Emily Pfautsch, Mechanical Engineering

Year in School: Senior
Hometown: Harrisonville, MO
Faculty Mentor: Dr. Robert Tzou, Mechanical and Aerospace Engineering
Funding Source: College of Engineering Honors Undergraduate Research Option

Ultra-fast, ultra-intense lasers for use in surgery

Ultra-fast, ultra-intense lasers (UUL) produce laser pulse durations that last only a femtosecond (10-15 s). Because the laser pulse is so short, the heat-affected area is greatly reduced, and less tissue is damaged when it is used on biological material. As a result, the laser has many applications for surgery because it would insure more successful surgeries and quicker recovery time for the patient. The UUL laser was invented in 1996, and is still rather new, so in order to better understand how the laser interacts with biological material, laser simulations needed to be developed. Previous research has examined the effects of one laser pulse on biological tissues. The goal of my research is to understand how an additional pulse will affect biological material. To simulate the lasers, numerical methods were developed to analyze the response of biological tissue to UUL pulses, which were then used to develop a computer program. The results from the simulation predict that the first laser pulse forms plasma, which is like an electron gas. The newly-formed plasma absorbs a great deal of the second laser pulse's intensity and reduces its duration. Therefore, I have determined that it would be more efficient to use single pulses for drilling or cutting through biological tissue than two pulses, since the intensity and duration of the second pulse is hindered by the plasma. My research has helped us learn more about how the UUL laser works, and has produced some key information that will be required to implement the UUL laser into surgical procedures.