

SMU Department of Mechanical

Engineering

SEMINAR

Ph.D. Defense:

Inertially Actuated Baton Robot



Joe Zoghzy

Thursday, December 12, 2013

11:00 A.M. – 12:00 P.M.

Huitt Zollars 115 in the Embery building

Abstract: Our main research goal is to develop robots that can generate a variety of gaits using mechanical systems, ranging from a bouncing ball to a system of masses connected with rods. We focus on the second generation of the family tree, the baton, which consists of two masses connected with a massless rod. Recent studies have shown that the baton system exhibits different gait patterns, such as front tapping, back-and-forth tapping, hopping, galloping, etc. The main challenge is to design and implement a system that can generate locomotion using impulsive forces at ground contact points to compensate for energy losses. We proposed a planar model for the baton locomotor, consisting of two concentrated masses at the ends of the rod. Spring legs were used to cushion the effect of impacts, and conserve the energy of the system. We developed actuation schemes to apply inertial forces to the ends of the baton in order to generate and maintain locomotion. We successfully implemented the theory in our prototype Pony I. We also present a more advanced actuation mechanism with two spinners at each end of the rod, rotating in opposite directions. The spinners cross twice every full rotation cycle at the rendez-vous angle, generating a sinusoidal force along the direction of the rendez-vous points. We demonstrated that this actuation method generates several gaits: dragging, tapping, galloping and hopping. In addition, we investigated the feasibility of two different control methods (PID and SMC) that help maintain the periodic gaits. Finally, we demonstrated that our robotic baton, Pony II, was successful at generating all the studied gaits using numerical simulations. Pony II can progress on icy and lubricated surfaces, as well as on general ground surfaces.

Bio: Joe Zoghzy received his B.E. degree from the American University of Beirut in 2007, and his M.S. degree from the Southern Methodist University in 2010, both in mechanical engineering. He is currently a mechanical engineering Ph.D. candidate working under the supervision of Dr. Yildirim Hurmuzlu in the Systems Laboratory, [Bobby B. Lyle School of Engineering](#), SMU. His current research

interests include robotics, locomotion, mechatronics, controls, mechanical systems and designs, and impact mechanics.