# MoJoint: A Motion Visualization and Kinematic Analysis Software for the Musculoskeletal System

Mei, Angela (School: Academic Magnet High School)

Musculoskeletal disorders (MSDs) affect about 1.7 billion people worldwide. As most MSD cases are associated with abnormal motion of joints, motion assessment of joints provides a powerful tool for the prediction, diagnosis, and treatment of MSDs. However, the present-day diagnosis methods use medical imaging (e.g., MRI), which can only provide static and limited dynamic images. A compelling solution to this challenge is to combine medical imaging with marker-based motion tracking techniques to capture joint motion in an anatomically precise manner. However, the current lack of a user-friendly, open-source software that coordinates the data from medical imaging and motion tracking systems limits the clinical application of this approach. Here, we developed a software (MoJoint) that integrates geometry files generated from medical imaging and motion data from a marker-based motion tracking system to calculate joint motion and perform kinematic analyses. To make musculoskeletal kinematic analysis readily available to researchers and clinicians, we developed a graphical user interface (GUI). After completing the first stable version of the software, we used it to assess mandibular kinematics, which is crucial to understanding the cause of highly prevalent temporomandibular joint disorders (TMDs) (affecting about 5-12% of the population) and disparities in TMD risk (including by occlusal class and race). Our data showed that Class II subjects and Caucasians have the highest amount of mandibular translation and rotation in lateral movements, consistent with their high prevalence of TMD. These results demonstrated that our software has a huge potential for improving the prediction, diagnosis, and treatment of MSDs.

**Awards Won:**