

Iowa State engineer wants to 'sculpt' more powerful electric motors and generators

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Iowa State University's Dionysios Aliprantis is working to improve the performance of electric motors. Credit: Photo by Bob Elbert/Iowa State University

Dionysios Aliprantis took up an imaginary hammer and chisel and pounded away at the air.

"Think of the ancient Greeks and their sculptures," said the Iowa State University assistant professor of electrical and [computer engineering](#).

Now apply the idea of a sculptor precisely chipping away at stone to the electric motors that run our machines and generate our electricity. Aliprantis is working to develop computer modeling technology that will show engineers how to chip away at the surfaces of electric motors to create new designs and shapes that can increase [power generation](#).

"The goal is to get more [power](#) out of the same size motor," he said. "Or, that could mean getting the same power with a smaller motor."

Aliprantis is quick to say he's not looking for a huge improvement in a motor's performance.

"I'm looking for a little bit of increase, maybe 5 percent or 1 percent," he said. "But multiply that number by the number of [hybrid cars](#), let's say, and you could get savings in the billions of dollars. The potential here could be huge."

Aliprantis' project is supported by a five-year, \$400,000 grant from the National Science Foundation's Faculty Early Career Development Program. The grants support junior faculty identified as teacher-scholars through outstanding research, excellent education and the integration of education and research.

Assisting with the motor design project is Yanni Li, a doctoral student in electrical and computer engineering.

Aliprantis and Li want to take advantage of the fact that most electric motors and generators operate in just one direction – in most applications there's no real need for them to go into reverse. The motors, however, have long been designed to offer equal performance no matter which way they're rotating.

And so the engineers are exploring how electric motors can be improved by optimizing performance in a preferred direction of rotation. To do that, they've written a computer modeling program that incrementally changes the design of the motors – just like a sculptor chipping away – and calculates when the surface shape is just right.

The teeth that hold coils of wire within an electric motor, for example,

have typically been built with a symmetrical shape that maintains performance in either direction. By making the teeth asymmetrical, the engineers hope the motor can pick up some power when rotating in the preferred direction.

"We are trying to develop a systematic way of getting to the right shape," Aliprantis said. "This idea is very simple, but motors are still being designed using techniques that are essentially one hundred years old."

Aliprantis is also busy with other projects to improve electric motors, advance alternative energy systems and improve engineering education:

- Another project is aiming to improve the models used to predict the dynamic performance of electric motors as engineers experiment with different power electronics and control technologies. The idea is to develop more sophisticated control systems that capture more of a motor's performance characteristics. The project is supported by Iowa State's department of electrical and computer engineering and includes Yuanzhen Xu, a master's student in electrical and computer engineering.
- Aliprantis is also collecting data on how much solar energy is available throughout a day. The idea is to improve power forecasts by developing better models of cloud cover. That would help utilities make better estimates of the power they can expect from solar panels on a given day. Chengrui Cai, a doctoral student in electrical and computer engineering, is assisting with the project.
- Aliprantis is part of an Iowa State faculty team that's developing a new, multidisciplinary doctoral program in Wind Energy Science, Engineering and Policy. He's also using a National Science Foundation grant to work with Purdue University faculty

to improve undergraduate education in power electronics and motor drives by modernizing student lab equipment and course content.

Because electric motors are all around us – in vehicles, wind turbines, power plants and all kinds of machinery – Aliprantis said finding new ways to improve their performance can make a real difference in the development of sustainable energy resources.

Provided by Iowa State University

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