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ASME INTERNATIONAL GAS TURBINE INSTITUTE

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It's Turbo Time!

ASME Turbo Expo 2018 | June 11 - 15

Norway Exhibition and Convention Centre, Lillestrøm, Norway

Now in its 63rd year, ASME Turbo Expo is recognized as the must-attend event for turbomachinery professionals. Whether you are a student, professor, engineer, or other industry professional - there is something for you!

Networking Events

Female registrants are invited to join their colleagues for a networking event that will feature motivating talks by GE and Pratt & Whitney representatives. Attendees will have the opportunity to network with women in the industry and learn about the career paths of some successful women in the industry.

If you are a student or early-career engineer, network with your peers at the mixer on Wednesday night.

Join your colleagues for complimentary light refreshments during the welcome reception. The casual atmosphere of these events is ideal to catch up with friends and meet the thinkers from around the world who are shaping the future of turbomachinery and the power industry.

The Advance Program is online, which allows you to look over the technical sessions and decide, now, which sessions you would like to attend. See if there is anything new that sparks your interest—perhaps a new technology that could be of great significance in the future. For a small additional registration fee, consider attending one of the six Pre-Conference Workshops.

Plan now to join 3,000 turbine colleagues from around the world at ASME Turbo Expo, ASME's premier turbine technical conference and exposition!

Turbo Expo 2018 | June 11 - 15

Norway Exhibition and Convention Centre, Lillestrøm, Norway. For more information, visit https://www.asme.org/events/turbo-expo

Tuesday Plenary

Impact of Additive Manufacturing on Future Gas Turbine Engines and Parts

Wednesday Plenary

Big Data in MRO

Featuring

- Michael Winter, *Pratt & Whitney, Senior Fellow Advanced Technology*
- Neil A Mantle, *Rolls-Royce, Head of Additive Layer Manufacturing*
- Masahito Kataoka, *Mitsubishi-Hitachi Power Systems, General Manager Large Frame Gas Turbine Engineering*
- Markus Seibold, *Siemens Power & Gas, Head of Additive Manufacturing*
- Bernhard Krüger-*Sprengel, Lufthansa Technik, Senior Vice President Engine Services*

Keynote Panel MRO in the Light of Digitalization

Mr. Paul Stein is currently Research & Technology Director at Rolls-Royce. He joined the company in 2010 as Chief Scientific Officer. Previously he was Director General, Science and Technology at the UK Ministry of Defence, responsible for national investment in defence science and technology. Prior to that role, Paul was Managing Director of Roke Manor Research, at that time owned by Siemens and was a member of the Siemens UK executive management board, leading on technology and contributing to business strategy.

Dr. Zuo Zhi Zhao is currently Chief Technology Officer in the Power & Gas division at Siemens. He joined the company in 2009 at its Chinese hub in Shanghai as Program Manager of Gas Turbine Technology Development and held the positions of Engineering Manager of Gas Turbine Shanghai Engineering Hub, General Manager of Gas Turbine Business Operation and General Manager of Gas Turbine Business Unit. Previously he was a Project Leader on aircraft engine research and development at GE Global Research in Niskayuna, NY, USA.

As the Turbine Turns...

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Lee S. Langston, Professor Emeritus
University of Connecticut
Mechanical Engineering Dept.

New Bird Ingestion Tests?

For those of us who attended last year's ASME TURBO EXPO '17 in Charlotte, North Carolina, there was an opportunity to visit a unique museum jet airliner display. The largely intact wreck of the Airbus A320 that landed safely in the Hudson River is on display at Charlotte's Carolinas Aviation Museum, complete with its two bird-ingested disabled jet engines.

As you may recall, this was an airline bird strike incident that has come to be called "Miracle on the Hudson". On January 15, 2009, US Airways flight 1549, this Airbus 320 with 150 passengers was taking off from La Guardia Airport bound for Charlotte. About 3 minutes from takeoff and at about 2800 feet altitude, it struck a flock of Canada geese just northeast of the George Washington Bridge. Each CFM56 engine ingested at least two geese (weighing about 8 pounds each), one of which was ingested into each engine core. This caused mechanical damage, which prevented both engines from maintaining thrust for sustained flight. The crew then successfully ditched the aircraft in the Hudson River with no loss of life.

Dual bird ingestion engine incidents in twin engine jets are proving not to be a rare occurrence. Three other such incidents occurred in 2009 (a Boeing 737 destroyed at Rome's Ciampino Airport, an A320 on takeoff at Bourgas, Bulgaria, and a Boeing 737 in Ireland).

Aviation regulators are now proposing new bird ingestion tests for aircraft engine certification to address these growing flight safety issues. I'll give a short review of all of this in what follows.

Bird Ingestion Engine Damage

As Boeing points out [1], bird strikes occur at various aircraft locations (see Fig. 1) but usually inflict most damage to the engines. Airplane damage and effect on flight from bird strikes are closely correlated to kinetic energy, derived from the mass (determined by the bird species) and the velocity of collision squared. (A 20% increase in speed raises the kinetic energy by 44%.)

Just how many engine bird strikes occur for civil aviation? Dolbeer, et al [2] report on statistics for the U.S. (which includes U.S. registered aircraft in foreign countries) for the recent quarter century, 1990-2015. During these 25 years, 17,494 jet engines were struck in 16,694 bird strike events. Out of these, 4516 engines were damaged in 4370 bird strike events (4227 events with one engine damaged, 141 with two engines damaged (such as the Hudson landing event), 1 with three engines damaged, and 1 with four engines damaged).

These U.S. statistics indeed show that bird ingestion in commercial jet engines is significant and even more so, when combined with records from the rest of the flight world.

Current statistics show that incidents of commercial aircraft jet engine bird ingestion are increasing, and are considered to be a continuing challenge over the next decade. Factors that contribute to this avian threat are increasing populations of large birds and increased air traffic by quieter, turbofan powered aircraft [2]. These and other factors have been discussed in two past issues of this column [3] [4].

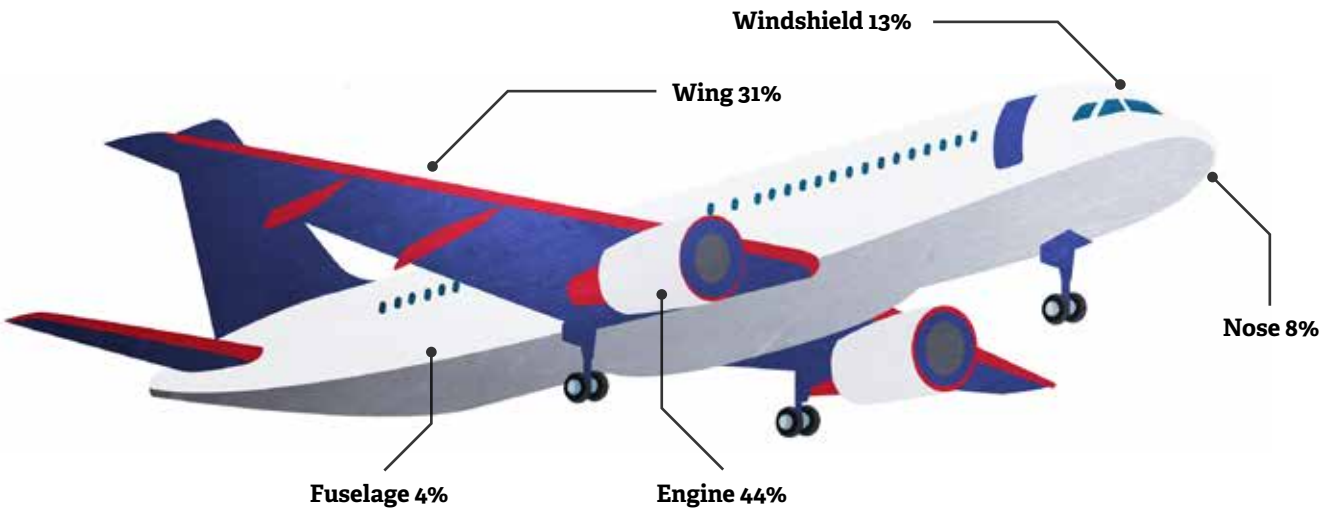


Figure 1: Locations Of Bird Strike Aircraft Damage [1]

Bird Strike Certification Testing

All commercial jet engines must comply with bird ingestion regulations established by regulatory authorities such as the U.S. Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA). These regulations involve certification testing of commercial jet engines for bird ingestion, calling for demonstrations of an engine's ability to ingest birds in small, medium and large categories at takeoff power and still maintain a specified level of performance. I refer the reader to a concise and a fascinating GGTN article by Robert Mazzawy [5] on details of current bird strike certification testing by OEMs.

Recently, EASA, working with other authorities, is proposing additional OEM bird ingestion testing requirements for an engine operating under climb conditions, following the ingestion of a medium sized bird into the engine core. The test engine must continue to operate with a fan speed representative of climb conditions, and then approach conditions for a safe landing. (If the test engine includes features that prevent bird material from entering the core, the engine should continue to operate at approach conditions, after ingestion.)

It seems that the major findings in the EASA led proposal, is that current tests don't result in enough bird mass reaching the engine core where it can lead to significant power loss. They want OEMs to increase the threat mass (bird size and/or number) and to adjust the engine RPM and bird velocity to increase the chance for a bird to get through fan blades and reach the core (as happened with the Hudson landing incident). They also are placing priority on doing run-on tests of the engine after the strike to validate its ability to safely land. Fan blade design has advanced to where blade failure is not the issue (although proving this is still part of the certification testing) so any new testing is focused on the core intrusion by the bird(s) along with run-on requirements.

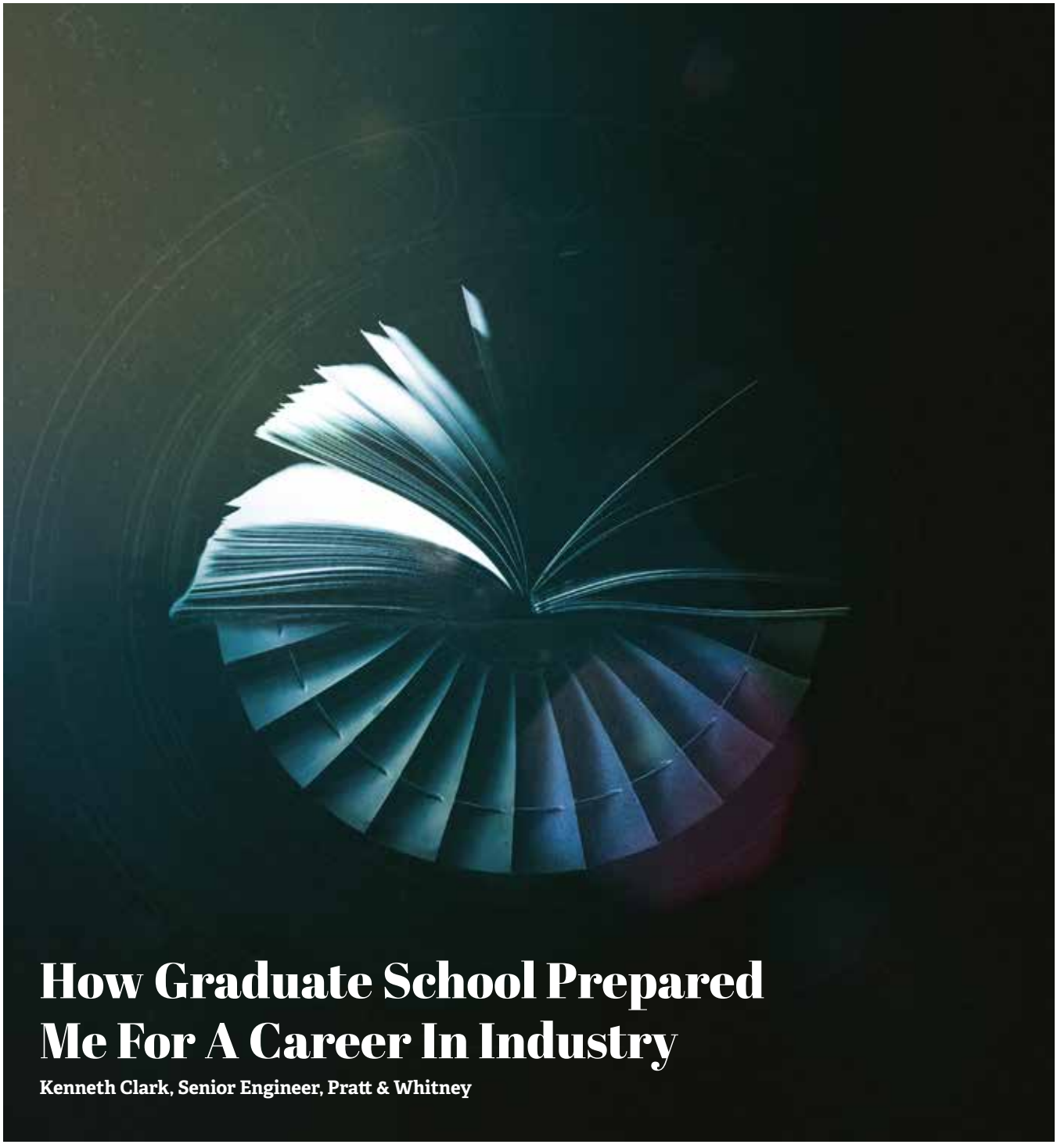
A Few Comments

As I commented in an earlier column [4], approaches to solve birdstrike issues by the civil aviation community are rather fragmented. Engine companies are repeatedly called upon to make their engines strong enough to endure bird ingestion, rather than regulations being enacted to prevent the bird strikes themselves.

As Capt. Paul Eschenfelder, a retired Delta airlines pilot has told me, the proposed regulations discussed above are a big and best change, in that they require an engine robust enough to last until a successful turn back can be made. But what is really needed is a new systems approach to adequately mitigate the risks of aircraft and bird occupying the same air space at the same time.

References

1. Nicholson, Roger and Reed, William S., 2011, "Strategies for Prevention of Bird-Strike Events", Boeing Aero, Issue 43, Q 03, pp. 17-24.
2. Dolbeer, Richard A., Weller, John R., Anderson, Amy L., and Begier, Michael J., 2016, "Wildlife Strikes to Civil Aircraft in the United States 1990-2015", U.S. Federal Aviation Administration and U.S. Department of Agriculture, November.
3. Langston, Lee S., 2012, "Birds and Jet Engines", Global Gas Turbine News, December, p. 51.
4. Langston, Lee S., 2014, "Avian Avoidance and Aviation", Global Gas Turbine News, pp. 50, 54.
5. Mazzawy, Robert S., 2013, "The Big Bang - Bird Strike Certification Testing", Global Gas Turbine News, April, pp. 52, 54.



How Graduate School Prepared Me For A Career In Industry

Kenneth Clark, Senior Engineer, Pratt & Whitney

Gas turbines have fascinated me since I first started working on them my senior year of college. They are complex, powerful machines, with endless exciting technical challenges to work on—they are a mechanical engineer's dream, or nightmare depending on how you look at it. About a year ago I fulfilled a long-term goal of mine, to complete my doctoral program and begin a career as an engineer at a gas turbine company. In this article I will discuss how my graduate education has helped me begin my career at Pratt & Whitney, and I will share advice I have for those who will soon graduate or for those who have recently graduated and started a career in industry.

During the last year of my undergraduate degree at Brigham Young University, I got involved in gas turbine research. I worked as a research assistant performing computational fluid dynamics (CFD) simulations to study compressor aerodynamics. I enjoyed the research, and stayed at Brigham Young to pursue a M.S. degree, learning many important skills while there, including how to dig deep into a research question, how to accurately perform numerical simulations, and how to process large data sets. My gas turbine experience, however, was narrowly focused as I only did numerical work. To prepare myself better for a career I needed to expand the breadth of my gas turbine knowledge.

After my M.S. I chose to pursue a Ph.D. at Penn State University, as there was a great opportunity to develop a new turbine research facility and perform experimental research. While at Penn State I helped develop the Steady Thermal Aero Research Turbine (START) Lab in close partnership with government and industry sponsors, including the U.S. Department of Energy – National Energy Technology Lab and Pratt & Whitney. I learned a lot about facility design, instrumentation, test planning, data collection, data analysis, turbine hardware, cooling flows, and heat transfer. Doing experimental work helped me gain a breadth of understanding that I lacked, which helped immensely when I interviewed for industry jobs. I also learned important soft skills in graduate school, including teamwork, time management, technical communication, and being able to accept and learn from criticism.

"Doing experimental work helped me gain a breadth of understanding that I lacked, which helped immensely when I interviewed for industry jobs."

Through Penn State's close partnership with Pratt & Whitney I was fortunate to meet and associate with many professional engineers while at graduate school. Networking with engineers while still in graduate school also helped me when I interviewed for jobs. After graduation I began working as an engineer for Pratt & Whitney in the aerodynamics group. In my first year of employment I have worked on a wide variety of projects ranging from commercial to military programs, from preliminary to detailed designs, and from single airfoil to full engine tests. The transition from graduate school to industry has been surprisingly natural. Being a graduate student in the START Lab truly prepared me for the rigors of an industry job. Just as in graduate school, there are a host of complex technical problems to solve as we push the envelope to more efficient and more powerful engines. It is the opportunity to work on these exciting technical problems that motivates me.

My Ph.D. work was in the area of turbine heat transfer. I now work in compressor aerodynamics. Although my current job has little in common with my Ph.D. work, the skills I learned in graduate school are what have really helped me at Pratt & Whitney. Those skills include learning how to dissect and analyze complex problems, always examining the fundamental physics, and thinking critically about both models and data. I have enjoyed applying the same research skills that I learned in graduate school to the many technical challenges of operational gas turbines. Realize that in industry you will have the opportunity to apply your research skills to design and research problems to create exciting new products. Your research skills will help you excel in a career in industry.

"Your research skills will help you excel in a career in industry."

Although there are similarities between graduate school and industry, there are differences that should be highlighted. For example, even though Penn State had a close partnership with Pratt & Whitney, there was always an insulative layer between the START graduate students and the product. We didn't always know all the details about why we were testing specific hardware. Now that I am working at Pratt & Whitney, I see how my work directly impacts current and future products. Working in industry close to the products has been especially rewarding.

Graduate students receive substantial mentoring from their advisors, research associates, and fellow students. The soft skills you learned in graduate school of teamwork and collaboration will be stretched even further in industry as you join a much larger team of engineers. It was eye opening to me to see how much engineers in industry must rely on each other in such a highly collaborative environment. It is important to complete your work assignments, as others are relying on you. You are not on your own though, as you will be able to seek mentorship from many experts in your company. That said, be mindful of others' time, as everybody is extremely busy balancing their own workload. Be patient as you go through the learning process; someday you will be the expert and young engineers will come to you for help.

Finding your first job after graduate school is stressful no matter if you want to work in industry, academia, or government. With so many commercial and military engines currently on order and many future applications yet to be designed and tested, there will always be lots of engineering work at gas turbine companies. Remember that you are at the beginning of a long career. You will hold many different positions, and there will be many opportunities to work on a variety of projects. Try to apply the same skills you learned in graduate school to learn as much as you can on each project, and you will find success and satisfaction in your work.

Awards Information

ASME IGTI Student Scholarship Program

Student application deadline is June 15, 2018 for the 2018-2019 School Year. Scholarship winners will be notified by the end of October 2018. Scholarships will be dispersed in November.

Application is available at: https://community.asme.org/international_gas_turbine_institute_igti/w/wiki/4029.honors-and-awards.aspx.

The ASME R. Tom Sawyer Award

The R. Tom Sawyer Award is bestowed on an individual who has made important contributions to advance the purpose of the Gas Turbine Industry and to the International Gas Turbine Institute over a substantial period of time. The contribution may be in any area of institute activity but must be marked by sustained forthright efforts. The award was established in 1972 to honor R. Tom Sawyer who, for over four decades, toiled zealously to advance gas turbine technology in all of its aspects and includes a US $1000 honorarium and a plaque presented during ASME Turbo Expo.

The nomination must be complete and accompanied by three to five Letters of Recommendation from individuals who are well acquainted with the nominees' qualifications. Candidate nominations remain in effect for three years and are automatically carried over. The completed reference form from a minimum of 3 people will need to be sent in with the nomination package. It is up to the "Nominator" to submit all required information.

Your nomination package should be received at the ASME Office no later than August 15, 2018 to be considered. igtiawards@asme.org

Congratulations to the 2017 ASME R. Tom Sawyer Award winner Dr. Alan H. Epstein, Vice President Technology and Environment, Pratt & Whitney

The ASME IGTI Aircraft Engine Technology Award

The Aircraft Engine Award recognizes sustained personal creative contributions to aircraft gas turbine engine technology.

The Aircraft Engine Technology Award will include an optional opportunity to deliver a lecture or present an invited technical paper on the work for which the award is being bestowed, at ASME Turbo Expo. The recipient of the award will very desirably, but not necessarily, be a member of The American Society of Mechanical Engineers. The award will be made to a single individual.

Nominating and supporting letters for the Aircraft Engine Technology Award should be sent by October 15, 2018 to: igtiawards@asme.org

Congratulations to the 2017 Aircraft Engine Technology Award winner Professor Michael G. Dunn, Director of the OSU Gas Turbine Laboratory- Department of Mechanical Engineering at The Ohio State University.

The ASME IGTI Industrial Gas Turbine Technology Award

The Industrial Gas Turbine Award recognizes sustained personal creative scientific or technological contributions unique to electric power or mechanical drive industrial gas turbine technology.

The Industrial Gas Turbine Technology Award will include an optional opportunity to deliver a lecture or present an invited technical paper on the work for which the award is being bestowed, at ASME Turbo Expo. The recipient of the award will very desirably, but not necessarily, be a member of The American Society of Mechanical Engineers. The award will be made to a single individual.

Nominating and supporting letters for the Industrial Gas Turbine Technology Award should be sent by October 15, 2018 to: igtiawards@asme.org

Congratulations to the 2017 Industrial Gas Turbine Technology Award winner Dr. Eisaku Ito, senior general manager in marketing and innovation at the headquarters of MHI.

ASME IGTI Dilip R. Ballal Early Career Award

Early Career Awards are intended to honor individuals who have outstanding accomplishments during the beginning of their careers. Historically, there has been no such award to recognize early career engineers working in the area of turbomachinery.

An early career award is intended for those starting a professional career, which is typically after a relevant terminal degree: BS, MS, or PhD. A criterion of seven-years-from-degree will be used to define the nominee's eligibility. The nominee must receive the award prior to the completion of the seventh year beyond the terminal degree.

Nomination packets are due to ASME on or before August 1, 2018. Send complete nomination to: igtiawards@asme.org.

Congratulations to the 2017 Dilip R. Ballal Early Career Award winner Dr. Subith Vasu, assistant professor at the Center for Advanced Turbomachinery and Energy Research (CATER), Mechanical and Aerospace Engineering at the University of Central Florida.