ARJUN H. RAO

Department of Industrial & Systems Engineering

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RESEARCH INTERESTS

My research lies at the interface of systems engineering, safety and risk analysis, and human factors. The fundamental aim of my research is to develop theoretically sound modeling and analysis techniques that leverage the data-rich environment for safety analytics. I anticipate that these data-driven approaches will help engineer safer socio-technical systems (e.g., healthcare, air-traffic control), and enable stakeholders to make risk-informed decisions. The outcomes of this research can guide decisions in system design and operation.

Expertise: Safety in aviation and healthcare; accident modeling; resilience engineering and team resilience; user centered design.

EXPERIENCE

Texas A&M University   *College Station, TX*
Assistant Research Engineer   *June 2018–Present*
Affiliation: Department of Industrial & Systems Engineering
Supervisors: Prof. Farzan Sasangohar & Prof. Mark Lawley

The Ohio State University   *Columbus, OH*
Research Specialist   *May 2016–May 2018*
Affiliation: Center for Aviation Studies
Supervisors: Prof. John Horack & Prof. Seth Young

EDUCATION

Purdue University   *West Lafayette, IN*
Ph.D. in Aeronautical and Astronautical Engineering   *December 2016*
Major: Systems Engineering
Thesis: *A New Approach to Modeling Aviation Accidents*
Advisor: Prof. Karen Marais
Committee Members: Prof. William Crossley, Prof. Mary Johnson, and Prof. Steven Landry

University of Illinois at Urbana-Champaign   *Urbana, IL*
MS in Aerospace Engineering   *May 2012*
Thesis: *Measurement of Aerodynamic Characteristics of MAVs Using Motion Tracking*
Advisor: Prof. Michael S. Selig

R.V. College of Engineering   *Bangalore, India*
B.Eng. in Mechanical Engineering   *May 2009*
Thesis: *Estimation of Plastic Stress Concentration factor around Elliptical Cut-outs*
Advisors: Prof. C. S. Murthy and Mr. Mohan Kumar

RESEARCH EXPERIENCE

Texas A&M University

Harmonizing Safety Databases   June 2018–Present

There exist several publicly available safety databases detailing information of accidents or incidents from several safety-critical domains including aviation and process industry. This research identifies publicy available database and evaluates them using several criteria including amount of information contained, ease of accessibility, and readiness for analyses.

Smart Post-Traumatic Disorder (PTSD) System   June 2018–Present

This research provides sensor-based monitoring of important mental state information and will help veterans to communicate patients' key mental state changes, thus enabling clinicians to access and monitor patients by presenting them with information that supports their work and meets their expectation. Findings from this research will be presented in conference proceedings and journal articles.

The Ohio State University

Pilot Decision-Making During Unexpected Events   May 2016–May 2018

Pilots are increasingly faced with unexpected events during flight for which there are generally no readily available checklists. This research attempts to provide guidance to pilots by using resilience engineering principles.

Weather Technology in the Cockpit   May 2016–May 2018

With the prevalence of weather information devices and products available to pilots, it is important to understand pilot perception of weather conditions and the use of weather information products. This multi-year project seeks to better understand the above topics.

Safety Analysis for General Aviation   May 2016–May 2018

This project leverages the use of flight data records from General Aviation aircraft to provide safety insights to pilots and instructors. As part of this research, we also developed an interface to communicate findings from the analyses of flight data.

Flight Path Management   March 2017–December 2017

This research, carried out in collaboration with MITRE, surveyed pilots from several major airlines to understand the procedure versus practice gap in the context of flight path management. Among several questions, pilots were asked to highlight the reasons for unstabilized approaches and failed go-arounds. Findings from this research were submitted as a technical report to the Federal Aviation Administration (FAA).

Purdue University

State-based Modeling of Aviation Accidents   January 2013–March 2016

In an effort to better understand accident causation, part of this research developed an accident modeling technique that leverages the existing historical accident data contained in the National Transportation Safety Board (NTSB) database. Findings from this research were disseminated through several presentations, posters, conference and journal publications.

Rotorcraft ASIAS   October 2013–March 2016

Supported by the Federal Aviation Administration (FAA), this multi-university research effort sought to improve rotorcraft safety using data-driven techniques. As part of this research, I investigated

the reasons for rotorcraft accident causation using a combination of quantitative and qualitative data analyses. While the quntitative analysis used a retrospective accident analysis approach, I implemented a survey to collect qulitative data from subject matter experts (SMEs).

University of Illinois at Urbana Champaign

Human Factors and Cognitive Engineering Group   October 2011–May 2012

Worked as a member of a team headed by Dr. Alex Kirlik. The research objective was to optimize aircraft taxi times and reduce departure delays. The findings from this research were published in a journal article.

UAV Aerodynamics Using Motion Tracking   January 2010–May 2012

Low Reynolds number, unsteady aerodynamic characteristics of RC-scale UAVs are not well understood. This research used motion tracking cameras to capture position and attitude of UAVs, and derived aerodynamics flight parameters.

PUBLICATIONS

Journal Articles

1. "Continuous Monitoring and Detection of Post-Traumatic Stress Disorder (PTSD) Triggers Among Veterans: A Supervised Machine Learning Approach", McDonald, A.D., Sasangohar, F., Jatav, A., **Rao, A.H.**, *IISE Transactions on Healthcare Systems Engineering* (In Review)

2. "High-Risk Occurrence Chains in Helicopter Accidents", **Rao, A.H.** and Marais, K., *Reliability Engineering and System Safety*, Vol. 170, pp. 85–98, 2018. `https://doi.org/10.1016/j.ress.2017.10.014`

3. "Estimation of Plastic Stress Concentration Factor around Elliptical Cut Outs", Kumar, M. M., **Rao, A.H.**, Vijaykumar, J., Arun, S.N., Chandy, M., *International Journal of Engineering Research and Development*, Vol. 8(8), pp. 33–40, 2013.

Book Chapters & Technical Reports

1. "Physiological and Psychological Aspects", **Rao, A.H.**, Mehta, R. K., and Sasangohar, F., *Clinical Engineering Handbook* (In Review)

2. "Standard Operating Procedures: Flight Path Management (FPM) Air Carrier Operations", A. A. Herndon, Jr. Jarrott, W. M., Lyall-Wilson, E., McKnight, C. V., Miller, S., Pruchnicki, S., **Rao, A. H.**, Reed, C. B., MITRE Technical Report, MTR170XXX. Released for FAA Review.

Peer-Reviewed Conference Proceedings

1. "Retrospective Analysis of Approach Stability in General Aviation Operations", **Rao, A.H.** and Puranik, T.G., *18th AIAA Aviation Technology, Integration, and Operations Conference*, AIAA Paper 2018-3049, Atlanta, GA, June 2018. `https://arc.aiaa.org/doi/pdf/10.2514/6.2018-3049`

2. "Deep-learning based Time Series Forecasting of Go-around Incidents in the National Airspace System", Subramanian, S.V. and **Rao, A.H.**, *AIAA SciTech 2018*, AIAA Paper 2018-0424, Kissimmee, FL, January 2018. `https://doi.org/10.2514/6.2018-0424`

3. "Prevalence of Resilient Skills in General Aviation Crews", **Rao, A.H.** and Pruchnicki, S., and Young, S. B., *7th REA Symposium*, Liege, Belgium, June 2017.

4. "A Survey to Understand the Use of In-flight Weather Information Products and Services", **Rao, A.H.**, Pruchnicki, S., and Young, S. B., *17th AIAA Aviation Technology, Integration, and Operations Conference*, AIAA Paper 2017-3780, Denver, CO, June 2017. `https://doi.org/10.2514/6.2017-3780`

5. "Exploring Facilitated Debriefing Techniques Using a Diary Study", Pruchnicki, S. and **Rao, A.H.**, *19th International Symposium on Aviation Psychology*, Dayton, OH, April 2017.

6. "Comparing Hazardous States and Trigger Events in Fatal and Non-Fatal Helicopter Accidents", **Rao, A.H.** and Marais, K., *16th AIAA Aviation Technology, Integration, and Operations Conference*, AIAA Paper 2016-3916, Washington, DC, June 2016. `https://doi.org/10.2514/6.2016-3916`

7. "Top Causes for Fatal and Non-Fatal Accidents in Helicopter Operations" **Rao, A.H.** and Marais, K., *72nd American Helicopter Society International Annual Forum 2016*, West Palm Beach, FL, May 2016

8. "Challenges and Opportunities in Flight Data Mining: A Review of the State of the Art" Gavrilovski, A, Jimenez, H., Mavris, D, **Rao, A.H.**, Marais, K., Shin, S., and Hwang, I, *AIAA SciTech, 2016*, AIAA Paper 2016-2135, San Diego, CA, January 2016. `https://doi.org/10.2514/6.2016-0923`

9. "Analyzing Maintenance Risk from Helicopter Accident Data" **Rao, A.H.**, Fala, N., and Marais, K., *AIAA SciTech, 2016*, AIAA Paper 2016-0923, San Diego, CA, January 2016. `https://doi.org/10.2514/6.2016-2135`

10. "Identifying High-Risk Occurrence Chains in Helicopter Operations from Accident Data", **Rao, A.H.**, Marais, K., *15th AIAA Aviation Technology, Integration, and Operations Conference, 2015*, AIAA Paper 2015-2848, Dallas, TX, June 2015. `https://doi.org/10.2514/6.2015-2848`

11. "Glide and Powered Flight Characteristics of Micro Air Vehicles from Experimental Measurements", **Rao, A.H.**, Uhlig, D.V., Selig, M.S., *AIAA Applied Aerodynamics Conference, 2012*, AIAA Paper 2012-2768, New Orleans, LA, June 2012. `https://doi.org/10.2514/6.2012-2768`

12. "Determining Aerodynamic Characteristics of Micro Air Vehicles Using Motion Tracking" Uhlig, D.V., Sareen, A., Sukumar, P., **Rao, A.H.**, Selig, M.S., *AIAA Guidance, Navigation and Control Conference, 2010*, AIAA Paper 2010-8416, Toronto, Canada, 2010. `https://doi.org/10.2514/1.C031996`

Posters & Presentations

1. "A State-based Approach to Modeling General Aviation Accidents", **Rao, A.H.**, *Industrial and Systems Engineering Seminar Series*, Texas A&M University, College Station, TX, May 2018. (Invited Talk)

2. "Safety Analysis of General Aviation Runway Operations", Dittoe, S., **Rao, A.H.**, and Young, S. B., *University Aviation Association*, October 2017, **3rd Place in Graduate Category**, `https://www.uaa.aero/poster_contest_2017_winners.php`.

3. "Resilient Capabilities in Single Pilot and Crewed Flight Operations", Pruchnicki, S, **Rao, A.H.**, and, Young, S. B., *7th REA Symposium*, June 2017, Liege, Belgium.

4. "Problem Solving/Decision Making and Procedures for Unexpected Events", **Rao, A.H.** and Pruchnicki, S., and Young, S. B., *PEGASAS Annual Meeting*, College Station, TX, June 2017.

5. "Problem Solving/Decision Making and Procedures for Unexpected Events", **Rao, A.H.** and Pruchnicki, S., and Young, S. B., *International Society on Aviation Psychology*, Dayton, OH, April 2017.

6. "Comparing Hazardous States and Trigger Events in Fatal and Non-Fatal Helicopter Accidents", **Rao, A.H.** and Marais, K., *16th AIAA Aviation Technology, Integration, and Operations Conference*, , Washington, DC, June 2016.

7. "Analyzing Maintenance Risk from Helicopter Accident Data", **Rao, A.H.**, Fala, N., and Marais, K., *AIAA SciTech, 2016*,, San Diego, CA, January 2016.

8. "Identifying High-Risk Occurrence Chains in Helicopter Operations from Accident Data", **Rao, A.H.**, Marais, K., *15th AIAA Aviation Technology, Integration, and Operations Conference, 2015*, , Dallas, TX, June 2015.

9. "Identifying High Risk Safety Events in Helicopter Accidents", **Rao, A. H.** and Marais, K., *HeliExpo 2015*, Orlando, FL, March 2015.

10. "Glide and Powered Flight Characteristics of Micro Air Vehicles from Experimental Measurements", **Rao, A.H.**, Uhlig, D.V., Selig, M.S., *AIAA Applied Aerodynamics Conference, 2012*, New Orleans, LA, June 2012**.**

TEACHING EXPERIENCE

ISEN 630: Human Operator in Complex Systems   Fall 2018
Co-Instructor   *College Station, TX*

Instructing sessions relating to warning and documentation, controls, amd human error in complex socio-technical systems. Assisting in writing exams and project report grading.

ISEN 485-502: Aggie Challenge   Fall 2018
Co-Instructor   *College Station, TX*

Assisting with the administration and development of tasks for student-led design and app development teams. Student teams work towards developing a usability-tested PTSD suport app. Co-instruct sessions on heuristics, user-centered design, usability testing, and prototyping.

AVN 4500: Aviation Senior Capstone   Spring 2018
Co-Instructor   *Columbus, OH*

Restructured the senior year aviation capstone class to provide additional time for student research. Solicited project ideas from aviation companies and stakeholders. Instructed a class of 41 undergraduate students and advised to research project teams.

AVN 3300: Aviation Human Factors and Safety   Fall 2017
Guest Lecturer   *Columbus, OH*

Instructed sections on theoretical models to understand aviation accident causation to a class of 30 aviation juniors and seniors. Also wrote homeworks and exam questions relevant to my lectures.

AAE 251: Introduction to Aerospace Design   Spring 2013
Teaching Assistant   *West Lafayette, IN*

Helped restructure a sophomore aerospace design course to make it more interactive, improving student-teacher accessibility. Led and facilitated discussion sessions on topics related to aircraft and spacecraft design.

AAE 351: Aerospace Systems Design   Fall 2012, 2013
Teaching Assistant   *West Lafayette, IN*

Interacted with and advised student teams on the importance of writing good requirements. Carried out periodic reviews and assisted students with their conceptual designs. Assisted the instructor in writing homeworks and exams.

CS 101: Introduction to Computer Science for Engineers   August 2010–May 2012
Section Instructor   *Urbana, IL*

Instructed and assisted students (freshman and sophomore) in MATLAB and C programing. Taught multiple sections of an introductory Computer Science course for engineering majors. Assisted in writing exams, labs, and machine problems.

AE 100: Introduction to Aerospace Engineering   Fall 2009
Teaching Assistant   *Urbana, IL*

Interacted with 40 freshman aerospace engineers. Answered questions in office hours and served as a mentor to undergraduates. Guest lectured aircraft stability and control modules. Also helped organize class field trip.

WORKSHOPS ATTENDED

- Academic Coaching Tools organized by the Purdue Coaching Community (PCC)   Spring 2015
- "Effective Teaching: A Workshop"–Conducted by Dr. Richard Felder   Fall 2012

HONORS AND AWARDS

- "*Outstanding Researcher Award*" from the Federal Aviation Administration   June 2016
- Awarded "*Purdue Graduate Student Government (PGSG) Tavel Grant*"   Fall 2015
- Awarded "*College of Engineering Travel Grant*"   Spring 2015
- "Magoon Excellence in Teaching Award" by Purdue University   Fall 2013
- "List of Teachers Ranked as Excellent by their Students" for **five** semesters   2010–2012
- Awarded the *"Graduate Teachers Certificate"* by the Center for Teaching Excellence   Fall 2012

PROFESSIONAL SERVICE

Committee
- AIAA General Aviation Technical Committee
- Helped facilitate Rising Leaders in Aerospace (RLA) sessions as part of the AIAA Young Professionals Committee

Reviewer
- Safety Science
- Human Factors: Journal of Human Factors and Ergonomics Society
- Risk Analysis
- Transportation Research Record
- Journal of Aviation Technology & Engineering (JATE)
- Journal of Aviation/Aerospace Education and Research (JAAER)
- AIAA Aviation Technology, Integration, and Operations (ATIO) conferences
- AIAA SciTech conferences

Session Chair

· AIAA Aviation Technology, Integration, and Operations (ATIO) conferences 2015–2018

Departmental Service

· Chair for aerospace engineering student seminar series at Purdue
· eMentoring: Served as mentor to an aerospace graduate student at Purdue
· Professional Development chair for an aerospace graduate student organization at Purdue
· Aerospace graduate student representative reporting to the associate dean of engineering at Purdue
· Served on graduate student advisory committee at the University of Illinois Urbana Champaign

PROFESSIONAL AFFILIATIONS

- Member of the American Institute of Aeronautics and Astronautics

- Member of the Human Factors and Ergonomics Society

Arjun H. Rao (August 2018)