

Legged robots provide a promising solution to the challenge of exploring dangerous, remote, or difficult areas on earth and throughout the solar system. Historically, research and development of legged robots has benefited from reduced order spring-mass models that capture the center of mass motions and energy transfer characteristics of animal locomotion. In this dissertation, I expand these model based approaches to underwater legged locomotion, which presents unique challenges not present on land. I explore variations and extensions to the Spring-Loaded Inverted Pendulum (SLIP) model of walking and running that are intended to capture key aspects of underwater walking, based on the Fluid-Field SLIP (FF-SLIP) model developed by earlier researchers. These extensions include accounting for added mass effects, foot slip, and biologically inspired lift forces. Through experiments on legged robot hardware, I validate the predictive capacity of these modeling extensions. These modeling approaches allow me to generalize strategies for walking underwater that will be relevant to a wide variety of aquatic applications.