Electric Motor Trends

A look at current and future motor technologies

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Elemental Motors has developed a unique architecture that dramatically reduces the size and weight of torque motors.

It's an exciting time in the electric motor industry. In the past two years more truly innovative new technology development has occurred than in the previous two decades. We can thank the e-mobility movement for that. It's not just cars, trucks, bikes and buses, but just about everything else that moves on wheels as well as on water and in the sky.

What exactly is behind all this new motor technology development? Increased energy efficiency has been the prime mover. Not only to extend EV range with existing battery technology, but beyond e-mobility independent research commissioned by ABB found that 91 percent of 2,400 global businesses surveyed said that energy efficiency now had a critical influence on their choice of electric motors.

But there are lots of other factors driving new electric motor innovations, such as reduced weight, different form factors, increased power and torque density, rare earth magnet free, reduced copper, quieter operation, longer life, design for circular economy, etc.

The following are but a few of the new electric motor technologies introduced in the past 24 months that address those factors. One must keep in mind, though, that some may not yet be commercially available while others can be designed into OEM equipment today.

With geopolitics contributing to supply chain concerns regarding rare earth magnets, German powertrain company, ZF, has introduced its In-Rotor Inductive-Excited Synchronous Motor, a compact magnet-free design with performance equivalent to the most common motors for e-vehicles, permanent-magnet synchronous motors. What's truly innovative here is the inductive exciter inside the rotor shaft that reduces losses for the energy transmission into the rotor by 15 percent.

Founded just five years ago, U.S. company H3X Technologies produces high-density, lightweight electric motors for aviation, other industries ranging in power from 30 kilowatts to 30 megawatts. What's unique is that their motors are produced with integrated inverters, making their claim of power density up to 12 kW/kg continuous even more impressive.

The concept of in-wheel or hub motors for EVs continues to be debated, but German motor technology company DeepDrive has developed a unique dual rotor motor technology that produces a two-in-one motor for greater energy efficiency and torque density. A single stator drives both rotors simultaneously. DeepDrive has gotten early support from BMW Group with a $33.5 million investment.

Axial flux motors are a hot topic today in the e-mobility world because of not only their torque and power density benefits as well as the potential to produce high direct torque at relatively low speeds,

The HPDM-30 is a 33-kW integrated motor drive weighing 4.1 kg.

Capable of delivering up to 2.5 MW, the WM2500 motor has a power density of around 18-20 kW/kg.

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thereby eliminating the need for gearing. But industrial users were left just looking until Brazilian motor manufacturer, WEG, introduced its line of W80 AXgen axial flux motors configured as NEMA frame replacements for higher energy efficiency in stationary industrial applications requiring up to 500 ft. lb. torque.

Copper can be significantly reduced with Printed Circuit Board stator technology developed by U.S. company, E-Circuit Motors. What's truly innovative is that OEMs can use ECM's software tools to design their own PCB stator motors with up to 80 percent less raw materials and greater than 90 percent efficiencies while being up to 70 percent lighter.

C-Motive Technologies in the United States is the only company developing commercially viable electrostatic motors, which use no magnets and printed circuit boards with a proprietary dielectric fluid to produce high efficiency, low speed direct drive torque without gearboxes or active cooling. A 2 hp C-Motive electrostatic motor is estimated to save up to $1,400 a year in energy costs in a typical industrial application.

Chinese EV manufacturer, GAC, through its Ruipa Power Technology Company, has recently introduced a new EV motor based on an amorphous alloy they claim is the most advanced soft magnetic material in the world. It is claimed to be very easy to magnetize and has an ordinary magnetic permeability 20–100 times that of silicon steel sheets. Supposedly 90 percent thinner than traditional silicon steel sheets, the iron loss is reduced by more than 50 percent. GAC claims the new motor technology achieves up to 98.5 percent efficiency, with a 13 kW/kg power density at 30,000 rpm.

But don't think that one company's proprietary soft magnetic composite material precludes you or others from developing high efficiency electric motors. Australian company, Kite Magnetics, is commercializing a novel nanocrystalline magnetic core material developed at Monash University for motors and generators and will be offering stator cores that reduce core losses by up to 97 percent compared to traditional electric steel cores. The Aeroperm cores offer a three percent increase in torque density over conventional materials, allowing motors to be more compact and powerful.

In terms of exciting motor technology for automation applications, U.S. company, Elemental Motors, has developed a novel transverse flux motor topology that folds 6 axial and 3 radial airgap shear areas into the same case size as a conventional motor. In robotic applications the high torque density of the motor can eliminate a single stage planetary gearbox and at roughly one-fifth the weight of similar torque capability servomotors.

The embryonic field of electric flight is bringing about some incredible performance breakthroughs for large electric motors capable of powering passenger planes. New York based Wright Electric has laid claim to developing the world's most advanced electric motor for aviation. With power density up to 16 kW/kg and producing 2.5 megawatts of shaft power, the Wright motor has the potential to enable zero-emissions one-hour flights.

While all of this new electric motor technology development can be mind-boggling to the average OEM or motor manufacturer, what is most impressive is the "trickle down" effect these developments will have on industrial and commercial motors of the future. No longer can one look at the electric motor industry as stagnant and overly conservative. By and large, creative young engineers are able to respond to the tremendous growth potential e-mobility brings by looking at electric motor technology development with a fresh perspective while having a growing toolbox to call upon.

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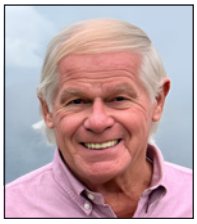

John Morehead has helped leading American, European and Asia electric motor manufacturers significantly grow their businesses for 25+ years—from UAV drone motors and ESCs to 800V EV motor systems and everything in between.