Tanmay D. Mathur

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Research Interests

Rotorcraft and jet engine gearboxes, rotating machinery design, testing, and reliability analysis, contact mechanics, lubrication systems, rotordynamics

Education

Doctor of Philosophy in Mechanical Engineering **Aug 2015 - Feb 2019**
The Pennsylvania State University, University Park, PA, USA GPA: 3.94/4

- *Dissertation*: Comprehensive analysis, design, and fabrication of Pericyclic mechanical transmission with straight bevel gears
- *Advisors*: Prof. Edward C. Smith, Prof. Liming Chang
- *Date Conferred*: 05/04/2019

Master of Science in Mechanical Engineering **Aug 2013 - Aug 2015**
The Pennsylvania State University, University Park, PA, USA GPA: 3.96/4
Date Conferred: 12/19/2015

Bachelor of Technology in Mechanical Engineering **Aug 2008 - May 2012**
Indian Institute of Technology Roorkee, Uttarakhand, India GPA: 7.995/10
Date Conferred: 08/05/2012

Academic Experience

Assistant Professor **May 2023 - Present**
Aerospace Engineering, IIT Kanpur, UP, India

- PI: drivesystem research lab to support VTOL UAV, rotorcraft, and jet engine gearbox R& D at TRL 1 to TRL 4 levels
- Instructor - Introduction to Vibrations (AE233), Dynamics and Vibration (AE 688), Aersp. Struct. Analysis II (AE 687). Recipient of Director's letter of commendation for excellence in teaching.

Industrial Experience

Drive system technical leader **Aug 2021- Apr 2023**
Leonardo Helicopters, Philadelphia, PA, USA

- Lead the US drivesystem team in civil certification by FAA of world's first ever commercial tiltrotor AW-609
- Presented lunch and learn seminars on "Tiltrotor drivesystems - state of the art and way forward"
- PI-FAA proposal on "Drivesystem ratings for multirotor fly-by-wire VTOL aircrafts" and author of 2 reports and 1 conference paper.
- Developed design, manufacturing, and inspection methods for mechanical components and subsystems for next generation tiltrotor drive system
- Formulated flight test plans and resolved flight test squawks

Research Engr. - Mechanical Components/Systems **Jul 2019 - Jul 2021**
GE Research, Niskayuna, NY, USA

- Design and commissioning of test rig for full scale testing of next generation narrow body aircraft engine power gearbox
- Lead test programs for aerospace bearings for operation at elevated stress levels and in contaminated environments - test planning, execution, data analysis, and reporting

- Responsible for test rig design and commissioning for testing and validating supercritical CO_2 gas bearings (funded by DOE) for turbomachinery. Lead on rotordynamics analysis and pressure vessel design
- PI from GE Research on high reduction ratio transmission development DOD proposal led by Boeing
- Created python based tool to generate exact gear CAD models imitating parts generated from manufacturing process and perform computational contact analysis
- Conceptualized and executed wind main bearing sub-scale test programs
- Managed a total research budget of $2 MM.
- Recipient of 2 impact awards for FY-20

Engineering Intern **Jul- Sept 2015 & Jun - Aug 2016**
Sentient Science Inc, Idaho Falls, ID (2015) and Buffalo, NY(2016)

- Developed a boundary element method (BEM) based 2-D fatigue crack propagation analysis tool in Python
- Predicted fatigue life of wind turbine gears from analysis of crack propagation in helical gear teeth using FRANC3D
- Developed a gear analysis software in Python with similar capabilities as OSU load distribution program (LDP) for spur and helical gears

Business Technology Analyst **Jun 2012 - Jun 2013**
Deloitte Consulting, Hyderabad, India

Engineering Intern **May 2010 - Jul 2010**
Eicher Tractors, Bhopal, India
Project: The influence of gear profile modifications on the transmission error in tractor drivelines

Research Experience

Graduate Research Assistant **May 2014 - Feb 2019**
Pennsylvania State University, University Park, Pennsylvania USA

- Responsible for technical maturation of a novel transmission technology - Pericyclic drive, from concept to prototype for testing under load
- Developed comprehensive design tools for components (gears, bearings, shaft) and drive system from first principles in Python and MATLAB
- Single point-of-contact for designing, drafting, vendor relations, and purchasing needs for the project
- Collaborated with several manufacturers and NASA Glenn Research Center personnel for prototype development and testing
- Project recognized for **NASA group achievement award** as a part of Revolutionary Vertical Lift Technology Team (RVLT) tasks
- Experienced in writing grant proposals to federal agencies and private consortia

Postdoctoral Scholar **Mar 2019 - Jun 2019**
Pennsylvania State University, University Park, Pennsylvania USA

- Performed advanced analysis of Pericyclic drive prototype performance, and oversaw completion of fabrication
- Dissemination of Pericyclic drive research with an over-all program review at conferences, and technical meetings with collaborators

- Recruited and trained new graduate student to continue the research and development efforts

Computational Skills

Languages: Python, MATLAB
CAE: SolidWorks, Ansys, Autodesk Inventor, ABAQUS, Romax Designer, XLRotor, FRANC3D
Data Acquisition: Simcenter Testlab, IADS telemetry

Teaching Experience (before joining IITK)

Graduate Teaching Assistant **Aug 2013 - May 2014**
Pennsylvania State University, University Park, Pennsylvania USA

- Teaching assistant for ME-450 (Modeling of Dynamic Systems) with a class strength of 60+ each semester
- Featured in Penn State news for a lecture on "zombie apocalypse simulation" model

Journal Papers

- **Mathur, Tanmay D.**, Edward C. Smith, and Robert C. Bill, "A Novel Loaded Tooth Contact Analysis Procedure with Application to Internal-External Straight Bevel Gear Mesh in Pericyclic Drive" J. Tribol. Oct 2021, 143(10): 101201 (13 pages)
- **Mathur, Tanmay D.**, Edward C. Smith, Hans DeSmidt, and Robert C. Bill, "System and Component level Design Procedure for High Reduction Ratio Pericyclic Drive" Journal of the American Helicopter Society (2022)
- N. Weinzapfel, N. Bolander, **T. Mathur**, E.C. Smith, H. DeSmidt, "Dynamic Load Analysis of Motion Converter Ball Bearings in a Pericyclic Transmission", Journal of the American Helicopter Society (2023), selected as **best paper** in propulsion session of VFS Forum 78.

Conference Publications & Presentations

- P.P. Sute, P. Verma, **T. Mathur**, P. Hajela, "Multi-objective Design Optimization of a Helicopter Tail Shaft", VFS Forum 81, May 2024, Virginia Beach, Virginia, USA
- D. Sootail, **T. Mathur**, B. Thompson, "A variable speed traction drive for rotary wing UAV applications", IndiaTrib-2024, 19-21 December 2024, Kolkata, India
- J. McGovern, E.C. Smith, H. DeSmidt, R. Bill, **T. Mathur**, M.A. Stevens, C.M. Mistingas, E.S. Schroen, "Preliminary results from dynamic testing of a Pericyclic Drive System", VFS Forum 80, May 2024, Montreal, Quebec, Canada
- N. Albuck, **T. Mathur**, A. Haidar, "Development of a coupled torsional dynamics and gear contact model to predict peak loads in a tiltrotor drive system", VFS Forum 79, May 2023, West Palm Beach, FL, USA
- **T. Mathur**, E.C. Smith, R. Bill, "Development of the Pericyclic drive from concept to prototype – a path towards rotorcraft transmission weight and noise reduction" VFS Propulsion and Power Technical Meeting, Oct. 2019, Hampton, VA, USA
- **T. Mathur**, M.A. Stevens, E.C. Smith, R. Bill, "Pericyclic Transmission Prototype: Detailed Component Design, Analysis and Fabrication", AHS Forum 75, May 2019, Philadelphia, PA, USA
- **T. Mathur**, E.C. Smith, H. DeSmidt, R. Bill, "Design of a High Power Density Pericyclic Drive Prototype for Testing at NASA Glenn Transmission Test Facility", AHS Forum 74, May 2018, Phoenix, AZ, USA
- **T. Mathur**, E.C. Smith, L. Chang, R. Bill, "Contact Mechanics and Elasto-Hydrodynamics Lubrication Analysis of an Internal-External Bevel Gear Mesh in a Pericyclic Drive", Proceedings of ASME-2017 IDETC, Cleveland, Ohio, USA, Aug 6-9, 2017

- **T. Mathur**, E.C. Smith, H. DeSmidt, R. Bill, "Load Distribution and Mesh Stiffness Analysis of an Internal-External Bevel Gear Pair in a Pericyclic Drive", AHS 72nd Annual Forum, West Palm Beach, Florida, USA, May 17-19, 2016
- **T. Mathur**, Z. Saribay, R. Bill, E.C. Smith, and H. DeSmidt, "Analysis of Pericyclic Mechanical Transmission with Straight Bevel Gears," 56th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, January 2015
- **T. Mathur**, "Pericyclic Drive - A quiet transmission suited for Rotorcraft transmission" Center of Acoustics and Vibration (Penn State) Review '15 -'16, April 2016 (**Presentation only**)

Professional Affiliations

- Vertical Flight Society (VFS): member of propulsion technical committee and education committee
- Senior member of Indian National Academy of Engineering (INAE)
- Reviewer for Journal of American Helicopter Society, ASME Journal of Tribology, Mechanism and Machine Theory, Journal of Aerospace Engineering (SAGE)