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Electroflight - fast-tracking the development of an all-electric aircraft

E3 series®

ELECTRO FLIGHT

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Joe Holdsworth
Control Systems Engineer, Electroflight

Electroflight - fast tracking the development of an all-electric aircraft

Electroflight is an innovative technology company focused on accelerating the development, integration and testing of electric powertrains and is a partner in a Rolls-Royce-led initiative called ACCEL. As part of the Accelerating the Electrification of Flight (ACCEL) research initiative, Electroflight is aiming to set a new world speed record of more than 300mph for an all-electric aircraft, involving the creation of one of the most power dense flying battery packs in the world.

To support an ambitious technology roadmap, the team selected Zuken's E³.series to create the electrical and fluid schematics, and to generate comprehensive outputs for wire harness manufacture. In using E³.series, Electroflight is also benefitting from E³.series' popularity in motorsports, where it helps teams meet tight race season deadlines.

Setting a new record

Flight has always captured human imagination, as has speed, and satisfying both urges together has resulted in some amazing engineering achievements and enabled the aerospace industry to break far more barriers than just the 'sound'.

Even now, with the aerospace sector starting to explore the electrification of flight in a bid to make air travel greener, the need for speed has not abated. At the time of writing, a 17-strong team of engineers working in a hangar at Gloucester Airport is developing the battery packs, powertrain, control circuitry and airframe of a single-seater aircraft they hope will exceed 300mph. If successful, they will take the speed record for an all-electric aircraft; a record currently held by Siemens at 210mph.

ACCEL - the electrification of flight

The Gloucester-based engineers work for Electroflight - an innovative technology company focused on accelerating the development, integration and testing of electric powertrains – and partner companies in a Rolls-Royce-led initiative called ACCEL. Disciplines within the team include hardware, software and mechanical engineers, as well as safety specialists.

An abbreviation of 'accelerating the electrification of flight', ACCEL is not just about breaking the current speed record. Indeed, the project's focus is officially described as 'an effort to build, test and commercialise a specially designed aircraft powered by megawatts' - all within a self-imposed 24-month timeframe.

The ACCEL aircraft is based on a Nemesis NXT racing aircraft airframe and the clock began ticking on the project in the summer of 2018. The team hopes to take the speed record in 2020.

The aircraft will have a three-bladed prop, driven by three YASA 750R electric motors sharing a common prop shaft; where YASA is the motor supply partner in the project. The motors will have a combined peak power of 700kW, which is about the same power as the internal combustion engine used on a standard NXT in record run trim. Also, 700kW equates to circa 1,000 horsepower, which is about the same as a Formula 1 racing car.

E³.series®

At a glance

- E³.series is part of Electroflight's investment in best-in-class engineering tools to support ambitious business development plans.
- E³.series enables the rapid evaluation of design concepts to ensure optimisation of the aircraft.
- E³.series' support of both electrical and fluid plans in one single project helps coordinate design efforts.
- Detailed schematics and BOMs generated in E³.schematic enable streamlined wiring harness manufacture.
- E³.series' popularity in aerospace/motorsport enables valuable synergies for Electroflight's engineering team.

ELECTRO FLIGHT

Electroflight was founded in 2011 and it is the company's vision to be a driving force in the electrification of flight plus a leading supplier of energy storage systems and surrounding technologies.

The source of the electrical power will be 6,000 battery cells, and much of Electroflight's development focus is around the power management of those cells. The team is working towards what it hopes will be one of the most power dense flying battery packs in the world. It will have enough power to fly from London to Paris on a single charge and will contain a liquid cooling system to regulate heat.

Investment in enigneering toolchain

With a highly praise-worthy start-as-we-mean-to-go-on attitude, Electroflight is adopting best working practices, is documenting all processes and is aiming for ISO9001 accreditation in 2020, on the road to further aerospace approvals. As part of this journey, Electroflight has invested in engineering toolchain products that support its growth plans. One such tool is Zuken's E3.series electrical and fluid engineering solutions.

We met with Stjohn Youngman, Electroflight's Programme Manager, back in 2018, at the Farnborough Air Show, where he told us: "With such a compressed timeframe for the ACCEL aerospace initiative, speed is everything. E^3.series was selected because of its ease-of-use, flexibility, and output capability for all data, including bills of materials, needed to manufacture wiring harnesses."

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Stjohn Youngman, Electroflight's Programm Manager

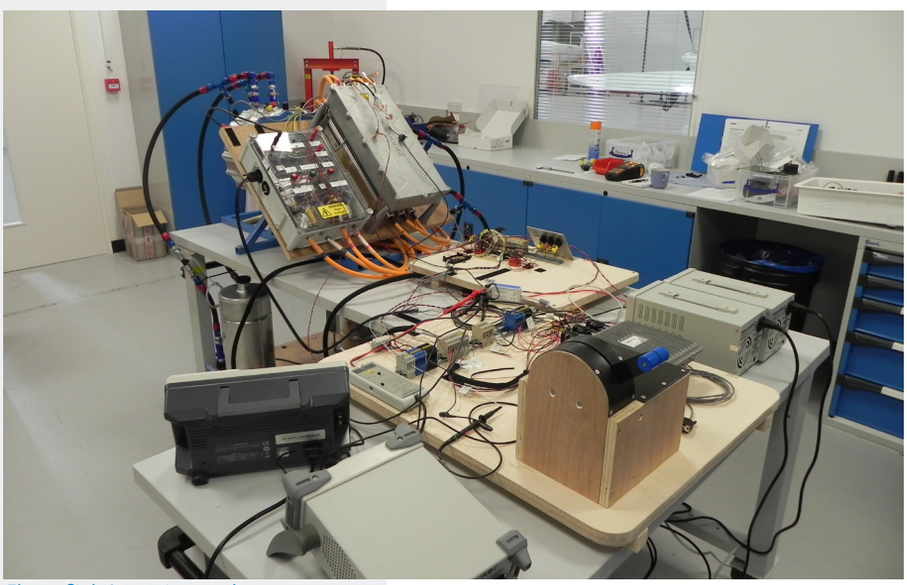
At a more recent meeting, this time in Electroflight's hangar, Joe Holdsworth, the company's Control Systems Engineer, recounted: "We evaluated two leading CAD vendors of which Zuken was the clear winner because its E^3.Series software also supports the development of hydraulics, which our aircraft has for the cooling of the battery and key powertrain components."

Learning from motorsports

Another compelling reason for Electroflight's selection is that E^3.series is already popular in the aerospace industry. It is also fast becoming the wiring harness tool-of-choice within the motorsport industry too, where it helps teams meet tight race season deadlines. Electroflight plans to take advantage of E^3.series' aerospace and motorsport synergies, and the team will be using System 25 mil-spec motorsport connectors and harness construction techniques on the ACCEL project.

What-if scenarios

Because of the nature and compressed timeframe of the project, the Electroflight team is using E³.series to explore a variety of 'what-if' scenarios and has built a test rig to evaluate their concepts. E³.series is used for the schematic capture and design of the wiring harnesses (mainly on the low voltage side). To help meet an ambitious development schedule, rigorous version control is place. "The test rig on which we're developing our hardware is completely in sync' with the E³.series schematic, the bill of materials and the wiring loom details, such as pin outs", comments Holdsworth. "This means when we outsource the build of the loom, we'll be able to supply everything in one go."



Electroflight's test rig uses the same components, sensors and connectors that will be used for the aircraft

The components, sensors and connectors used on the test rig are the same ones that will be used for the aircraft. "Also, we're using CANbus as much as possible, to keep the weight down", says Holdsworth.

The aircraft will have a relatively simple instrument panel, providing the pilot with enough information to fly safely and quickly. Information presented will include air speed, altitude, power usage, maximum power available and system temperature warnings. "There's also an ECU as part of our design," Holdsworth added. "Its role is to optimise the aircraft's performance but, should the unit fail, safety will not be compromised. The aircraft will still fly."

Electroflight is using a battery management system and other modules that are popular in motorsport but the team is also building bespoke PCBs, most of which are needed for data acquisition purposes; i.e. signal conditioning followed by the presentation of data onto CANbus in order to give the ECU visibility.

Flight Plan

At the time of writing the project is in its systems testing phase, and the propulsion system is being run on a dyno to ensure it meets safety and performance requirements.

Subsequent tests will continue throughout the remainder of 2019. These will include wiring harness tests and sign-off. The harness will then be manufactured in November/ December in readiness for aircraft integration, which will be carried out over the winter. Ground and flight tests are scheduled for the first half of 2020.