

A musculoskeletal modeling and simulation framework for *in silico* investigations and exchange

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ABSTRACT

Movement science is driven by observation, but observation alone cannot elucidate principles of human and animal movement. Biomechanical modeling and simulation complement observations and inform experimental design. Biological models are complex and specialized tools are required for building, validating, and studying them. Furthermore, common access is needed so that investigators can contribute models to a broader community and leverage past work. We are developing OpenSim, an open source musculoskeletal modeling and simulation application specialized for these purposes, by providing: musculoskeletal modeling elements, such as biomechanical joints, muscle actuators, passive forces, compliant contact, and controllers; and tools for fitting generic models to subject-specific data, performing inverse kinematics and forward dynamic simulations. OpenSim performs an array of physics-based analyses to delve into the behavior of musculoskeletal models by employing Simbody, an efficient and accurate multibody system dynamics code. Models are publicly available and several have been reused for multiple investigations because they provide a rich set of behaviors that enables different lines of inquiry. This presentation will demonstrate one model developed to study walking and applied to gain deeper insights into muscle function during running and in pathological gait. Then, the implementation of a postural stability platform with the model under reflexive control provides a framework for performing human posture experiments *in silico* and illustrates how simulations can test fundamental hypotheses and focus the aims of *in vivo* experiments. We encourage wide adoption of OpenSim for community exchange of biomechanical models and methods and welcome new contributors.