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# ECCE 2017 Will Highlight Exciting Developments And Opportunities In Aircraft Electrification

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Now in its ninth year, the Energy Conversion Congress & Expo (ECCE) is considered the foremost IEEE conference in the field of electrical and electromechanical energy conversion. The conference, which drew a record 1600 attendees last year from industry and academia, addresses a wide range of topics concerning the design of power electronics and electric machines. With its emphasis on higher power applications and attention to both motors and power converters in systems, ECCE has provided a respected forum for the latest advances in many big, energy-sensitive applications. These include grid-scale/utility applications, renewable energy, and industrial automation, to name a few. The conference has also been strong in addressing transportation applications in automotive and other areas. This year's conference, which will be held October 1-5, 2017 in Cincinnati, Ohio will devote special attention to the subject of aircraft electrification.

GE Aviation's Electric Power Systems division, which is based in nearby Dayton, Ohio, will play a leading role in bring discussion of aircraft electrification to the fore at the conference. The company's executive engineering leader in Aviation – Electrical Power, Joe Krisciunas, will help kick off the conference by delivering a welcome speech for the full audience at the open ceremony Monday morning. Dr. Hao Huang, chief technologist and advanced technology leader of GE Aviation-Electrical Power, will deliver the plenary talk, speaking on "Future Electrification: Beyond More Electric Aircraft" in the plenary session, describing his vision and understanding of where air vehicle electrification is headed in the coming decades.

Huang, who is also an IEEE Fellow, will discuss industry efforts in three areas—more electric aircraft, hybrid electric propulsion and jet engines—looking at the status and progress made in each area, the relationship between them, and a technology roadmap for these areas. In discussing these trends, Huang will also explore the opportunities these developments will create for engineers working on power electronics and machines.

Huang also aims to dispel some of the confusion surrounding progress in the MEA area. Huang notes that the industry started working on MEA about 15 years ago, overcame many difficulties and made great strides, culminating in the development of two noteworthy planes—Boeing's commercial 787 and Lockheed Martin's F-35 fighter. In the wake of these developments, many thought the MEA would be on every new aircraft after the 787. But that didn't happen, as companies slowed down MEA technology implementation in favor of improvements in jet engines. And then, with jet engines pushing the limits of efficiency, there has been growing interest in hybrid electric propulsion.

"Hybrid electric propulsion is really driven by the continuous improvements made in jet engine technology. These engines are much-more efficient now, and getting more efficient still. But they are starting to approach the limits of what the physics can do although there is still room to improve," says Huang.

As Huang explains, many people are wondering which way the aviation industry is headed and what comes next. Will MEA concepts be abandoned for hybrid electric propulsion? Huang will argue that MEA still has a role to play. "You cannot drop more electric," says Huang. "More electric is still important but the question is when do you do it? How do you do it? So I will talk about those issues."

For those engineers developing power electronics and electrical machines for aircraft, Huang's talk will provide an opportunity to learn about what's needed in the aircraft industry, where and how these power converters and machines will ultimately be deployed, and their expected impact on human aviation. For those involved with the strategic planning of power electronics and machines, Huang's talk will offer insights into the coming business opportunities.

Huang also notes that the aircraft industry is experiencing rapid technological change. In his plenary talk, he will offer some guidance on how power electronics engineers can prepare themselves for the changes taking place in the aviation field. He also wants to encourage engineers working in these areas so critical to aviation electrification and hopes to inspire them as he paints the big picture of where aerospace electrical power is headed in the next few decades.

"We're in a fast moving time in power electronics. New devices are coming along with new ways to control things through the Internet and the "digital twin" concept," says Huang, who will also discuss how engineers in

the ECCE community and others can "prepare themselves for this big fast moving area and enjoy this exciting time of industry advancement."

Huang's plenary will pave the way for deeper dives into aircraft electrification during the conference. While, there are always multiple papers in the technical program with relevance to aviation, this year's ECCE will directly address the key aspects of aviation electrification in four Aerospace Special Sessions. The themes for these sessions are:

1. Electrical Power for Aviation Applications;
2. IOT and Digital Twin for Aviation Applications;
3. Wide Band Gap Devices and Applications for Aviation;
4. Advanced Aircraft Electrification beyond MEA (more electric aircraft).

Each session will last 1 hour 40 minutes and feature three lectures, each of whom is allotted 30 mins for his/her presentation with 5 mins added for Q&A. Naturally, GE engineers are among the presenters, which will also include speakers from other companies and from academia. (Watch for more details on these sessions on the ECCE website.)

Elaborating on the subject matter covered in each session, Huang explains that the first one, electrical power for aviation applications, deals with the new electrical power system architectures in the Boeing 787 and F35, exploring the many advancements there. Topic #3 will address the silicon carbide and gallium nitride power semiconductor devices that are now the subject of broad discussion throughout power electronics, but with a focus on aviation. As in other areas, SiC and GaN devices are enabling greater efficiency and smaller size for aviation applications.

However, topic #2, explores some possibly less familiar territory for power electronics engineers, discussing the impact of cloud computing and the "digital twin" idea. Explains Huang, "You can do the Internet computation using the cloud and you can put a lot of calculations, predictions and data into the system. This allows you to use the system to monitor aircraft health and to do the prognostics for aircraft engines, systems, real-time modeling, hardware in the loop, and those kinds of things."

He continues, "At GE, we call this the 'digital twin.'" He likens this idea to a person having all of their medical history in the cloud (their digital twin) so that when they go to the hospital for any reason, the doctors can use the stored history to better assess and treat them. Huang comments that there is great excitement in the aviation industry over this idea, which is actually growing the aviation industry as it allows for improvements.

The digital twin, says Huang, is making "aircraft safer and more efficient. It can also predict for aircraft how much time-of-flight is left and how many hours remain to finish a mission before you change parts or subsystems."

Finally, he notes that the fourth special session will offer presentations on both more-electric aircraft and hybrid electric propulsion.

Another element of this year's ECCE conference relating to aviation concerns a pre-conference event. On Sunday ECCE will be hosting a tour of the Air Force Museum in Dayton. For more information on the tour or the special sessions outlined above, please contact special sessions chair Peter Wung, email me or see the conference website.