

Dr. Eshwar Kuncham (Ph.D)

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Research Interests

Bayesian filtering, Inverse problems, Structural health monitoring, Vibration-based analysis, Bayesian filtering, Fatigue life prediction, Fatigue loading, Vehicles-bridge interaction, Crack modeling and detection, Mechanical and thermo-mechanical loading.

Thesis Objective

My doctoral dissertation discusses predicting remaining useful life (RUL) of a bridge structure robust to real-time uncertainties. In my research, Bayesian filter-based algorithms were developed to predict the RUL of bridge joints based on available sensor data under uncertainty in measurement and loading (mechanical and thermo-mechanical). To reduce computational and instrumentation density costs, an algorithm is developed that integrated substructure predictor models with Bayesian filters. The algorithm was further extended to predict the RUL of a bridge structure under realistic loading conditions by studying the interaction of vehicles with the structure under preexisting and without crack scenarios.

Through this journey, I expertised myself in real-life structural health monitoring (SHM) dealing with high end numerical modelling through coding or software, filtering-based SHM approaches, handling several sensor types (accelerometer and strain sensors, wired and wireless types), data acquisition system, anemometer, etc.




Academic Experience

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| Jun 2019 – Jan 2020 | 📌 Project Associate, Indian Institute of Technology Mandi
Research title: <i>Numerical analysis of a bridge structure in the presence of varying temperatures</i> |
| May 2018 – Nov 2018 | 📌 Research Fellow, Indian Institute of Technology Patna
Research title: <i>Development of structural health monitoring technique for existing bridges in Bihar: Pilot study</i> |
| Aug 2017 – May 2018 | 📌 Research Assistant, Mahindra École Centrale, College of Engineering
Research title: <i>Lateral Response Reduction of Tall Buildings Using Portal Frame as TMD</i> |
| Nov 2016 – Jul 2017 | 📌 Research Assistant, Anurag University
Research title: <i>Progressive collapse analysis of two-dimensional reinforced concrete framed structure</i> |
| Jul 2015 – Oct 2016 | 📌 Lecturer, JayaPrakash Narayan College of Engineering |

Major projects at IIT Mandi

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| Aug 2022 – | 📌 ARDB: Digital Twin development employing Bayesian filters with sub-structured predictor models for aerospace application. |
| Jul 2023 – Sep 2023 | 📌 Consultancy: Bridge inspection and testing on Karcham Wangtoo HE Project (1045MW). |
| Aug 2023 – Sep 2023 | 📌 Consultancy: Non-destructive Testing on RBI building. |
| Jun 2019 – Apr 2022 | 📌 DST-ECR: Vibration-based health monitoring of tensegrity structures incorporating the effects of ambient temperature. |

Education

- 2020 – 2023  **Ph.D., Indian Institute of Technology Mandi**, [8.23/10].
Research Work: *Fatigue life assessment for civil infrastructures using Bayesian filtering-based algorithms.*
- 2015 – 2017  **M.Tech. Structural Engineering** Jawaharlal Nehru Technological University Hyderabad, [8.86/10].
Thesis title: *Progressive Collapse Analysis of Reinforced Concrete Structure.*
- 2011 – 2015  **B.Tech. Civil Engineering** Jawaharlal Nehru Technological University Hyderabad.
Thesis title: *Stabilization of Fine Aggregate with Foundry Sand*, [75.71%].

Research Publications

Journal Articles

1. **Kuncham, E.**, Aswal, N., Sen, S., and Mevel, L. Bayesian monitoring of substructures under unknown interface assumption, 2023. **Mechanical Systems and Signal Processing.**
2. **Kuncham, E.**, Sen, S., Kumar, P., and Pathak, H. An online model-based fatigue life prediction approach using extended Kalman filter, 2022. **Theoretical and Applied Fracture Mechanics.**
3. Hoda, Md. A., **Kuncham, E.**, and Sen, S. Response and input time history dataset and numerical models for a miniaturized 3D shear frame under damaged and undamaged conditions, 2022. **Data in Brief.**
4. Aswal, N., **Kuncham, E.**, Sen, S., and Mevel, L. Health assessment of high dimensional structures under spatial thermal variation using localized estimation approach. *Mechanical Systems and Signal Processing. (under review)*
5. **Kuncham, E.**, and Sen, S. Fatigue assessment of bridges using interacting filtering approach with substructured predictor model based on current health. *Journal of Bridge Engineering. (under review)*
6. Hoda, Md A., **Kuncham, E.**, and Sen, S. Development of efficient probabilistic health assessment approach for high dimensional civil infrastructures. *Structures. (under review)*
7. **Kuncham, E.**, Hoda, Md A., and Sen, S. Force estimation in bridge substructure boundary under vehicle loading using interacting filtering approach. *International Journal of Advances in Engineering Sciences and Applied Mathematics. (under review)*
8. Faridi, Md. A., **Kuncham, E.**, Roy, K., and Singhal, V. Operational modal analysis of a bridge under ambient excitation using limited roving sensors. *Journal of Civil Structural Health Monitoring. (under review)*
9. Shereena, O.A, **Kuncham, E.**, Sen, S., Jain, P. C., and Mevel, L. Mitigating high dimensionality in damage identification for plate-like structures through substructuring with interacting filtering-based approaches. *Engineering Structures. (under preparation)*

Book Chapter/Lecture Notes

1. **Kuncham, E.**, and Pasupuleti, V. D. K. Progressive Collapse Analysis of Two Dimensional Reinforced Concrete Framed Structure, 2019. **Advances in Intelligent Systems and Computing.**
2. Chilakalapalli, R. V., Palvai, P., **Kuncham, E.**, and Pasupuleti, V. D. K. Lateral Response Reduction of Tall Buildings Using Portal Frame as TMD, 2020. **Lecture Notes in Civil Engineering.**

Conference

1. OA, Shereena., Sen, S., Aswal, N., **Kuncham, E.**, and Mevel, L. Monitoring a sparsely observed high dimensional structures with virtual sensor-based identification framework defined in lagged time domain. **IOMAC 2024.** Naples, Italy. *(submitted)*

2. Rashid, S., **Kuncham, E.**, and Sen, S. Integration of numerical and experimental approaches for ultrasonic wave propagation-based damage detection. **CARRS 2023**. IIT Hyderabad, India. (*submitted*)
3. Aswal, N., **Kuncham, E.**, Sen, S., and Mevel, L. Subdomain Fault Isolation for Linear Parameter Varying Systems through Coupled Marginalized Particle and Kitanidis Filters. *22nd IFAC World Congress 2023*. Yokohama, Japan.
4. Aswal, N., **Kuncham, E.**, Sen, S., and Mevel, L. Robust Interacting Particle-Kalman Filter based structural damage estimation using dynamic strain measurements under non-stationary excitation - an experimental study. *10th SHMII 2021*, Porto, Portugal. - (*online*)
5. **Kuncham, E.**, and Sen, S. Development of computationally efficient health benchmarking approach for a bridge structure by coupling substructuring technique within interacting filtering approach. *10th EWSHM 2022*. Palermo, Italy.
6. **Kuncham, E.**, Hoda, Md A., and Sen, S. Identifying the cracks in beam structures using a simplified substructure technique. *4th SICE 2022*. IIT Hyderabad, India.
7. **Kuncham, E.**, Hoda, Md A., and Sen, S. Force estimation in bridge substructure boundary under vehicle loading using interacting filtering approach. *67th ISTAM 2022*. IIT Mandi, India.
8. Hoda, Md A., **Kuncham, E.**, and Sen, S. Detection of edge crack in beam like structure modelled as rotational spring by using Bayesian filtering. *67th ISTAM 2022*. IIT Mandi, India.
9. **Kuncham, E.**, and Sen, S. Damping Estimation in Composites Structures: An Inverse Damping Modelling Technique. **NDE 2019**. Bengaluru, India.
10. **Kuncham, E.**, and Pasupuleti, V. D. K. Structural Vibration During Progressive Collapse. **ICVOP 2017**. IIT Guwahati, India.
11. **Kuncham, E.**, and Pasupuleti, V. D. K. Progressive Collapse Analysis of Three- Dimensional Reinforced Concrete Structures. **ICEE 2017**. Padang, Indonesia.

Skills

Coding & Scripting	■	MATLAB, Python, L ^A T _E X.
Software	■	Abaqus CAE, CSiBridge, ETABS, SAP 2000, LISA, AutoCAD, Sketchup.

Academic Responsibility

During my time at IIT Mandi, I was a teaching assistant in bachelor and masters courses, such as, Strength of materials and structures, Design practicum, Reverse engineering, Structural dynamics with application to earthquake engineering, and Structural engineering laboratory.

I was part of the team that set up the i4S laboratory. We purchased the equipments and sensors related to non-destructive testing and vibration-based testing. I became familiar with the installation process of horizontal shake table, wired and wireless sensors (strain and acceleration), data acquisition systems, and anemometer. I was also part of a team that conducted laboratory tests and real-time bridge evaluations across Himachal Pradesh, India.

Academic Awards and Achievements

- 2020 ■ **Certificate of appreciation for Teaching Assistant**, in the National Workshop on “Advanced Composites for Aerospace: Design, Manufacturing and Condition Monitoring Perspective. Feb 11-15 at Indian Institute of Technology Mandi.
- 2017 ■ **Best Presenter Award**, 4th International Conference on Earth Sciences and Engineering at Padang, Indonesia.
- 2015 ■ **Merit Award**, Jayaprakash Narayan College of Engineering.
- 2009-2011 ■ **Merit Scholarship**, for completing intermediate education from the same institute.

Interests

Playing badminton; Backpacking; Crafting

References

Dr Subhamoy Sen

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