

Cheaper, faster hybrid vehicles thanks to new class of power inverter with 'infinite-level voltages'

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(Phys.org)—With a laboratory breakthrough once thought impossible, an Indiana University-Purdue University Indianapolis assistant professor has invented a new class of power inverter that could put cheaper and more efficient renewable energy products on the market.

Professor Afshin Izadian, a researcher at the Richard G. Lugar Center for Renewable Energy at IUPUI, has invented a power inverter that employs just a single switching transistor and generates infinite-level voltages.

Power inverters are at the heart of several [renewable energy technologies](#). Solar power, [battery storage](#), electric vehicles, motor drives and manufacturing robots all use inverters to generate AC power efficiently.

However, the current inverters with multiple switching transistors generate limited [voltage](#) levels, are heavy, generate unwanted harmonics (voltage frequencies) and require filters to reduce the harmful effects to the electric grid.

Izadian's invention, the result of a creative reconfiguration of an electrical circuit during a laboratory experiment, would make inverters cheaper, lighter and therefore more efficient than current models.

"The thrilling moment of any research is when your thoughts, designs

and implementations come out right and you reach the goal," Izadian said. "An on-demand change of voltage polarity might not seem very exciting, but it becomes increasingly important if you can accomplish it while maintaining desired voltage amplitudes."

Izadian, who has a doctorate in electrical engineering and is a former postdoctoral researcher from UCLA, teaches in the Purdue School of Engineering and Technology at IUPUI. While studying how voltage levels and polarities are created in inverters, he made his discovery. In a creative moment at his lab bench, he began reconfiguring an inverter circuit and discovered a new property technique to create infinite voltage levels and invert the voltage polarity of [power circuits](#). This discovery in turn leads to a corollary insight that the researcher employed to create the new class of inverters.

Not only did the bench test work, it led to the discovery of several other circuits and controllers for high-power inverters with lower switching loss, higher voltage performance and lighter reconfigured circuits.

For example, unwanted harmonics are greatly reduced with Izadian's invention. This means car manufacturers can reduce the size and insulation of traction motors so that electric vehicles can be made cheaper. The size and weight of the power electronics can also be reduced, which can boost fuel economy in hybrid cars and buses. Such advantages translate into wider adoption of green technologies and more affordable renewable energy for homes, vehicles and businesses.

"The Lugar Center is a tremendous asset to the school's creative and innovative research process," said David J. Russomanno, dean of the School of Engineering and Technology. "We are delighted with Dr. Izadian's work and the possibility that his inverter can impact the renewable energy market. His efforts are a quintessential example of the cutting-edge research that enhances the school's image and reputation

and allows us to compete in the [renewable energy](#) arena."

Izadian's work is under review by a prestigious technical journal, and several large companies have shown interest in the new inverters. They are interested in how Izadian's breakthrough can result in simpler, cheaper and smaller systems with better performance than today's technology.

Izadian has several patents pending on his invention and is seeking research funding to complete the development of the analysis and controls needed for commercial viability. Products could be ready for the marketplace in as little as three years.

Provided by Indiana University

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