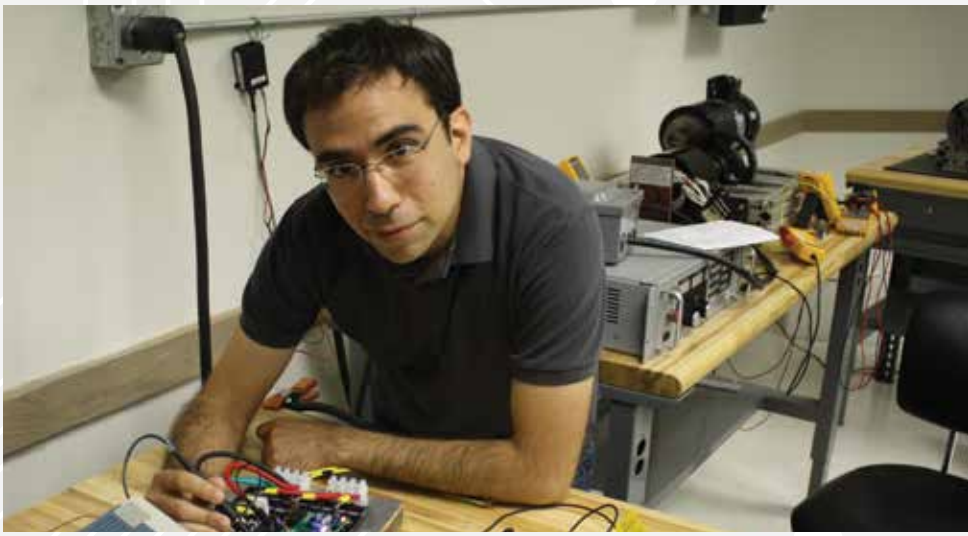
Electrical Engineer

Interview by Amy Entwisle



Yusuf Gurkaynak, PhD
Senior Control Engineer, Southwest Windpower

Yusuf Gurkaynak received bachelor's degrees in both electrical engineering and electronics and communication, as well as a master's degree in control and automation engineering, from Istanbul Technical University in Turkey. He earned his PhD in electrical engineering from the Illinois Institute of Technology. Now, at Southwest Windpower in Broomfield, Colorado, Dr. Gurkaynak uses his skills to help develop renewable energy. Here, he talks about what makes a good engineer, and why he considers the coming decade engineering's golden age.

How did you become interested in engineering?
My father is a chemical engineer. He's a professor at a university in Turkey. I was very inspired by his work, which focused on developing a method to manufacture materials for industrial use. In school, my favorite classes were always mathematics and science. It seemed natural for me to become an engineer.

How did you become interested in electrical engineering in particular?
Actually, I didn't choose to study electrical engineering. In Turkey, you take a national exam, and your score helps determine what you study and where you attend university. You make a list of programs you want to attend, and the test results indicate which is best suited to you. I might have studied chemical engineering, or genetic engineering, but electrical engineering was the best fit for me. After the first year, you have the option to switch majors, but I decided to broaden my knowledge of engineering by adding a second major, in electronics and communication engineering.

Can you describe the work you do?
At Southwest Windpower, I design algorithms to control wind turbine power. The goal is to harvest as much energy as possible while protecting the electrical storage systems, which are vulnerable to damage from overly high voltage and current. Electrical sensors measure key variables—current, voltage, wind speed, generator speed—and, depending on the measurements, the control algorithm then decides what action it should take to optimally maintain the system.

What's a typical day like for you?
Each day is different, but in general, I identify a problem, such as how to maximize the amount of energy produced when the wind is high as well as when it's low. I start by designing a basic control algorithm and mathematical model of the wind turbine and its electronic components. I then run computer simulations to see how the algorithm works in the model. If the simulations go well, I program the algorithm into the system's microcontroller and test the product virtually. Such "alpha testing" allows us to see if everything works as intended; if it does, we move on to beta testing, or field testing. We might place the turbine on top of a truck, which gives us flexibility to find a good, windy spot, or we may take it to the nearby National Wind Technology Center, where we can test in a controlled environment. The system variables are continuously monitored to see if the turbine is operating optimally.

How much time do you spend working with computers versus working in the field?
Until recently, we were working on alpha testing, so I've mostly been on the computer. Now that we're at the beta testing stage, I'll spend most of my time on the outside in the coming months. So the work is dynamic; it changes from day to day.

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What do you find most rewarding about your work?

My projects are like my babies. I watch them grow up and improve over time. The ultimate reward is probably seeing successful beta testing, knowing that what you've worked so hard on is working in the field. Yesterday, we got a good result, and everybody was cheering for us. That's very rewarding.

Our readers might be coming into a career like yours in another 10 years or so. What might they be working on?

It's estimated that we will exhaust the supply of fossil fuels in about 50 years. The need for renewable energy—especially solar and wind energy—will increase dramatically, even within the next decade. There will be a need for power engineers to work on energy generation and transmission systems, and for control engineers—like me—to work on systems control and automation in power plants and smart grids.

In addition, President Obama has announced tough fuel economy standards that will be implemented beginning in about five years. This means we're going to have many more electric cars. Everything will have to be much more efficient, and we'll need engineers to work on that. Finally, everybody is using smartphones and tablets, and the technology is moving very fast, so there will be a need for electronics engineers and communications engineers. There will be a wide range of projects for all branches of electrical engineering. The golden age is coming.

What skills or qualities does somebody need to be successful in this field?

Being an engineer is about much more than excelling in school. You need good skills in analytical thinking and mathematics. You also need a good imagination, because electricity is something you can't see or touch. You have to be able to visualize what you're doing, to imagine, for example, what might happen if you do something this way, or what's going happen if you do that. Einstein said, "Logic will take you from A to B. Imagination will take you everywhere." Additionally, if you want to pursue something like energy policy—in which case you might study business and electrical engineering together—you'll need good social skills, good social networking skills, and good leadership skills.

What advice would you give students who are interested in a career in electrical engineering?

Obviously, mathematics is important, so you should study mathematics. You can improve your imagination by pursuing some of the visual arts such as painting, drawing, and photography. Study the existing technologies. You'll find tons of information on existing technologies and what the future might hold just by looking on the Internet. Read magazines like *American Scientist, IEEE Spectrum, and Technology Review*. Start building small circuits at home, such as those used in autonomous robots. That will really get you thinking about how electricity works.

Be curious about everything. Being an engineer is not only about having a job to pay the bills. Engineering is a lifestyle that requires you to be curious, searching, always learning new stuff. Einstein said, "I don't have a special talent, but I'm patiently curious." That's really important.

What do you think is some of the coolest emerging technology?

Electric cars. There are many problems we have to figure out, such as how we're going to charge them when we're driving long distances. Although electric cars don't run on fuel, power plants will generate additional emissions when they produce the extra energy needed to charge those cars. How will we manage those emissions? How will we maintain the cars? Ultimately, there will be a smart grid that could buy the extra energy stored when you park your car at work and use it during the day for industrial loads. This would mean less work for power plants and fewer emissions during the daytime. At night, most of the power giants would be off, freeing up power plants to charge your car while you sleep. The smart grid will play a key role. How is it going to work? How can we keep the costs down? Integration of the vehicles and the grids will be an important goal. i

What electrical engineers do

Electrical engineers research, design, develop, test, and operate electrical systems, radar and navigational systems, power generation systems, cars, robots, cell phone systems, and lighting and wiring in buildings.

Where they work

Electrical engineers work in commercial, industrial, military, and scientific settings, as well as universities. They generally work in offices, but may also visit sites to observe equipment.

Education and training required

A bachelor's degree is required for nearly all electrical engineering jobs. A master's degree and PhD may provide additional employment opportunities, particularly in academia. Employers value practical experience such as internships.

Salary range

The U.S. Department of Labor lists the 2010 median annual wage for electrical engineers as $87,180.

For more information

American Society for Engineering Education
www.asee.org

Technology Student Association
www.tsaweb.org