High-Tech Motors Evolving from PM Muck

University Lab's Motor Eliminates Pricey Magnets

We know them as "rare earth" metals used for permanent magnets. They are used in sophisticated, high-performance electric permanent magnet (PM) motors for a growing number of motion control applications, including precision-demanding aerospace and weaponry systems and electric vehicles. In truth, it is not so much their availability that is rare — although to some extent there's that. No, the rarity is reflected in their dear price.

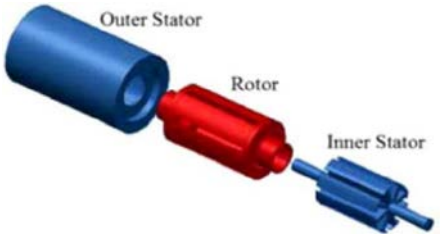
Indeed — isn't a more accurate name for these precious metals *dear earth* magnets?

What makes them rare, dear — whatever — is the fact that since 2010, U.S. purveyors of the stuff can no longer sustain supplying it. We left that up to — oh, you bet — *China* — who now of course controls the world's supply — pollution consequences notwithstanding. So any progress developing high-tech electric motors with similar capabilities — but sans those costly rare earth magnets — is most welcome.

Drum roll here please for Dr. Babak Fahimi, a University of Texas at Dallas (UT Dallas) professor of electrical engineering at the school's Erik Jonsson School of Engineering and Computer Science, and director of REVT (Renewable Energy and Vehicular Technology). He recently received $2.8 million through a Dept. of Energy (DOE) Advanced Research Projects Agency-Energy (ARPA-E) program aimed at reducing the need for rare earth metals (magnets) in electric motors. The DOE's ARPA-E program hosts an annual summit in Washington for researchers, entrepreneurs, investors, corporate executives and government officials to share transformational, pre-competitive research funded through the program. In addition to their award, Fahimi's REVT team was one of only five invited to actually demonstrate their work to lawmakers and participate in a roundtable discussion on climate change.

Thus far the government has sponsored as many as 10 ARPA-E-funded, high-performance no-magnet motor developments. Precipitated, many believe, when magnet prices were soaring and it became clear that that we no longer had any on-shore suppliers for rare earth magnets.

What in essence the UT Dallas REVT team has done is eliminate the need for permanent magnets (PMs) — *in some cases* — by substituting an SR (switched-reluctance) motor with two stators. Thus you can build a structure resembling a PM axial flux motor, but an SR motor and two SR stators replace the PM rotor and two stators. For more on this latest, evolutionary-but-not-quite-revolutionary step in motion control, we put some questions to aforementioned ARPA-E program member Dr. Fahimi.



The REVT Team's motor achieves higher-torque-per-Ampere, lower core losses, and better operation efficiency.

Power Play (PP): Eliminating the need for magnets seems like a *major* breakthrough — but way under the radar. Why has no one heard about it?

Babak Fahimi (BF): We are in the process of developing a 100-killowatt prototype of this concept that will be tested in the propulsion of a pick-up truck, and further tested in a compressor application in collaboration with an industrial partner. This partner is working very closely with us on integration of this concept for automotive and compressor applications, and we expect to launch the commercialization and marketing in 2015.

PP: Wouldn't NASA be deeply involved in something like this?

BF: NASA is interested in highly efficient electric motors that are compact; this technology, DSSRM, would address both, so we believe that NASA, or any industry that is seeking alternative solutions or highly efficient, fault-tolerant and compacts electric motors can take advantage of our technology.

PP: Can you tell me what other "transformational research" has over the years been successfully presented and implemented at the ARPA-E Summit?

BF: Our research presented at the ARPA-E Summit has been focused on DSSRM (double- stator switched-reluctance motor) technology.

PP: Is the Renewable Energy and Vehicular Technology Laboratory (REVTL) funded only by the DOE?

BF: No, others include the Office of Naval Research, the National Science Foundation, the Department of Energy, as well as many large and small businesses.

PP: How will the money award help further this project?

BF: This award has allowed us to modify the design for ease of manufacture, improving the performance and, most important, building prototypes at 2, 10 and 100 kilowatts. These prototypes have demonstrated or validated the results of our theory and analysis.

PP: How far away would you say the motor is from commercial availability?

BF: How far away depends on how industry would push this technology forward. The prototype alpha is already at hand, and we anticipate that by 2015-2016, the first products based on this technology to be available to this market. (Article Source: *newscenter@utdallas.edu.*)

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(*The Power Play editors wish to thank* Dan Jones, *president of* Incremotion Associates Inc., *and a regular contributor to this magazine, for his assistance with this article.*)