Simulation Modeling of Medical Devices

The patella/knee is one of the most complex joints of the human body, from both structural and kinematic points of view. It is composed of two different joints; the femoro-tibial joint between the distal part of the femur (thigh bone) and the proximal part of the tibia (shin bone) and the patello-femoral joint, consisting of the patella, which articulates with femoral surface. Total Knee Arthroplasty (TKA) is required in severe cases to restore the joint in many patients each year. The knee is made of soft, spongy cortical bone, which is found predominantly in the limbs. During surgery, a plastic patella is implanted to augment the original patella. The plastic patella has an elliptical shape, made of polyethylene, and has three pegs on the bottom side. The original patella is flipped over, shaved flat, and drilled with three holes, into which the three pegs of the plastic patella are fit. Bone cement is placed between the plastic patella and the natural patella to stabilize the implant. The patella implant model was designed using ABAQUS™, a Computer Aided Engineering (CAE) software for creating geometry models, performing finite element stress analysis, and viewing results. When creating the plastic patella geometry model through ABAQUS/CAE, half of the side profile was created using a dome shape. The section was then revolved 360 degrees to complete the shape. An elliptical cut was made for the final length and width of the patella. Next, a generalized shape representing the surface of the natural patella was created with three holes having dimensions matching the posts on the back of the plastic patella model. A geometry model of the bone cement was then placed between the plastic patella and the natural patella. The final step will be to create a finite element mesh for the geometry model and perform a stress analysis for an applied force. The results of the stress analysis will be used to predict failure, including fracture of the plastic patella implant due to the forces of daily activities.

Student's Name:	**Lamont Johnson**
School Student Attends:	Alabama A&M University
Name of Mentor:	Boyd M. Evans III
Division:	Engineering Science and Technology
Program:	Research Alliance in Math and Science