – Dec 2025

Process Development • Protein Workflow Modeling

- Built internal bioinformatics tooling for antibody-drug conjugate (ADC) and antibody-peptide conjugate (APC) analysis, enabling automated characterization and attribution of conjugated protein sequences.
- Developed a computational pipeline for extinction coefficient estimation, reducing spectrophotometric protein quantification effort by multiple-fold relative to the prior manual workflow.

### Research Intern, Sony AI

Sep 2024 – Apr 2025

Human Biomechanics • 3D Motion Modeling • Physics-Grounded Generation

- Built pipelines to recover **3D human motion states** from broadcast video, including geometric reconstruction, PnP-based processing, smoothing, and physics-based post-processing; produced **6+ hours** of motion data across **50+ videos**.
- Processed a large-scale motion-capture dataset from raw optical tracking to SMPL format (**70+ sequences, 3+ hours**), establishing the data backbone for physics-conditioned generative modeling.
- Designed a diffusion-transformer architecture for dyadic human trajectory synthesis conditioned on physics priors and interaction cues; defined evaluation metrics for **physical plausibility** and interaction consistency.

### Research Intern, Mitsubishi Electric Research Laboratories (MERL)

May 2024 – Aug 2024

Dynamical Systems • Forecasting • Fault Detection

- Developed data-driven models for **long-horizon forecasting and state monitoring** of non-stationary industrial time series, improving predictive performance over transformer baselines across multiple motor datasets.
- Adapted advanced temporal models for **fault detection and isolation** across **4 motor datasets**, using spectral signature analysis to distinguish healthy and faulty system states.

### Research & Advanced Engineering Intern, Ford Motor Company

Jun 2020 – Aug 2020

Connected Vehicles • Multi-Agent Planning

- Designed and implemented an optimal search-based multi-agent path-planning algorithm for connected vehicles and integrated it into Carla for end-to-end evaluation, reducing path conflicts relative to the previous simulation baseline.
- Received **Most Popular Idea Award** at the company-wide intern hackathon.

## ACADEMIC EXPERIENCE

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PhD Researcher, Cognitive Systems Lab, Northeastern University

May 2021 – Jun 2026 (Expected)

Advisor: Prof. Deniz Erdogmus

Focus: Dynamical Systems Modeling, Physics-Informed ML, Generative Modeling, Healthcare Sensing

- Designed methods for **human biomechanics and motion modeling**, including JEPA-style skeleton representation learning and physics-conditioned generation from noisy visual observations. Under Submission at **ECCV 2026**.
- Developed recursive and physics-informed learning frameworks for **state estimation, nonlinear forecasting, and data assimilation** in dynamical systems, including semilinear PDEs and non-stationary time series; first-author publication at **ICLR 2024** and follow-on work on Koopman-based recursive modeling.
- Built **healthcare time-series models** for predicting aggressive behavior onset from wearable biosignals using temporal point process modeling, validated on **70+ inpatient participants**; co-authored publications in **JAMA Network Open (2023)** and **Nature Scientific Reports (2026)**.
- Built a **zero-shot VLM→LLM** pipeline for autism behavior analysis from anonymized videos, with VLM descriptor for structured behavioral descriptions and LLM as predictor. First author publication in **CVPR 2026** *cv4small*.
- Developed **dynamical modeling** approaches for fMRI to estimate latent brain states, alongside deep generative models for physiological prediction from neuroimaging data; first-authored publication in **EMBC 2021, SANS 2025, Nature Method (under review)**.
- Built **multimodal fusion** methods over fMRI, dMRI, and EEG for explainable prediction under **missing-modality** settings, supporting biomarker identification and robust clinical inference. Co-authored publication in **CMIG 2024**.
- Developed multimodal ML pipelines for privacy-preserving **clinical behavior understanding** from video, including explainable vision-language modeling and temporal localization of aggressive actions in autism-related care settings.

## EDUCATION

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<b>Ph.D., Computer Engineering</b>	May 2021 – Jun 2026 (Expected)
Northeastern University, Boston, MA   Focus: Machine Learning & Signal Processing	
<b>M.S., Electrical &amp; Computer Engineering</b>	Sep 2019 – May 2021
Northeastern University, Boston, MA   Concentration: ML, Computer Vision & Algorithms	
<b>B.Tech., Mechatronics Engineering</b>	Sep 2015 – May 2019
Manipal Institute of Technology, Karnataka, India   Minor: Robotics	

## PUBLICATIONS

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### Technical / Methodological Work

- **Path-JEPA: Path Signature Based Joint Predictive Learning for Skeleton Action Recognition.** Under review at *ECCV 2026*. First author.
- **KODA: A Data-Driven Recursive Model for Time Series Forecasting and Data Assimilation using Koopman Operators.** Under review. First author.
- **Learning Semilinear Neural Operators: A Unified Recursive Framework for Prediction and Data Assimilation.** *ICLR 2024*. First author.
- **Inv-SENet: Invariant Self-Expression Network for Clustering Under Biased Data.** *ICASSP 2023*. First author.
- **FigCaps-HF: A Figure-to-Caption Generative Framework and Benchmark with Human Feedback.** *RANLP 2025*. Co-author.

### Application / Domain Work

- **Toward Automated Behavior Understanding in Autism: An Explainable Vision-Language Model Approach.** *CVPR Workshop 2026*. First author.
- **Temporal Point Process Modeling of Aggressive Behavior Onset in Psychiatric Inpatient Youths with Autism.** *Nature Scientific Reports, 2026*. Co-author.
- **Wearable Biosensing to Predict Imminent Aggressive Behavior in Psychiatric Inpatient Youths with Autism.** *JAMA Network Open, 2023*. Co-author.
- **Advancing Post-Traumatic Seizure Classification and Biomarker Identification: Information Decomposition Based Multimodal Fusion.** *Computerized Medical Imaging and Graphics (CMIG), 2024*. Co-author.
- **Variation is the Norm: Brain State Dynamics Evoked by Emotional Video Clips.** *EMBC 2021*. First author.
- **Using Deep Generative Models for Simultaneous Representational and Predictive Modeling of Brain and Behavior.** Under review at *Nature Methods*. first-author.

## HONORS, SERVICE & TEACHING

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- Northeastern LEADERS Fellowship, 2025.
- Reviewer: CVPR 2026, ICLR 2026, ICLR 2025, IJCNN 2025, ICASSP 2024, MLSP 2024, ICASSP 2023, MLSP 2023.
- Teaching Assistant: Data Science Capstone, Data Management, Supervised ML, Machine Learning / Pattern Recognition.
- Runner-up, SPARCLink SPARC Codeathon 2021; Most Popular Idea, Ford Motor Company Intern Hackathon 2020.