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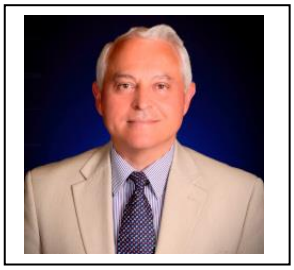

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Abstract

Title: Electric Aircraft – Recent Technology Developments in the US

Current research and development and field deployments of electric, hybrid, and turboelectric aircraft are highly motivated by the stringent need to reduce the energy use and carbon emissions towards an ultimate zero target. The presentation will overview trends with examples provided by a large number of recent and ongoing projects supported directly by industry, by the US Department of Energy (DOE) under the ARPA-E ASCEND program, and by NASA, including some of the projects to which the speaker and his research group have been directly contributing. Special emphasis will be placed on the ongoing NASA ULI IZEA project with academic partners, alongside University of Kentucky, from Florida FAMU-FSU, Georgia Tech, University at Buffalo – State University of New York, and industry including Boeing, Raytheon Technologies, Collins Aerospace, AML, and QM Power. A recently developed method for the initial sizing of aircraft electric power systems, based on the graph theory and computational intelligence, which has been published in the IEEE Trans on Electrification of Transportation, will be presented and used to illustrate possible architectures and highlight their relative merits and advantages. The discussion will cover topics of energy sources and storage, including hydrogen, fuel cells, and Li-ION batteries, and distributed systems with multiple electric circuits, and power electronic converters. Electric motors for aircraft propulsion will be also reviewed with topologies including PM synchronous in radial and axial flux configurations, special rotors of the PM and Halbach array type, and multiple rotor and stator units, each with relative merits in terms of ultra-high efficiency and power density, and fault tolerance. A new machine of the synchronous type with a robust consequent-pole reluctance rotor and dual stator excitation, employing an AC three-phase winding with concentrated coils and a special wave-type DC winding, will be described. Another section will be devoted to the latest manufacturing technologies for electric machines, coreless stators, special windings, superconducting and cryogenically cooled integrated systems. The conclusions will summarize the state-of-the art and the anticipated developments.