

Combining in vivo X-ray motion and force data to determine dynamic joint impedance and mobility - crab meets guinea pig!

Body segment dynamics can be determined with unprecedented accuracy using marker-based 3D X-ray motion analysis together with simultaneous foot force data. These kinematic and kinetic data are combined with inertial properties of the leg segments in an inverse dynamics analysis to determine the torques experience by a given joint. Time-varying 3D impedance can then be analyzed for each joint during various locomotor activities. Here we compare the biomechanics of a mammalian synovial joint (the guinea pig knee) and crustacean dicondylar joints (the hinge-like leg joints of crabs). The guinea pig knee is an endoskeletal joint that permits translation and rotation to varying degrees in more than one axis. In contrast, each joint between exoskeletal leg segments of crabs contains a pair of pivots that constrain it to a single degree of freedom, hence, motion in different axes is achieved by additional single-degree-of-freedom joints distributed along the leg. Our study applies the same set of techniques to compare joint impedance and mobility in these extremely different legged systems.

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