NRI: FND: Natural Power Transmission through Unconstrained Fluids for Robotic Manipulation

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Mechatronics & Robotics Research Lab: https://blogs.umass.edu/mrrl
Fluid-Structures Interaction Lab: https://www.umass.edu/fsi

Project Contributors:

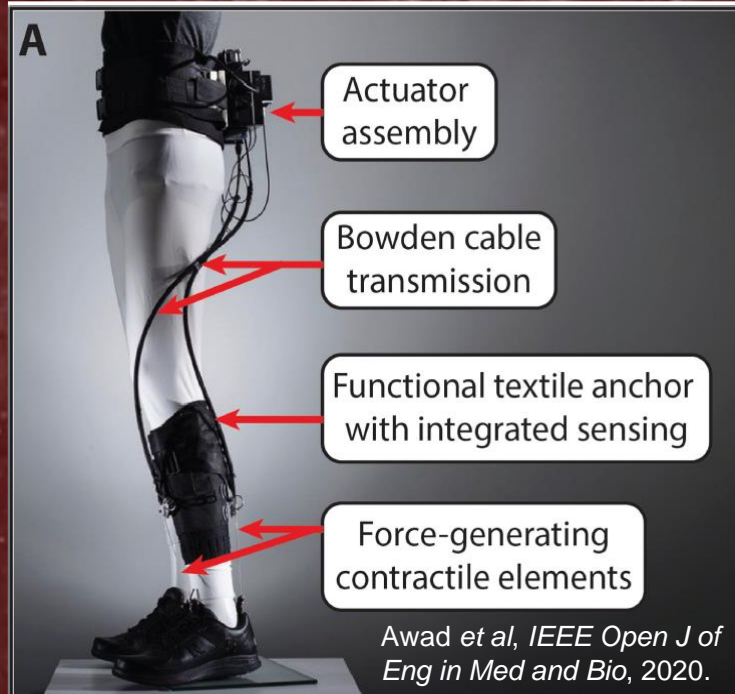Adrian Carleton, Umang Narendrakumar Patel, Soumitra Sitole, Meghan Mulloy, Dr. Todd Currier and Dr. Mark Price
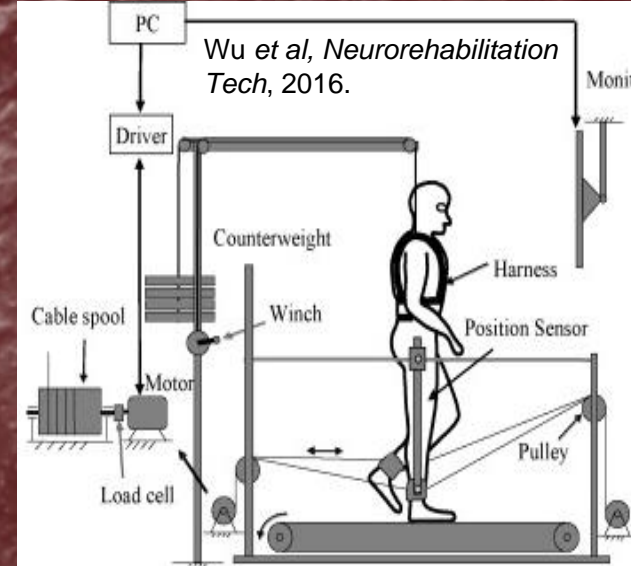
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Motivation: Assisting Human Gait

Rigid

Parker Indego

Compliant

A

Actuator assembly

Bowden cable transmission

Functional textile anchor with integrated sensing

Force-generating contractile elements

Awad *et al, IEEE Open J of Eng in Med and Bio*, 2020.

Cable

Wu *et al, Neurorehabilitation Tech*, 2016.

PC

Driver

Monitor

Counterweight

Cable spool

Winch

Harness

Motor

Position Sensor

Load cell

Pulley

Fluid

Flow Inlet

Treadmill

SwimEx Underwater Treadmill with Flow
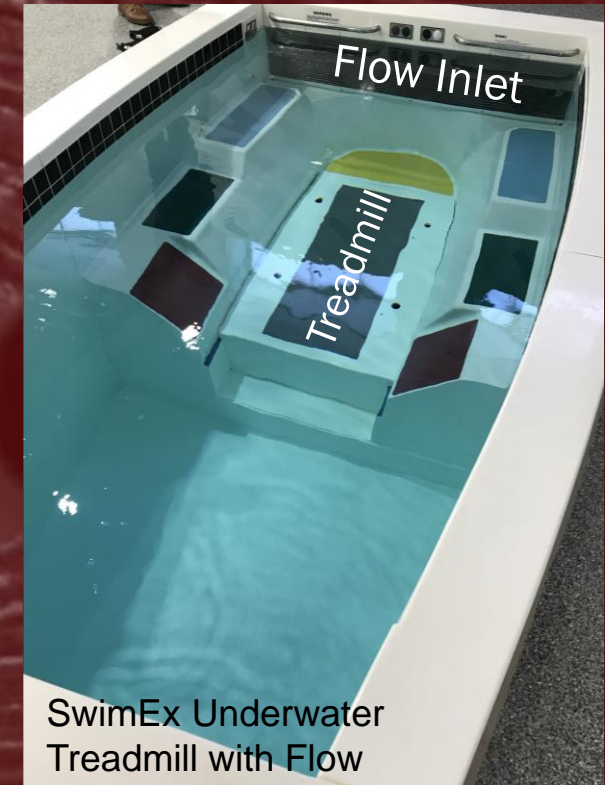
Challenge: Create an approach to control the transmission of power from a robot through a fluid environment to the object to be manipulated.

Hydrofoil Response in Wake of Rotating Cylinder

Solution: Leverage the open-loop natural response to control limit cycle oscillations to obtain the desired motion of objects in the downstream flow.
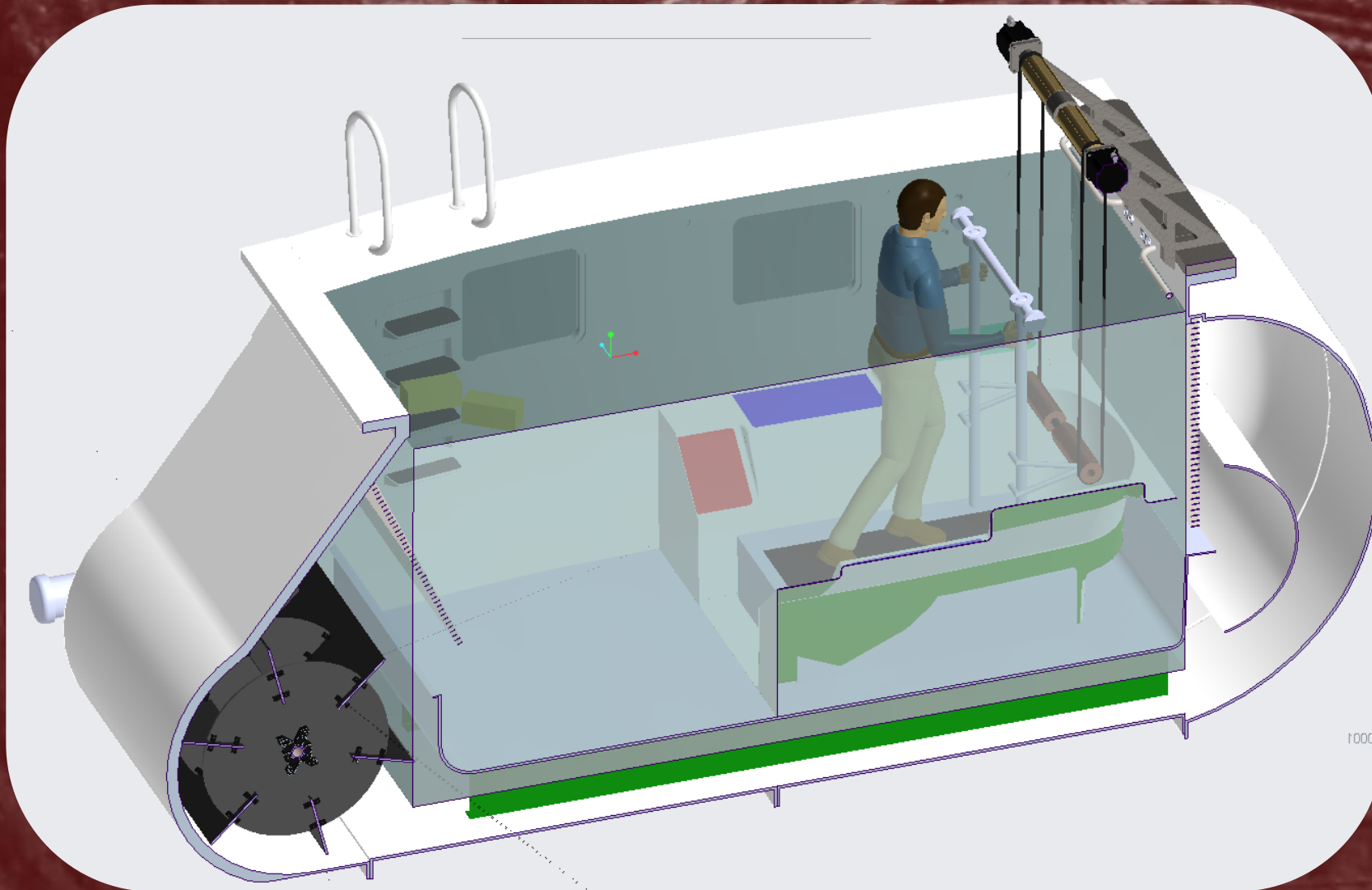
Alternating Jet in the Wake

Rotating Cylinder
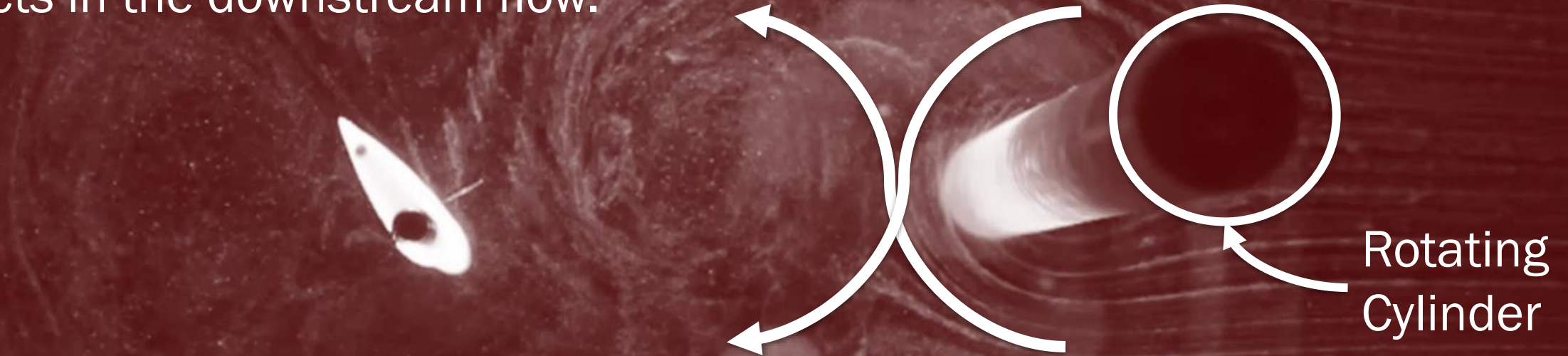
Scientific Impact: Enable a new type of manipulation strategy, which does not involve direct contact with the object with which it is interacting.
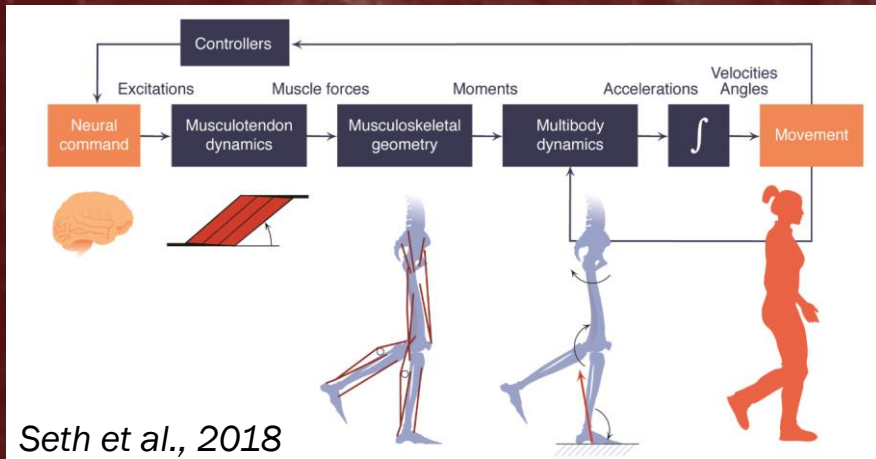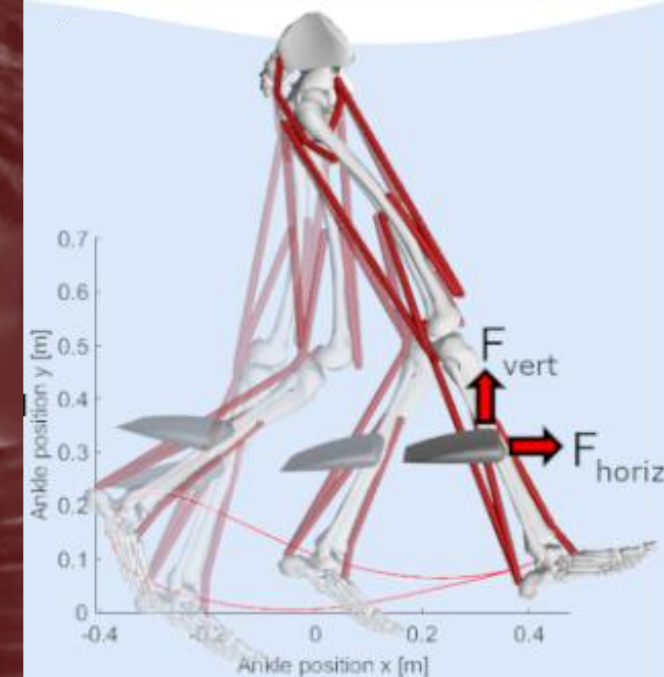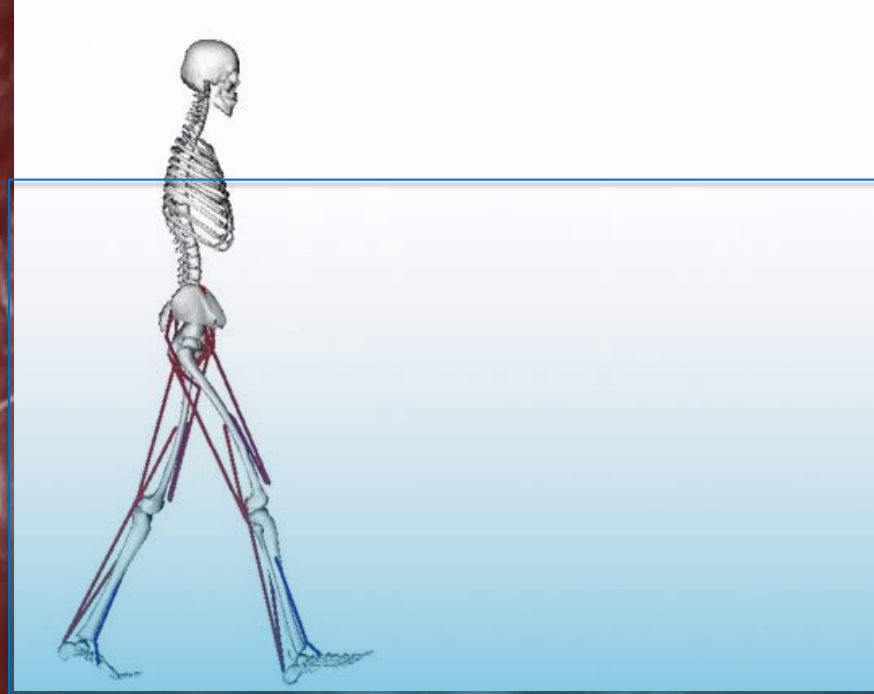
Underwater Treadmill Assistance

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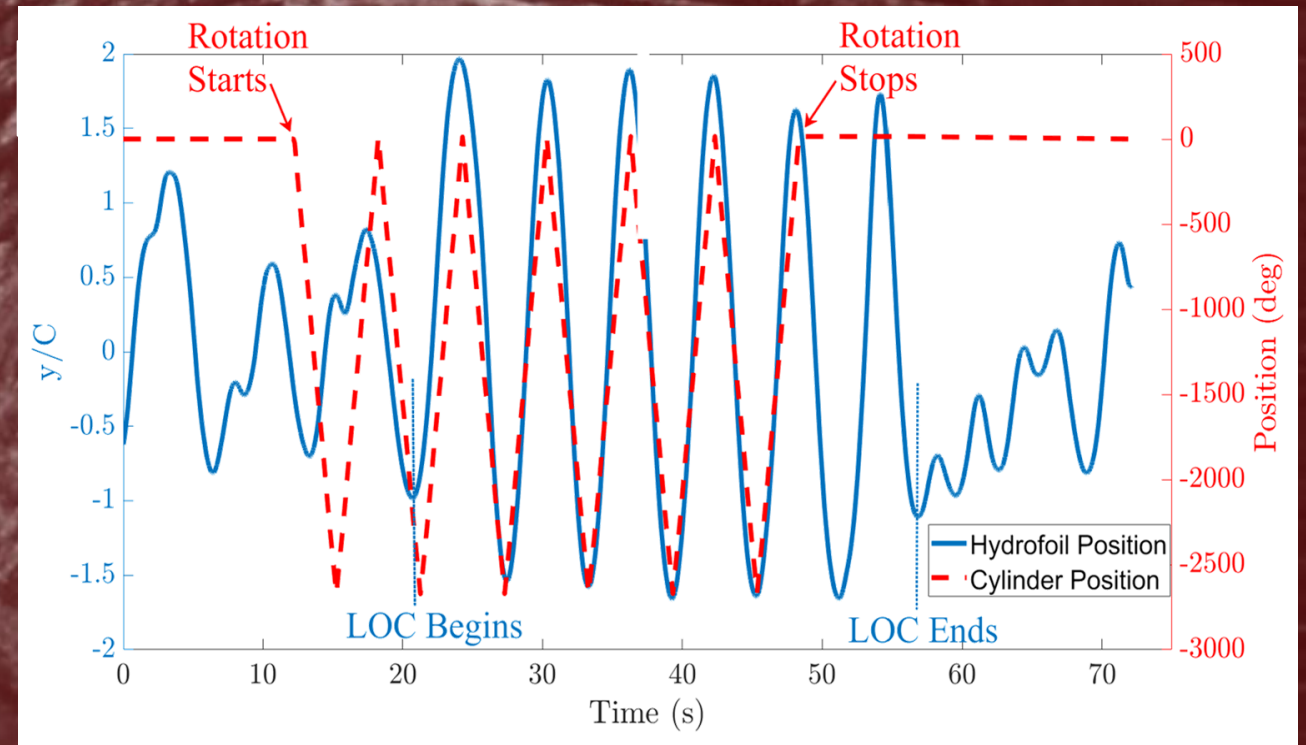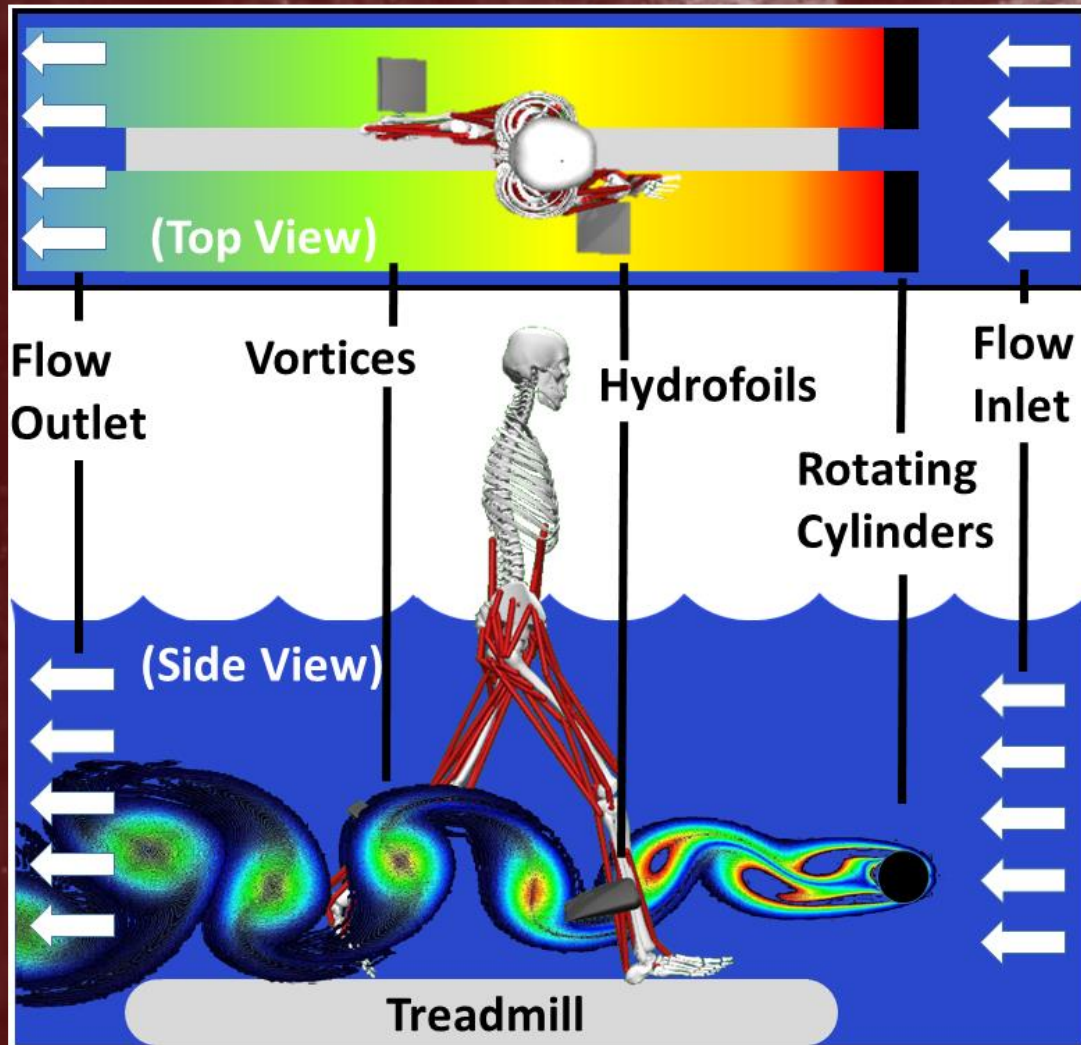
Immersive Fluid-Based Gait Trainer

Underwater Simulations of Assisted Gait

Seth et al., 2018

OpenSim: Open-source neuromusculoskeletal modeling and simulation

Broader Impacts

- Establish a novel method for natural and unconstrained gait training for persons recovering from stroke or injury.

- Applications in manufacturing and underwater robotics for fluid-based non-contact material handling and manipulation.

- Develop and deliver an innovative underwater robotics outreach program for K-12 students to demonstrate the physics as well as the beauty in engineering systems.

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