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[Invited] High Power Density Electric Motors for Electric Aircraft: Superconductor and Permanent Magnet Approaches

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Interest in fully electric and hybrid electric aircraft is being driven by gains in efficiency, fuel savings, noise and emission reductions and increased flexibility of aircraft and propulsion system design. magniX is developing and prototyping superconducting electric machines with the goal of demonstrating power densities in excess of 25 kW/kg.

Superconducting generators and motors are synonymous with enhanced efficiency, reduced weight and compact size compared to conventional technologies. magniX is building superconducting generators and motors suitable for intense energy and efficiency sensitive applications such as all electric aircraft motors and generators —it is the only known technology capable of satisfying these requirements.

magniX has unique capabilities and proven intellectual property in high power density electric motors suited to aircraft propulsion embodied in our magnifluxTM technology. Our approach overcomes many of the historical issues associated with superconducting machines by eliminating rotating cryogenic joints through the use of a stationary cryostat and non-cryogenic normal conducting rotor. Our novel flux directing coil arrangements maximize the air gap flux density while also eliminating the need for ferromagnetic shielding reducing overall weight significantly. A discussion of the progress of the magniflux alpha prototype design, construction and testing will be presented.

In the short and medium term, permanent magnet machines have a place in the electric aircraft segment. Results of the development and testing of our magni5 permanent magnet motor with a power density of 5kw/kg will be presented along with a discussion on thermal management and the optimization of the electromagnetic design of this class of machine.

Authors: KELLS, John (magniX Technoliges Pty Ltd); Dr CHAFFEY, Jason (MagniX Technologies Pty Ltd); Mr SERCOMBE, David (MagniX Technologies Pty Ltd)

Presenters: KELLS, John (magniX Technoliges Pty Ltd); Dr CHAFFEY, Jason (MagniX Technologies Pty Ltd)

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