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UNM wins \$5 million defense research grant

By Justin Bailey

The UNM Electrical and Computer Engineering Department has been awarded a five-year, \$5 million grant from the U.S. Department of Defense to study ways to reduce the size of pulsed power systems.

Edl Schamiloglu, an electrical and computer engineering professor and the principal investigator for the grant, said the award is a significant step for UNM's Engineering Department, which placed in the top 50 in the U.S. News and World Report rankings for engineering graduate schools this year.

"UNM is now competing with the big boys, and not only are we competing, we're winning," Schamiloglu said.

Pulsed power is used for scientific research applications such as controlled fusion research and laser generation, in which tremendously high levels of power are needed.

"Since power is energy per unit time, by releasing a given amount of energy in a very short time, one can generate very high output power pulses," Schamiloglu said.

Electricity is gradually stored in a network of capacitors and then released all at once in a quick burst, lasting a fraction of a second. The burst of power is channeled through a pulse-forming line that is similar in design to a cable used for television, but much thicker and encased in steel. The electricity goes through the line and then is transformed into a beam of electrons, which can be used for various purposes — such as high-powered microwave generation.

Pulsed power systems used in laboratories are large, often taking up entire buildings. Schamiloglu said the military would like to have smaller systems that could be installed on planes, vehicles and ships. He said portable sources of pulsed power could lead to the formation of non-lethal weapons technology for military use.

An example of non-lethal weapons technology would be a fighter plane disabling an enemy radar station with a microwave beam. Currently, the only effective way to take out an enemy radar station is with a bomb, leading to deaths and destruction of property. Schamiloglu said a microwave could be as effective as a bomb, without killing anybody.

He said eventually there could be commercial applications for the technology that might be useful in medicine, and research is being done in Europe exploring pulsed power's potential to kill disease-causing bacteria and viruses.

Schamiloglu said one way to develop a more compact system without losing power is to look into the properties of dielectrics — materials that do not conduct electricity — used as insulators to contain electric current. Pulsed power systems need good dielectrics. The diameter of a pulsed power line needs to be large because the extremely high levels of power make it necessary to use a lot of insulation. But the line's large diameter inhibits size reduction of the overall system.

Schamiloglu's project is to research the electrical properties of dielectrics — which can be solid, liquid or gaseous — and to incorporate newly developed ceramic insulators into the pulsed power system. Schamiloglu said the ceramic dielectrics have a very high insulating value, so less material may be needed. He said the new ceramic dielectrics have nonlinear characteristics, so they may break down in unknown ways when exposed to high levels of electric charge.

He said he wants to know what causes these breakdowns and how to take advantage of these materials. He said another option for an effective dielectric might be nitrogen or other gases under high pressure, which would greatly reduce the weight of the system, making pulsed power systems a possibility for airplanes.

The microwaves generated by pulsed power technology are about the same frequency and wavelength as the microwaves in a microwave oven, but one trillion times stronger. Schamiloglu used the analogy of a musical note coming through a speaker to explain the concept. If the volume is turned up, the sound wave creating the note is still the same frequency and wavelength, but the increased amplitude makes the sound louder and uses more power.

Schamiloglu said the military is the main source of funding for university science and engineering research. He said historically, many technological innovations that improve the quality of civilian life have come about because of research sponsored by the military.

"If not for the Department of Defense, there would be much less research," he said. "And a large part of the money goes into training grad students."
