



**Department of Mechanical and Aerospace Engineering**  
Indian Institute of Technology Hyderabad  
Kandi - 502285, Sangareddy, Telangana, India

### **MAE Seminar Series | Lecture 27**



**Title:** Bat-Inspired Flexible Wings for Improving Aerodynamic Performance in MAVs

**Speaker:** Dr. Sakthi Swarrup J, Ph.D.

**Affiliation:** Fulbright Nehru Postdoctoral Fellow, Brown University, USA

**Abstract** | Bats demonstrate extraordinary maneuverability and long-range flight through their active morphing and adaptive flexible wing configurations. Inspired by these natural adaptations, my research focuses on designing elastomeric, bat-inspired wings that replicate key aspects of bat flight. Specifically, the study explores how wing structure and material properties influence aerodynamic performance, addressing challenges in fixed-wing Micro Air Vehicles (MAVs) to enhance efficiency, agility, and adaptability. In this talk, the development of flexible, lightweight, and low-cost polymeric wings will be discussed, along with their mechanical and aerodynamic analysis. The fabrication methods for creating these elastomeric wings, testing protocols (structural, mechanical, and material), and wind tunnel experiments using robotic platforms simulating bat-like flapping flight will be explained. Experimental techniques will be discussed to demonstrate how these wings enhance aerodynamic forces compared to rigid-wing designs. The analysis includes high-speed camera observations of wing deformation, investigating the effects of flapping frequency, amplitude, and cambering on aerodynamic performance. Additionally, the sensory and muscular mechanisms bats use for flight control will be covered, which inspired the development of polymer-based sensors designed for vibration sensing. I will also cover the fabrication and optimization of ionic polymer-metal composite (IPMC)-based actuators for adaptive flapping wings. By integrating insights from

biology, materials science, structures, and aerodynamics, this interdisciplinary research aims to create energy-efficient, adaptable MAVs for defense, environmental monitoring, and aerospace applications, potentially transforming future flight technology.

**About the Speaker** | Dr. Sakthi Swarrup Jayabalan is a Fulbright scholar who recently completed a two-year Fulbright-Nehru Postdoctoral Research Fellowship at Brown University, collaborating with the Department of Engineering and Ecology and Evolutionary Biology. Her research expertise focuses on nanomaterial composites for aerospace applications, lightweight structural analysis, and the development of flapping wings inspired by natural mechanisms. Dr. Sakthi's interdisciplinary work in bio-inspired design, flapping-wing Micro Air Vehicles (MAVs), and Finite Element Analysis has been published in leading scientific journals. Dr. Sakthi investigated bat flight mechanics and aerodynamics at Brown, exploring flexible, bat-inspired wing designs to enhance MAV performance. She demonstrated leadership by mentoring graduate students, collaborating across departments, and spearheading laboratory development initiatives. Integrating artificial intelligence and data science into curricula earned her a prestigious Data Science Faculty Award. Additionally, she completed advanced certifications in inclusive teaching and storytelling techniques to enhance research presentations. Dr. Sakthi is dedicated to empowering underprivileged students through STEM education and has contributed to Brown's Diversity, Inclusion, and Equity Committee, serving as the social media chair for South Asian Students at Brown University.

Before her tenure at Brown, Dr. Sakthi was an Assistant Professor at the Centre for Nanotechnology Research at Vellore Institute of Technology (VIT), where she taught undergraduate courses in Control Systems, Sensors and Instrumentation, Nanotechnology, and MEMS. She actively mentored students, organized international conferences, and served on various academic committees. Before VIT, she was a Senior Research Associate at the Indian Institute of Science (IISc) for one and a half years following her Ph.D., focusing on Ionic Polymer Metal Composite actuators for insect-scale MAVs. With a multidisciplinary background in Electrical and Electronics Engineering (B.Tech) and Nanotechnology (M.Tech), Dr. Sakthi aims to advance bio-inspired flight design and smart materials, contributing to next-generation aerospace technologies.

**Date:** 06/11/2024

**Time:** 2:00 PM – 3:00 PM Hrs.