Prof. Ashish Pal

Assistant Professor, Structural Engineering | Department of Civil Engineering, IIT Bombay

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IIT Bombay Profile | Google Scholar | ORCID | LinkedIn

Research Identity

I develop physics-guided sensing, artificial intelligence, and scientific computing methods for structural health monitoring, digital twinning, nonlinear dynamical system identification, full-field response estimation, and data fusion for civil infrastructure systems.

Physics-informed ML | System Identification | Structural Dynamics | Damage Detection | Full-field Sensing | Data Fusion | Digital Twins | Scientific Computing

Academic Appointments

Assistant Professor April 2025 – Present
Department of Civil Engineering, Indian Institute of Technology Bombay
Structural Engineering group

Education

Ph.D. in Civil and Environmental Engineering 2019-24
Rice University, Houston, USA
Thesis title: System Identification and Damage Detection Solutions: Sensor Fusion, Algorithms and Physics-Guided Learning.
Advisor: Prof. Satish Nagarajaiah.

M.Tech., B.Tech. (Dual degree) in Civil Engineering 2013-18
Indian Institute of Technology Kanpur
Thesis title: On Modal Combination Rules of Response Spectrum Method for Peak Floor Accelerations in Multistoried Buildings.
Advisor: Prof. Vinay K. Gupta

Awards, Fellowships, and Honors

- SERB–Rice Fellowship, 2019–2023.
- Merit-cum-Means Scholarship, Government of India, 2013–2017.
- Academic Excellence Award, IIT Kanpur, 2015–16.
- Overall Best Project Award, IIT Kanpur, 2015.
- Certificate of Appreciation for fabrication project, IIT Kanpur, 2014.

Publications

Journal Articles and Preprints

[1] A. Das, A. Pal, S. Nagarajaiah, M. M. Sajeer, and S. Mukhopadhyay, "Signal-based online acceleration and strain data fusion using B-splines and Kalman filter for full-field dynamic displacement estimation," *Mechanical Systems and Signal Processing*, vol. 247, p. 113 951, 2026. DOI: https://doi.org/10.1016/j.ymssp.2026.113951.

[2] H. Wang, A. Pal, S. Nagarajaiah, S. Ke, and S. Zhu, "Latching control: Experimental study on pendulum latched mass damper," *Engineering Structures*, vol. 361, p. 122 745, 2026. DOI: https://doi.org/10.1016/j.engstruct.2026.122745.

[3] A. Pal, S. Bhowmick, and S. Nagarajaiah, "Physics-informed AI and ML-based sparse system identification algorithm for discovery of PDE's representing nonlinear dynamic systems," *Me-*

chanical Systems and Signal Processing, vol. 238, p. 113 238, 2025. DOI: https://doi.org/10.1016/j.ymssp.2025.113238.

[4] A. Pal and S. Nagarajaiah, "Data fusion based on short-term memory Kalman filtering using intermittent-displacement and acceleration signal with a time-varying bias," *Mechanical Systems and Signal Processing*, vol. 216, p. 111 482, 2024. DOI: https://doi.org/10.1016/j.ymssp.2024.111482.

[5] A. Pal and S. Nagarajaiah, *KAN/MultKAN with physics-informed spline fitting (KAN-PISF) for ordinary/partial differential equation discovery of nonlinear dynamic systems*, 2024. DOI: https://doi.org/10.48550/arXiv.2411.11801. arXiv: 2411.11801 [physics.comp-ph].

[6] A. Pal and S. Nagarajaiah, "Sparsity promoting algorithm for identification of nonlinear dynamic system based on Unscented Kalman Filter using novel selective thresholding and penalty-based model selection," *Mechanical Systems and Signal Processing*, vol. 212, p. 111 301, 2024. DOI: https://doi.org/10.1016/j.ymssp.2024.111301.

[7] A. Pal, W. Meng, S. M. Bachilo, R. B. Weisman, and S. Nagarajaiah, "Subsurface damage detection via noncontact laser based surface level strain sensing smart skin with carbon nanotubes," *Engineering Structures*, vol. 284, p. 116 017, 2023. DOI: https://doi.org/10.1016/j.engstruct.2023.116017.

[8] A. Pal, W. Meng, and S. Nagarajaiah, "Deep learning-based subsurface damage localization using full-field surface strains," *Sensors*, vol. 23, no. 17, p. 7445, 2023. DOI: https://doi.org/10.3390/s23177445.

[9] W. Meng, A. Pal, S. M. Bachilo, R. B. Weisman, and S. Nagarajaiah, "Next-generation 2d optical strain mapping with strain-sensing smart skin compared to digital image correlation," *Scientific Reports*, vol. 12, p. 11 226, 2022. DOI: https://doi.org/10.1038/s41598-022-15332-1.

[10] A. Pal, W. Meng, and S. Nagarajaiah, "Hybrid method for full-field response estimation using sparse measurement data based on inverse analysis and static condensation," *Journal of Infrastructure Intelligence and Resilience*, vol. 1, no. 2, p. 100 017, 2022. DOI: https://doi.org/10.1016/j.iintel.2022.100017.

[11] A. Pal and V. K. Gupta, "A note on spectral velocity approximation at shorter intermediate periods," *Soil Dynamics and Earthquake Engineering*, vol. 141, p. 106 422, 2021. DOI: https://doi.org/10.1016/j.soildyn.2020.106422.

[12] A. Pal and V. K. Gupta, "Peak factor–based modal combination rule of response-spectrum method for peak floor accelerations," *Journal of Structural Engineering*, vol. 147, no. 7, p. 04 021 095, 2021. DOI: https://doi.org/10.1061/(ASCE)ST.1943-541X.0003044.

Conference Papers

[1] W. Meng, A. Pal, S. M. Bachilo, R. B. Weisman, and S. Nagarajaiah, "Next-generation non-contact strain-sensing method using strain-sensing smart skin (S4) for static and dynamic measurement," in *Model Validation and Uncertainty Quantification, Volume 3*, ser. Conference Proceedings of the Society for Experimental Mechanics Series, R. Platz, G. Flynn, K. Neal, and S. Ouellette, Eds., Springer, 2023, pp. 153–159. DOI: https://doi.org/10.1007/978-3-031-37003-8_24.

[2] A. Pal, W. Meng, and S. Nagarajaiah, "Deep learning for image segmentation and subsurface damage detection based on full-field surface strains," in *Proceedings of the Society for Experimental Mechanics Series*, 2023.

[3] A. Pal, A. Gaur, and S. Mukhopadhyay, "Modal identification and damage detection of railway bridges using time-varying modes identified from train induced vibrations," in *Model Validation and Uncertainty Quantification, Volume 3: Proceedings of the 38th IMAC, A Conference and Exposition on Structural Dynamics 2020*, Springer, 2020, pp. 405–411.

Projects and Grants

High-Fidelity Digital Twins via Scientific Discovery Using Physics-Informed Machine Learning and Uncertainty Quantification for Structural Health Monitoring and Performance Assessment

ANRF-ECRG | Role: PI | Amount: INR 56 lakhs | Duration: 2026–Ongoing

This project develops high-fidelity digital twin frameworks for structural health monitoring and performance assessment of civil infrastructure. It integrates physics-informed machine learning, scientific discovery, nonlinear dynamics, and uncertainty quantification to improve model updating, damage interpretation, and predictive assessment.

Computer-Vision and Physics-Informed Machine Learning Based Bridge Structural Health Monitoring

Seed Funding for Collaboration and Partnership Projects | Role: PI | Amount: INR 10 lakhs | Duration: 2026–Ongoing

This project develops computer-vision and machine-learning methods for bridge structural health monitoring and condition assessment. It explores how visual measurements can support full-field monitoring of bridge response and complement traditional sensing approaches.

System Identification of Nonlinear Dynamic Systems Using Interpretable Machine Learning Methods for Applications in Structural Health Monitoring

IRCC Seed Grant | Role: PI | Amount: INR 50 lakhs | Duration: 2025–Ongoing

This project focuses on interpretable machine learning for system identification of nonlinear dynamic systems in structural health monitoring. The goal is to understand structural behaviour from measured vibration response and support reliable damage detection, interpretation, and assessment.

Teaching

Teaching Interests

- Finite Element Methods; Solid Mechanics; Structural Dynamics.
- Structural Health Monitoring; Damage Detection; System Identification.
- Machine Learning for Scientific Computing and Engineering Applications.
- Data-driven and physics-informed modelling of civil infrastructure systems.

Courses Taught

- CE 337 2025-26: Introduction to Structural Design, Autumn semester.
- CE 620 2025-26: Introduction to Finite Elements, Spring semester.

Research Guidance

Postdoctoral Researchers

- Dr. S. S. Jayakrishna, 2026–Ongoing.

Ph.D. Students

- Currently recruiting; prospective students may contact via lab website.

M.Tech. Students

- Saransh Kar, 2026–Ongoing.

B.Tech. / Undergraduate Projects

- Anushka Singh, 2025–26. Project: Computer vision methods for estimating full-field displacements of a vibrating continuous edge from videos.

Talks, Outreach, and Professional Service

Invited Talks and Workshops

- **Mechanical Sciences Young Investigators Meet (MSYIM) 2026**, IIT Kanpur. Invited talk: "Data Fusion Using Kalman-Filter Methods for Real-Time Structural Health Monitoring." March 13, 2026.
- **Core Meets Code**, Eigenplus. Invited talk: "From Equations to Solutions: Physics-Informed Neural Networks for Mechanics Problems." May 22, 2026.

Professional Service

- Reviewer for journals and conferences including Structural Control and Health Monitoring, Journal of Structural Engineering, Mechanical Systems and Signal Processing, Journal of Building Engineering, and the International Nonlinear Dynamics Conference.

Technical Skills

Computing	Python, MATLAB, LaTeX, Julia, C/C++, MAPLE, AutoCAD, Ansys, Abaqus, LS-DYNA, SAP2000, STAAD.Pro.
Machine Learning	PyTorch, physics-informed machine learning, sparse regression, Kalman filtering, system identification, finite element modelling.
Experimental / Sensing	Accelerometers, impact hammer testing, forced vibration testing, camera-based measurements, laser vibrometry, spectroscopic strain sensing, digital image correlation, full-field strain sensing, vibration testing.