Assessing in vivo neuromuscular function: implications for control of muscle function across locomotor behaviors

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The in vivo force-length behavior of muscles reflects time-varying patterns of force and length change in relation to neuromuscular activation. This underlies the dynamics of oscillatory limb motion and shifts in force production during stance versus swing. During walking and running, muscle work may be minimized in favor of economic force generation. During flying (and swimming), muscles must shorten to generate considerable power, typically operating at high frequencies and contractile strains. Ongoing work seeks to identify the extent to which muscle-tendon architecture constrains, or at least, influences a muscle's role for performing work versus economic force generation. Muscles must also stabilize the motion of an animal's limbs and body. Perturbation studies of running animals indicate that passive-dynamics likely underlie stabilization, supplemented by neuromotor feedback control. Passive mechanisms offer a rapid stabilization response until slower neural feedback mechanisms can be implemented. Recent work shows that muscle function can vary within and between muscle synergists, providing greater flexibility of muscle function in relation to varying locomotor requirements.