

**DR. SAGI RATHNA PRASAD**  
**sagi@iitpkd.ac.in**  
**+91 4912091474**



## Curriculum Vitae

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### EDUCATION

Program	Institution	%/CGPA	Year of completion
M.S+PhD	IIT Madras, India (Mechanical Engineering)	8.3/10	2022
B.E.	Aeronautical Society of India (Aeronautical Engineering)	60.05 %	2013
Intermediate	Shaankary Junior College, Telangana, India	92.0 %	2005
SSC	St. John's Convent High School, Telangana,India	84.83 %	2003

### PHD RESEARCH WORK

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**Thesis Title:** Vibration based fatigue crack diagnosis and fatigue life estimation of rotor shafts

**Guide/Supervisor:** Prof. A. Seshadri Sekhar, IITM

Research work completely hinges on Rotor Dynamics, Digital signal processing, Machine learning techniques and Vibration-based condition monitoring and fatigue life analysis.

During the Ph.D, I have gained expertise in the field of digital signal processing, data science, vibration-based condition monitoring, fatigue life analysis and prognostics of rotating machinery components- with recent work involving combining multiple data streams to create an statistical model for diagnosing incipient fatigue cracks and estimating fatigue life of rotor shafts. We have developed a customized experimental test rig, which is novel and unique by itself that facilitates generating a transverse fatigue crack in a shaft under conditions that mimic a real in-service loading environment of industrial shafts. An Indian patent is granted for this innovative test rig.

## RESEARCH PUBLICATIONS

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### Journal Papers:

- **Sagi Rathna Prasad and A. S. Sekhar**, Detection and localization of fatigue induced transverse crack in a rotor shaft using principal component analysis, *Structural Health Monitoring*, 20(2), (2021):513-531, Sage Publications.
- **Sagi Rathna Prasad and A. S. Sekhar**, Life estimation of shafts using vibration-based fatigue analysis, *Journal of Mechanical Sciences and Technology*, 32 (9) (2018) 4071-4078, Springer.
- **Rahul S, Sagi Rathna Prasad, A.S. Sekhar and Piyush S**, Online health monitoring of rotating machine elements using statistical spectral distances, *Structural Health Monitoring*, Sage Publications (Accepted).
- **Anuradha G, Sagi Rathna Prasad, Piyush Shakya and A. S. Sekhar**, Influence of geometric parameters on the dynamic performance of spiral bevel gear, *Journal of Vibration Engineering & Technologies*, Feb, 2024, Springer.
- **Sagi Rathna Prasad and A. S. Sekhar**, Diagnosis of rotor shaft fatigue crack through sensor data fusion approach, *Non-destructive Testing & Evaluation*, Elsevier, (Under Review).
- **Sagi Rathna Prasad and A. S. Sekhar**, Vibration-based fatigue life estimation of rotor shafts subjected to sine-on-random excitations, *Engineering Failure Analysis*, Elsevier (Under Review).

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### Conference papers:

- **Adam Clark, and Sagi Rathna Prasad**, Road data damaging event segmentation, classification, & analysis using standard & non-standard NVH processing methods, 30<sup>th</sup> International Congress on Sound and Vibration, Amsterdam 8-11 July 2024 (Paper Presented).
- **Rahul S, Sagi Rathna Prasad, Piyush Shakya and A. S. Sekhar**, Tachless instantaneous speed estimation of a wind turbine gearbox using vibration signals, Proceedings of ASME Turbo Expo GT2023, Turbomachinery Technical Conference and Exposition, , June 26-30, 2023, Boston, USA
- **Sagi Rathna Prasad and A. S. Sekhar**, Detection of Fatigue Crack in the Shaft using Time-Frequency Analysis, Sixth National Symposium on Rotor Dynamics, Part of the Lecture Notes in Mechanical Engineering book series, CSIR-National Aerospace Laboratories, Bangalore, NSRD-2019, July 2-3, 2019.
- **Sagi Rathna Prasad and A. S. Sekhar**, Diagnostics of fatigue crack in the shaft using spectral kurtosis, Proceedings of ASME Turbo Expo 2019: Turbomachinery Technical Conference and Exposition, GT2019, June 17-21, 2019, Phoenix, Arizona, USA.
- **Sagi Rathna Prasad and A. S. Sekhar**, Identification of shaft fatigue crack using hybrid statistical parameters, 14th International Conference on vibration engineering and technology of machinery, Lisbon, Portugal, 10-13 September 2018.
- **Sagi Rathna Prasad and A. S. Sekhar**, Fatigue crack detection in rotating shafts using vibration statistical parameters, Indian Conference on Applied Mechanics (INCAM) 2017, MNNIT Allahabad, 5-7th July 2017.
- **Sagi Rathna Prasad and A. S. Sekhar**, Damage detection in rotors using wavelet analysis of operational deflection shapes, 22nd International Congress on Sound and Vibration, Florence Italy 12-16 July 2015.

### International Workshops Attended:

- I received a Mobius Institute scholarship for participating in the hands-on Vibration Analysis training held in Abu Dhabi, UAE, from April 8-11, 2019. The training included interactive case studies and practical approaches for early diagnosis of faults in rotating machinery, presented by industry experts.

## PATENT GRANTED

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- **Sagi Rathan Prasad, A. Seshadri Sekhar, K. Suresh**, “A test rig for vibration-based fatigue analysis and a method thereof”, Patent (Granted): 453220, September 2023.
  - This test rig facilitates generating a fatigue crack in a shaft, under conditions that mimic a real in-service loading environment of industrial rotors such as sine-on-random excitations.
- **Sagi Rathan Prasad, Adam Clark, Evan Jones, Wendy Foslien**, “Automated road vibration data monitoring for event identification, clustering & analysis”, (Trade Secret): 81287612, February 2024.
  - This methodology reduces the computation cost in analyzing the road vibration data and aids in validating the service life of the product against its design life.

## PROFESSIONAL EXPERIENCE

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- **Junior Research Fellow (JRF), IIT Madras (April 2013- July 2015)**
  - Worked on the project titled, ‘The vibration-based technique for fatigue crack detection and life estimation of rotors’ (Sponsored by CSIR)
- **Project Officer (PO), IIT Madras, (July 2020-April 2022)**
  - Worked on the project titled, ‘Development of algorithm of prognostic tool for maintenance of helicopter gears’ (Sponsored HAL India)
- **Technical Consultant , Agnikul Cosmos, (April 2022-May 2022)**
  - Performed vibration based fault diagnosis for high speed motors related to aerospace applications.
- **Project Officer (PO), IIT Madras, (June 2022-August 2022)**
  - Worked on the project titled, ‘In-situ condition monitoring of o-ring’ (Sponsored by LAM Research)
- **Post Doctoral Researcher, IIT Madras, (September 2022-December 2022)**
  - Research work aimed to develop an online vibration monitoring system for propulsion gas turbine and gas turbine generator using AI (This research work is performed under the guidance of Prof. Krishnan Balasubramanian)
- **Associate Tech Lead, Trane Technologies, (December 2022 – October 2024)**
  - The main objective is to develop a IOT based technology to measure and monitor road vibration loads for transport HVACs.

## TEACHING EXPERIENCE

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- **Teaching Assistant (TA), IIT Madras, (July 2015- December 2021)**
  - TA for mechanical vibrations and mechanics of solids courses offered for both UG and PG students. Taught laboratory courses such as free & forced vibration, and strain gauge measurements.
  - TA for rotor dynamics course and its laboratory classes offered only for PG students. Demonstrated essential vibration measurement techniques, orbital plots, bode plots, balancing and modal analysis of Jeffcott rotor bearing system.
  - Conducted the laboratory sessions on free vibration, forced vibration and modal analysis for the following events organized by Machine Design Section, IITM.
    - Workshop on “Practical Vehicle Dynamics” at IIT Madras, November 2017.

- Training sessions on “Applications of Signal processing” for FCA Fiat Chrysler Automobiles Chennai, at IIT Madras, July 2018.
- Short Term Course on “Condition Monitoring for Railway Engineer, at IIT Madras, August 2018.
- **Conducted Hands-on Workshop at Trane Technologies, (June 2023)**
  - Taught the principles of vibration measurement and conducted hands-on training on experimental modal analysis and single axis shaker table testing for advanced engineering team as part of uplift one another program.
- **Conducted Hands-on Workshop at VIT Vellore, (October 2023)**
  - Conducted hands-on training on vehicle vibration measurement and analysis for faculty, UG & PG students of Department of Mechanical Engineering as part of faculty development program.
- **Teaching Assistant for Courses offered by Tom Irvine, (February 2024)**
  - Provided assistance in content development & taught few topics in basic shock & vibration, structural dynamics, & fatigue analysis. Participants from various regions of the world registered for these online courses.

## PROJECTS

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### **PROJECT #1: THE VIBRATION-BASED TECHNIQUE FOR FATIGUE CRACK DETECTION AND LIFE ESTIMATION OF ROTORS ( April 2013- July 2015 )**

**FUNDING AGENCY: CSIR INDIA, WORTH: Rs. 24.5 Lakhs**

#### Description:

- As a part of this project, a vibration-based fatigue test facility is developed that facilitates generating a fatigue crack in a rotor shaft under conditions that mimic a real in-service loading environment of industrial rotors.
- An algorithm is developed to estimate the fatigue life of the rotor shaft by using random vibration theory and statistical fatigue life relations.

### **PROJECT #2: DEVELOPMENT OF ALGORITHM OF PROGNOSTIC TOOL FOR MAINTENANCE OF HELICOPTER GEARS ( July 2020- April 2022)**

**FUNDING AGENCY: HAL INDIA, WORTH: Rs. 49.1 Lakhs**

#### Description:

- An analytical model describing the coupled axial-lateral-torsional vibration of helicopter spiral bevel gear is developed. The investigation focused on the influence of geometric parameters such as spiral angle and pressure angle on the system's dynamic characteristics, revealing a high sensitivity of the unbalance response to these parameters.
- To validate the analytical model, an experimental test rig is being developed to introduce the in-service loading conditions (translational & rotational loads) of helicopter tail gearbox system.

### **PROJECT #3: IN-SITU CONDITION MONITORING OF O-RING ( June 2022- August 2022 )**

**FUNDING AGENCY: LAM RESEARCH, WORTH: Rs. 18.5 Lakhs**

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#### **Description:**

- Strain gauges are embedded into the O-ring for monitoring its performance.
- A test setup is developed to study the performance of healthy and faulty O-ring under different pressure and temperature loads using strain gauge measurements.
- It is observed that the strain gauges embedded in the O-ring aids to identify its faulty condition.

### **PROJECT #4: GEAR CRACK DETECTION IN A GEARBOX SUBJECTED TO VARIABLE LOAD AND SPEED ( January 2021- December 2021)**

**FUNDING AGENCY: EXPLORATORY PROJECT, IIT MADRAS, WORTH: Rs. 9 Lakhs**

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#### **Description:**

- In-house wind turbine simulator is developed that mimic the real-life speed and load conditions faced by wind turbines. This test rig is used to perform fault diagnosis and life tests of high speed gears of wind turbines.
- An online condition monitoring framework is developed and tested to detect and diagnose the early faults in high speed wind turbine gears, bearings and shafts using spectral distances.

### **PROJECT #5: DYNAMIC CHARACTERIZATION OF B05 GROUND SUPPORT MISSILE LAUNCHER (Two Days, December 2022)**

**FUNDING AGENCY: Godrej Mumbai & L&T Defence Pune, Worth: 2 Lakhs**

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#### **Description:** ( This project was handled by me as an investigator)

- The main objective of the modal testing is to determine the natural frequencies of the B05 launcher.
- Natural frequencies are determined for five configurations of the B05 launcher: 1) Canister in original horizontal orientation (zero degrees) 2) Canister in original horizontal orientation (zero degrees) with engine in on-condition 3) Canister positioned in 45 degrees 4) Canister oriented in 90 degrees without ground rested 5) Canister oriented in 90 degrees with ground rested.
- Modal test is performed through acceleration measurements that were made on the canister under the impact excitations.

### **PROJECT #6: ONLINE FIELD VIBRATION DATA MONITORING OF TRANSPORTATION HVAC SYSTEMS (April 2023- On going project)**

**FUNDING AGENCY: Thermo King, Minneapolis, USA, Worth: \$ 25000**

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#### **Description:** (This project is a part of my current work as Associate Tech Lead, Trane Technologies)

- IOT based remote vibration measurement scheme is developed to collect road vibration suitable for performing structural health monitoring and fatigue durability of critical HVAC components.
- An algorithm to identify & classify road load damaging events based on data science techniques is being developed.

## **SCHOLASTIC ACHIEVEMENTS**

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- Path Breaker Award for outstanding performance in the project, Trane Technologies, March 2024.
- Spot Award for best performance in the project, Trane Technologies, May 2023.
- Life Member of Aeronautical Society of India.
- Secured all India 205 rank in AE GATE exam conducted in 2011.

## INVITED TALKS

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- AICTE sponsored online STTP on Vibration Measurement and Analysis on Rotating Machinery at MNM Jain Engineering College, Chennai, May, 2021.
- Intracacies of Road Load Vibration Data Acquisition, SRM Univerty Chennai, November, 2022.
- Online training program on Vibrations, Balancing, Alignment and Condition Monitoring of Rotating Equipement organized by Engineering Staff College of India, Hyderabad, October 2023.

## COMPUTATIONAL AND TECHNICAL SKILLS

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- MATLAB, ANSYS, PYTHON, SOLIDWORKS, AUTOCAD, NCODE
- Experimental Vibration Analysis, Signal Processing, Machine Learning, Statistical Analysis, Condition Monitoring, Prognostics, Experimental Stress Analysis.

## SENSOR AND INSTRUMENTATION SKILLS

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- Sound and Vibration: Accelerometers, Laser Vibrometer, proximity probes, and strain gauges
- Data Physics, 4-channel-Quattro, especially used for rotating machinery analysis.
- Dewe-43V, 8-Channel, especially used for basic structural vibration measurement.
- NI-9234, 4-Channel, especially used for vehicle onboard acceleration measurement.
- Dewetron, 32 channel, especially used for strain measurement.
- Bruel & Kjaer- Dactron used for FRF and modal analysis.
- Siemens TestLab- used to perform modal analysis and operational deflection shapes.
- Vibration Research Vibration Controller, used to perform single axis shaker table life tests.

## ABROAD VISITS/EXPOSURE

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- Florence, Italy: Presented a paper at International congress on sound and vibration (ICSV), July 2015.
- Abu Dhabi, UAE: Participated in hands-on training on vibration analysis delivered by industry experts, April 2019.
- Phoenix, USA: Presented a paper at ASME Turbo Expo, June 2019 and visited Honeywell Research Center.
- Thermo King, Minneapolis, USA, July 2023: Presented a proof of concept on online structural health monitoring and durability analysis of HVAC system critical components, which is then converted in to a new technology project. Furthermore, received trainings on single axis shaker table testing.

## APPENDIX

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Full List of my publications and citation information is available at My Google Scholar Page

<https://scholar.google.com/citations?user=8N8UKJcAAAAJ&hl=en>

My LinkedIn address: [linkedin.com/in/sagi-rathna-prasad](https://www.linkedin.com/in/sagi-rathna-prasad)

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