MuJoCo for Advanced Physics Simulation:
From manipulators to autonomous vehicles

Sumarize

As robotic systems become *more complex* and *operate in increasingly dynamic environments*, the need for high-performance physics simulation has grown rapidly. ***MuJoCo (Multi-Joint dynamics with Contact)*** has emerged as a powerful and flexible simulation engine, offering accurate modeling of multi-body dynamics and *efficient handling of contact and constraints*. Its *lightweight design* and *real-time capability* make it well-suited for both academic research and real-world robotic applications.

In this seminar, we will introduce the ***MuJoCo simulation framework*** and present a comparative discussion of its *advantages* and *limitations* relative to traditional platforms *like MATLAB Simulink and Simscape*. The talk will include live demonstrations of ***several robotic systems*** currently being developed within our research group, including:

- *Serial manipulators with 7 degrees of freedom*
- *Parallel mechanisms such as Stewart platform*
- *Autonomous mobile robots in 3D environments* (including underwater and aerial vehicles)

Beyond modeling and simulation, the seminar will also highlight ongoing efforts to ***integrate control algorithms*** focused on system stabilization, real-time implementation, motion planning, and optimization-based decision-making. This session is intended for students and researchers interested in advanced simulation tools and their applications in modern robotics.

Seminar agenda

1. Overview and introduction

2. Overview of MuJoCo and comparison with traditional simulator

3. Demonstration of Robotic systems

   (a) Serial manipulator (7-DOF): Model overview and kinematics implementation.

   (b) Parallel mechanism (6-DOF Stewart platform): Mechanisms constraints and stability control

   (c) Autonomous robots (AUV and UAV): Dynamic 3D environment, motion planning, optimization and real-time control concepts.

4. Open Q&A and Discussion.

Duration: *90 minutes. xx/06/2025*

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