Eshwar Kuncham

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Research Interests

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

Work Experience

Jan 2024 – Present	**Postdoctoral Research Associate**, University of Nebraska-Lincoln
Jun 2019 – Jan 2020	**Project Associate**, Indian Institute of Technology Mandi
May 2018 – Nov 2018	**Research Fellow**, Indian Institute of Technology Patna
Nov 2016 – May 2018	**Research Assistant**, Mahindra École Centrale, College of Engineering
Jul 2015 – Oct 2016	**Lecturer**, JayaPrakash Narayan College of Engineering

Research Experience

Postdoctoral research: *Substructure damage identification based on strain measurement*

The research focuses on the development of a damage identification algorithm for bridge structures, utilizing strain measurements through the Substructure technique. Initial validation of the proposed algorithm will be conducted through numerical beam simulations and lab-scale experiments.
As a research team, we are engaged in a large-scale experimental study conducted on an real bridge, we have captured strain data induced by a moving truck. This study encompasses various damage scenarios that have been implemented on the bridge to validate the proposed algorithm.

Doctoral Thesis: *Fatigue life assessment for civil infrastructures using Bayesian filtering-based algorithms*

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.

Major projects at IIT Mandi

Aug 2022 – Sep 2023	**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.
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].

2015 – 2017 **M.Tech. Structural Engineering** JNTU Hyderabad, [**8.86**/10].

2011 – 2015 **B.Tech. Civil Engineering** JNTU Hyderabad, [**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. **Kuncham, E**., and Sen, S. Fatigue assessment of bridges using interacting filtering approach with substructured predictor model based on current health, 2024. **Structural Health Monitoring**.

4. Hoda, Md A., **Kuncham, E**., and Sen, S. Development of efficient probabilistic health assessment approach for high dimensional civil infrastructures, 2024. **Structures**.

5. Faridi, Md. A., **Kuncham, E**., Roy, K., and Singhal, V. Using limited roving sensors to monitor bridge subjected to random traffic load, 2024. **Journal of Civil Structural Health Monitoring.**

6. **Kuncham, E**., Hoda, Md A., and Sen, S. Force estimation in bridge substructure boundary under vehicle loading using interacting filtering approach, 2024. **International Journal of Advances in Engineering Sciences and Applied Mathematics**.

7. 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**.

8. 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 review*)

Conference

1. Aswal, N., **Kuncham, E**, Sen, S., and Mevel, L. Subdomain Fault Isolation for Linear Parameter Varying Systems through Coupled Marginalized Particle and Kitanidis Filters. 22^{nd} **IFAC World Congress 2023**. Yokohama, Japan.

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.

3. **Kuncham, E**., and Sen, S. Development of computationally efficient health benchmarking approach for a bridge structure by coupling substructuring technique within interacting filtering approach. 10^{th} **EWSHM 2022**. Palermo, Italy.

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. 10^{th} **SHMII 2021**, Porto, Portugal. - (*online*)

5. **Kuncham, E**., Hoda, Md A., and Sen, S. Identifying the cracks in beam structures using a simplified substructure technique. 4^{th} **SICE 2022**. IIT Hyderabad, India.

6. Hoda, Md A., **Kuncham, E**., and Sen, S. Detection of edge crack in beam like structure modelled as rotational spring by using Bayesian filtering. 67^{th} **ISTAM 2022**. IIT Mandi, India.

7. **Kuncham, E.**, and Sen, S. Damping Estimation in Composites Structures: An Inverse Damping Modelling Technique. **NDE 2019**. Bengaluru, India.
8. **Kuncham, E.**, and Pasupuleti, V. D. K. Progressive Collapse Analysis of Two Dimensional Reinforced Concrete Framed Structure. **ICIIF 2018**. Ahmedabad, India.
9. Chilakalapallii, R. V., Palvai, P., **Kuncham, E.**, and Pasupuleti, V. D. K. Lateral Response Reduction of Tall Buildings Using Portal Frame as TMD. **ICETCE 2018**. Anantapuramu, 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, LaTeX, MS office.
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 ICEE 2017 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 Daniel Linzell
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