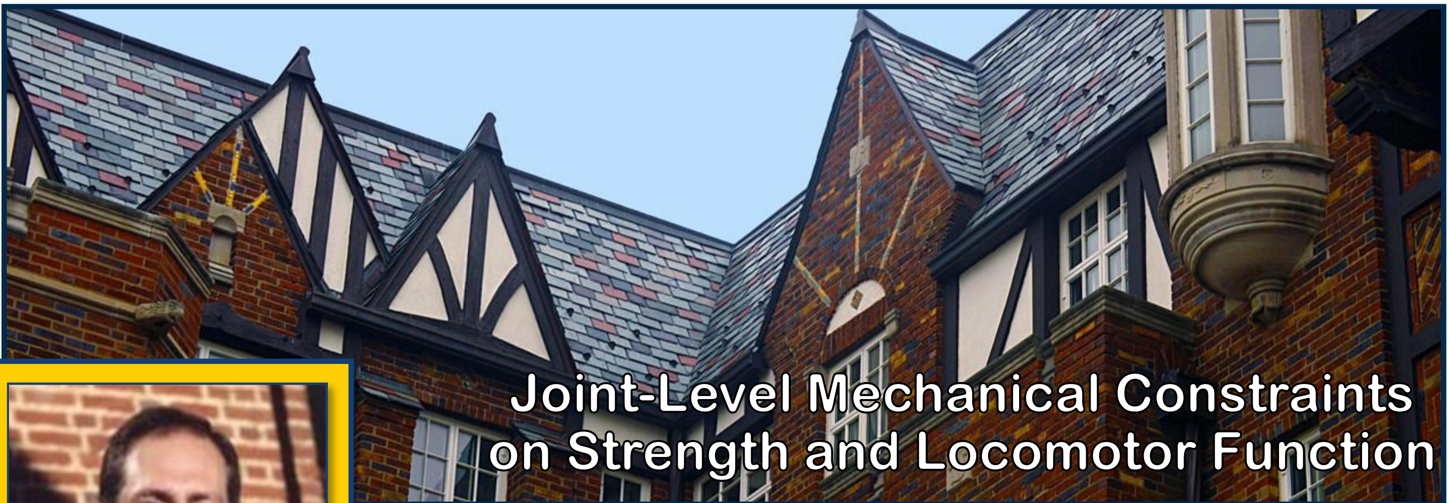

Joint-Level Mechanical Constraints on Strength and Locomotor Function

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Variation in musculoskeletal structure across species corresponds to movement specialization, but the implications of normal variation within a species are less clear. Human muscles are known to adapt to training and to disuse, but they do so within the constraints set by the lengths of limbs, the attachments and routings of tendons, and the structure and kinematics of joints. A growing body of evidence suggests that these constraints vary considerably across individuals and play surprising roles in either limiting function or enabling elite performance. Additionally, it appears that activity patterns during the growth period are determinative of skeletal characteristics with the potential to affect movement capacity in younger and older adults. Work in our laboratory has identified differences in human limb and joint structure between groups and established correlations between structure and human movement performance assessed using motion analysis techniques. For example, we have found elite human sprinters to have longer forefeet and shorter plantarflexor muscle lever arms, and we have found walking speed to correlate with plantarflexor lever arm in slower-walking older adults. We have coupled these human experiments with computer simulations of human movement designed to elucidate the mechanisms underlying relationships between structure and function. Recently we have begun experiments using an animal model (guineafowl) to study effects of exercise and inactivity on skeletal structure during development, and how skeletal structure in turn affects post-growth movement behavior.

BIO:

Stephen Piazza is a Professor in the Department of Kinesiology at Penn State University and he is also Professor-in-Charge of the Kinesiology graduate program. He received his doctorate in mechanical engineering from Northwestern University and his undergraduate training in engineering science at Harvard University. Dr. Piazza has served as President of the Gait and Clinical Movement Analysis Society and as Associate Editor of the Journal of Biomechanics, the Journal of Applied Biomechanics, and Foot & Ankle International. He currently serves as Program Chair for the upcoming 2017 Annual Meeting of the American Society of Biomechanics. Dr. Piazza's research interests are in joint biomechanics and computer simulation of human movement, specifically with how variation in joint structure in humans determines performance at the extremes of locomotor ability. In 2011, his research group won first prize in the Grand Challenge Competition to Predict In Vivo Knee Loads that was held at the ASME Summer Bioengineering Conference. Dr. Piazza's research has been funded by the National Science Foundation, the National Institutes of Health, private foundations, and industry sponsors, and has been featured in media outlets such as the BBC World Service and the New York Times.

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