Thesis Project Portfolio

A Patient-Specific Computational Model for Optimizing Surgical Planning to Treat Patellar Instability

(Technical Report)

Analyzing the Impacts of ML Image Recognition Systems on Physicians

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Patellar instability is an orthopedic condition that occurs when the patella slides out of its intended position within the femur's trochlear groove during knee flexion and extension. There is an emphasis on surgical treatment to address this condition; however, various anatomical etiologies cause recurrent patellar instability, making it difficult for physicians to treat this condition. Many surgical interventions to treat patellar instability seek to reduce the force vector acting on the patella to prevent continued dislocation, but these methods rely on the surgeon's subjective opinion. The patient-specific computational musculoskeletal model that my capstone group is creating will address the subjectivity problem that the field of orthopedic surgery for treating patellar instability is currently experiencing. This model can provide an assistive tool for subjective surgeries by simulating different surgical approaches and quantifying the net force vector that results to determine the optimal approach. When trying to understand the impact this model will have in medicine, it is important to consider how it will impact physicians, patients, and healthcare in general. This consideration is important because this technology will impact the actions physicians take when planning surgeries and the type of surgeries that patients experience, ultimately shaping the actions these two social groups will take.

Moving away from technical research but continuing in the realm of computer science and its intersection with healthcare, it's important to evaluate how artificial intelligence systems used for disease diagnostics also impact society and various social groups. To explore how these technologies impact physicians who rely on them for disease diagnostics, I used the theory of technological citizenship to see how physicians' rights and duties are affected. To accomplish this, I performed document analysis on various FDA documents for each disease diagnostic AI system I was analyzing. This analysis allowed for the evaluation of the transparency by companies regarding the data used to train the AI system and the complexity of the processes the algorithm uses to produce the diagnostic results. Both of these pieces of information are necessary to determine whether physicians can access enough knowledge to give informed consent and achieve technological literacy. This research showed a lack of transparency in companies, who have achieved FDA-approval for their AI technology, regarding clinical studies used to train and show the effectiveness of their technology, along with the lack of information provided regarding the algorithm's processes. When considered in concert, implications of the technical project and STS research include the idea that technologies can be created to revolutionize aspects of the healthcare field. However, it is still necessary for the creators to be transparent about how the technology works in order for its users to understand the technology and its impacts.