Tula's Latest Technology Drives Electric Motor Efficiency

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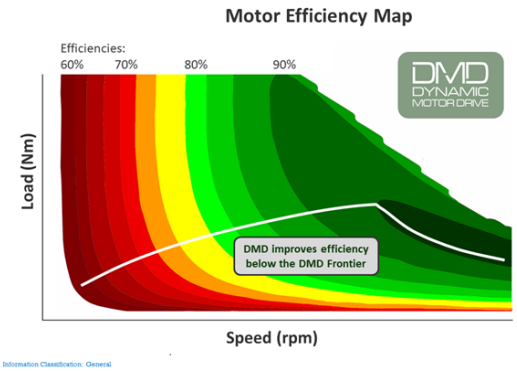
Executive Summary

The latest innovation from Tula Technology applies a pulsing operation to electric motors to achieve higher efficiency.



TULA DMD'S PULSED OPERATION DELIVERS OPTIMAL EFFICIENCY AT LOW LOADS.

The Silicon Valley software company behind multi-cylinder deactivation technology in internal-combustion engines is readying a similar concept to improve the efficiency of traction motors in electric vehicles.

Tula Technology, the inventor of Dynamic Skip Fire, now is ready to share its latest concept, Dynamic Motor Drive, or DMD, for BEVs.

DMD's predecessor, dubbed Dynamic Fuel Management by General Motors, allows some applications of the automaker's 5.3L and 6.2L V-8s to operate on one to eight cylinders depending on load and driver demand, resulting in as much as a 13% gain in real-world fuel economy with no loss of power or torque. GM is rapidly expanding the application of DFM in its V-8 engines in the current and coming model years.

Expanding the idea into BEVs, DMD uses Tula's patented "Pulsed Electric Motor Control" programming to generate torque at optimum efficiency across a motor's operating range, resulting in a minimum 2% gain in system efficiency on a complete drive cycle. That gain can be converted into smaller batteries or increased vehicle range, reduced motor costs or more efficient inverter operation, says Tula CEO Scott Bailey. Tula estimates a 2% efficiency gain equates to a $400 savings in battery cost.

The company so far has applied DMD to synchronous reluctance motors that operate at nearly the same efficiency as permanent magnet motors. Without the latter's need for rare-earth metals, the synchronous motors save substantially on motor cost, size and weight. And because DMD is a software solution, no big hardware changes are necessary, unlike DSF in combustion engines that requires changes in valvetrain and ignition management to operate.

Bailey says the basis for DMD grew out of Tula's work on Dynamic Skip Fire married with mild hybridization, resulting in a system the company markets as eDSF aimed primarily at diesel applications.

"We had our mainstream product line doing a significant amount of work in the electric motor space," Bailey tells Wards Intelligence. "That gave us a pretty decent foundation (for DMD). Strategically it made perfect sense. So, a lot of the knowledge that we built through the eDSF efforts was helpful in developing the dynamic motor drive."

John Fuerst, Tula senior vice president-engineering, says DMD's development was similar to DSF in that prior to Tula's innovation the industry was committed to mass cylinder deactivation, but the general consensus was that dynamic deactivation was impossible. Likewise, electric motors operate at extremely high efficiency in a steady state and are considered established technology with little efficiency to be gained.

Tula's innovation brings more efficiency via a pulsed operation made possible by the company's software. A motor operating at the same speed can produce the same torque at higher efficiency by pulsing the motor operation, Fuerst explains. The efficiency gains are greater at lower loads, such as when a vehicle is operating at a steady speed, similar to the lower demands on an ICE in steady operation.

Fuerst says work remains to demonstrate and prove out DMD, but so far, he hasn't encountered any barriers to successfully moving ahead. Given that DMD doesn't require the level of hardware modification as DSF, implementing the electric-motor technology should be far simpler and quicker, Bailey observes.