

SWING-UP AND STABILIZATION OF A CART PENDULUM AND TWIN PENDULUM SYSTEM

Using Nonlinear Control Strategies



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Master Thesis
Control & Automation



AALBORG UNIVERSITY
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Agenda

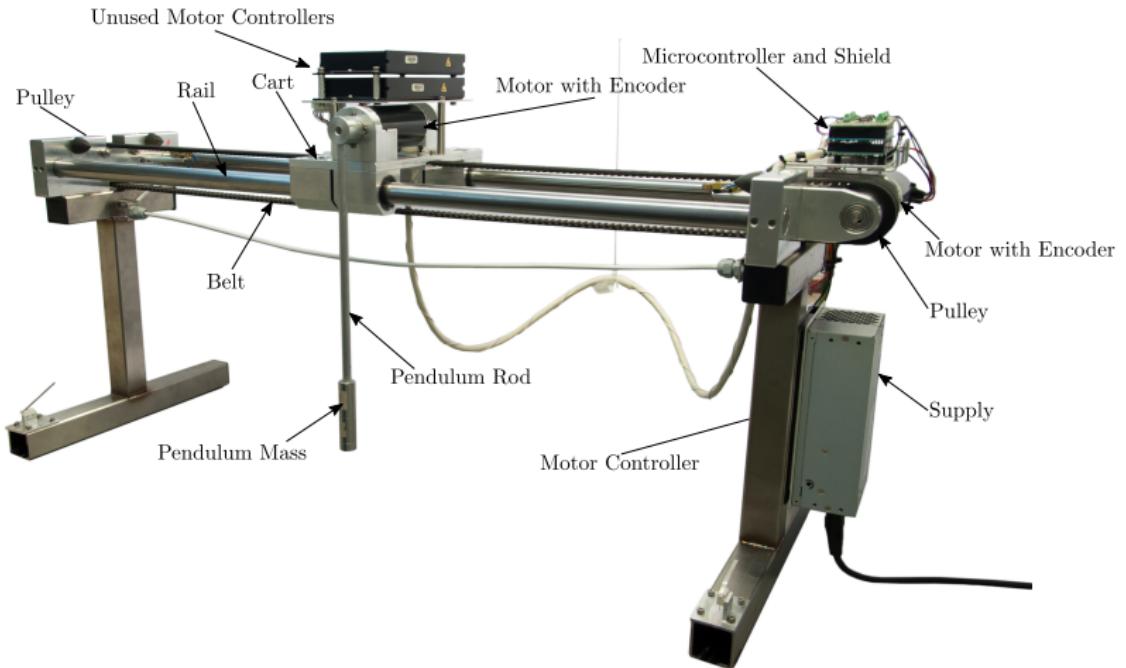


- ▶ Cart Pendulum
 - The System
 - Swing-Up and Catch
 - Results

- ▶ Twin Pendulum
 - The System
 - Swing-Up and Catch
 - Results
 - New Results

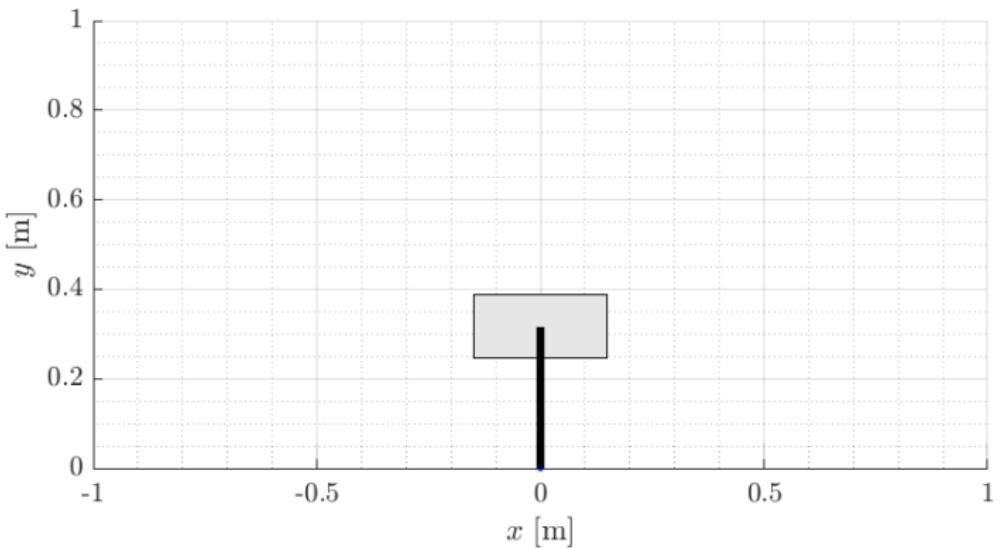
Cart Pendulum

The System



Cart Pendulum

Swing-Up and Catch



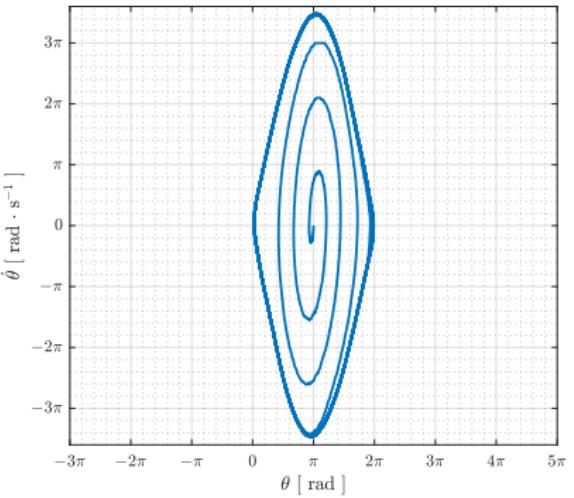
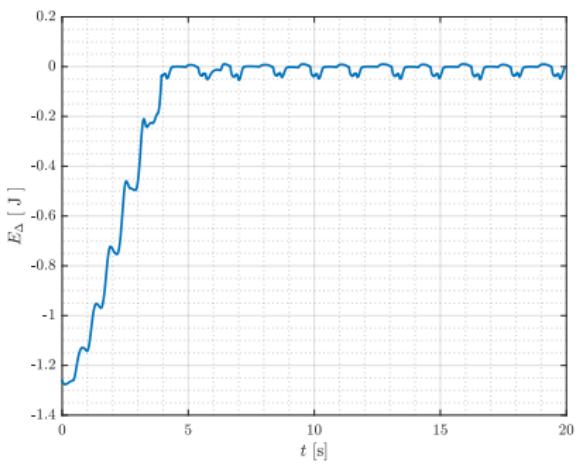
Cart Pendulum

Swing-Up and Catch



Cart Pendulum

Results

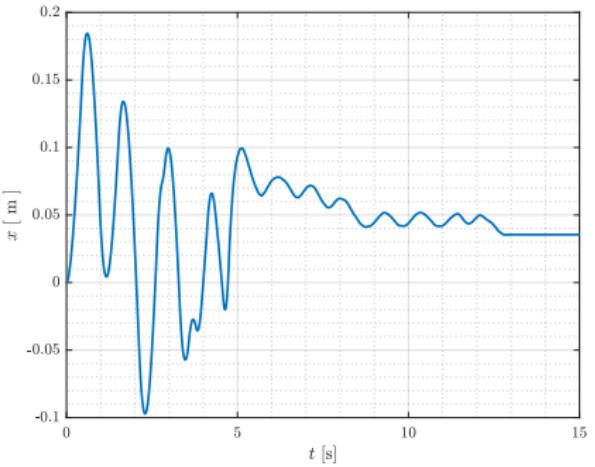
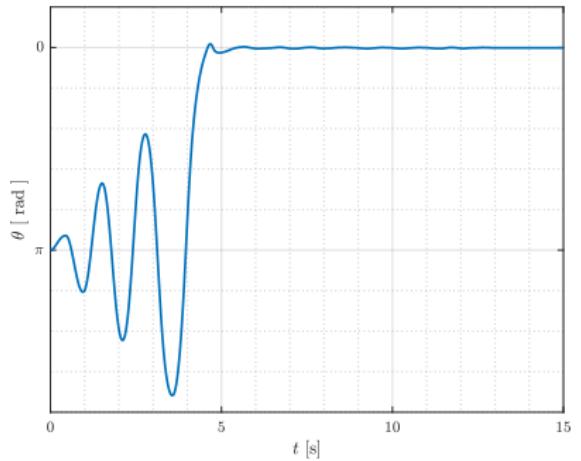


► Energy based control

► Heteroclinic orbit

Cart Pendulum

Results

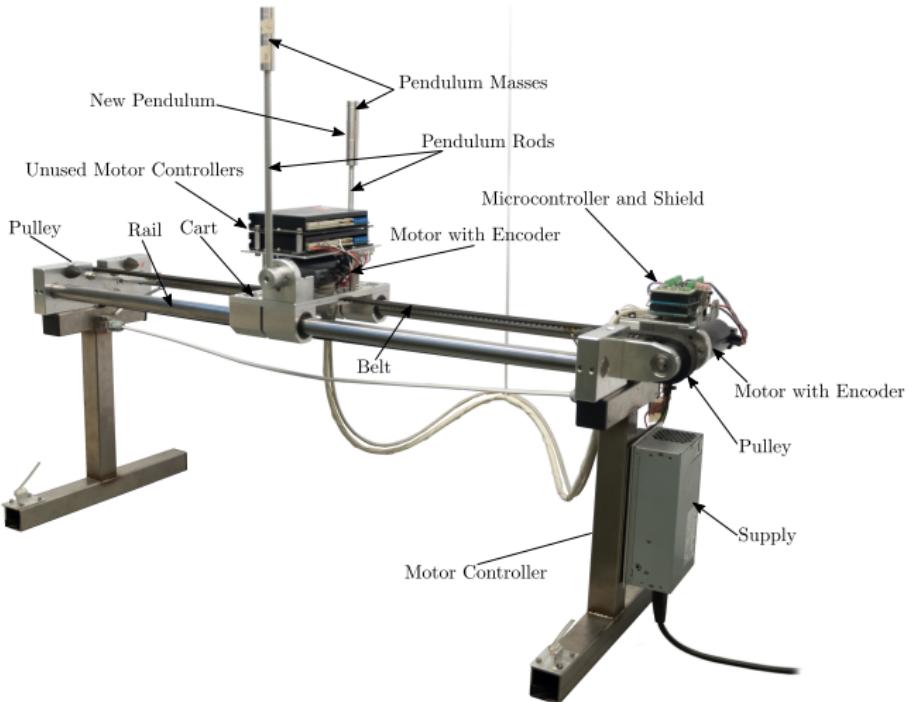


- ▶ Swing-up
- ▶ Catch using sliding mode

- ▶ Cart maintained near zero

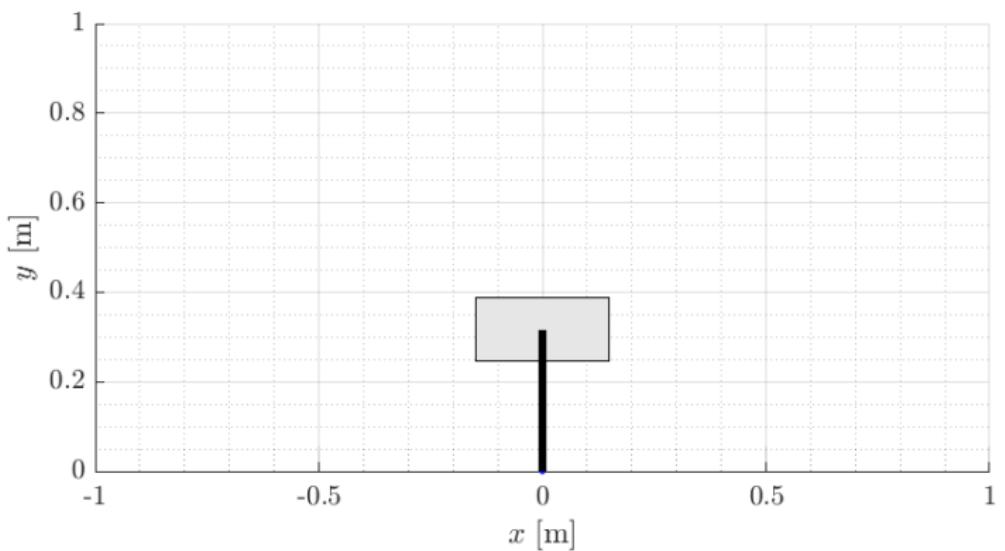
Twin Pendulum

The System



Twin Pendulum

Swing-Up and Catch



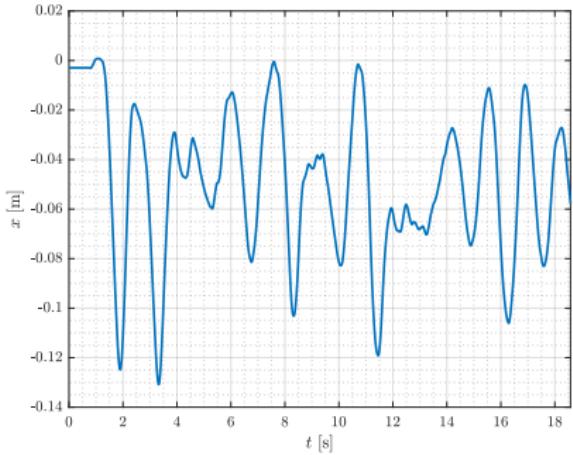
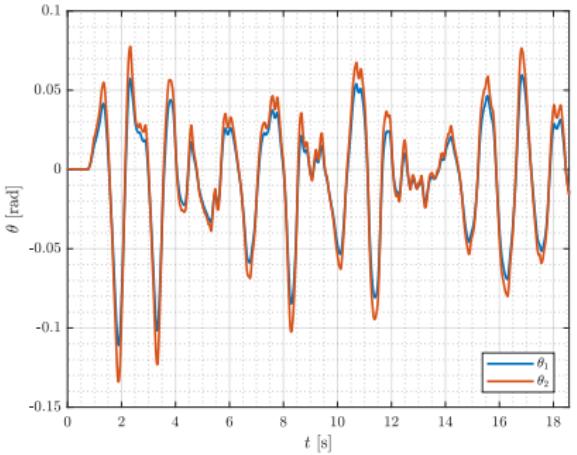
Twin Pendulum

Swing-Up and Catch



Twin Pendulum

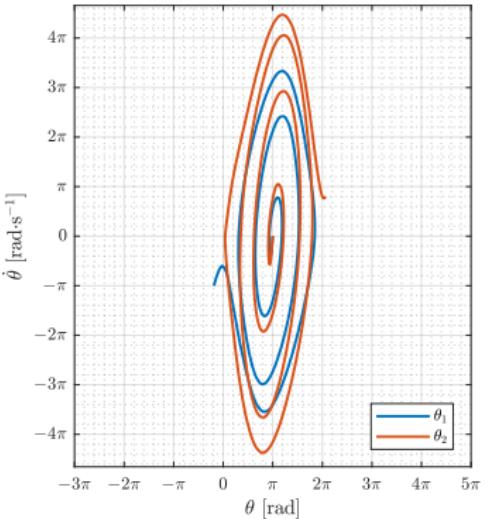
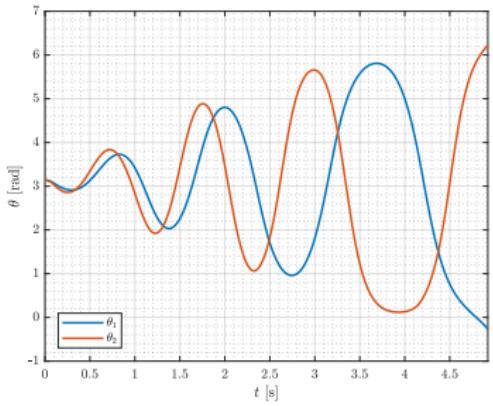
Results



- ▶ LQR stabilizing both pendulums
- ▶ Cart maintained near zero

Twin Pendulum

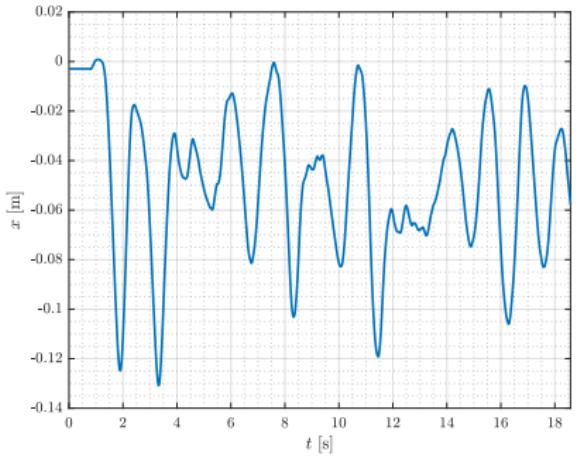
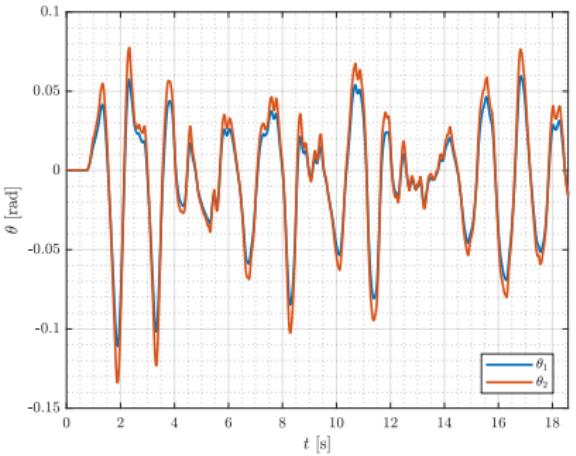
Results



- ▶ Swing-up not reaching equilibrium
- ▶ Pendulum 1 overshoots before pendulum 2 reaches equilibrium

Twin Pendulum

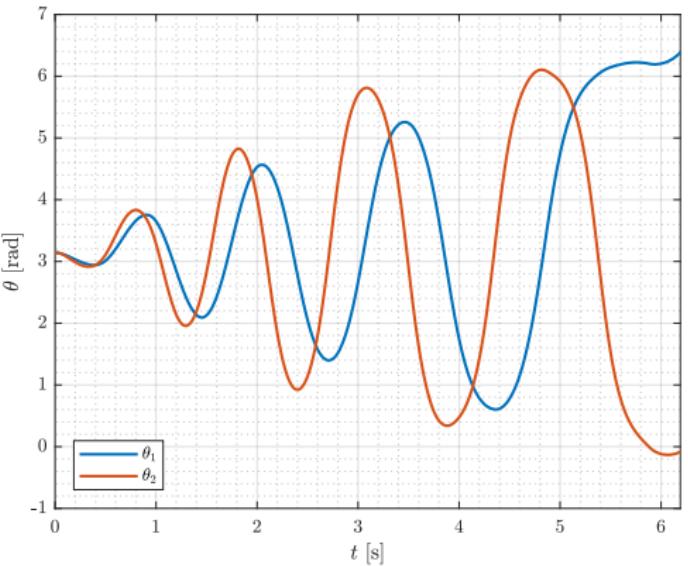
New Results



- ▶ Sliding mode stabilizing both pendulums
- ▶ Cart maintained near zero

Twin Pendulum

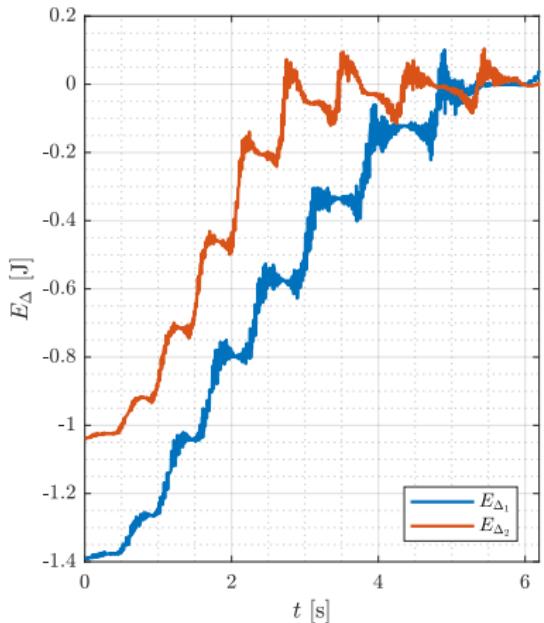
New Results



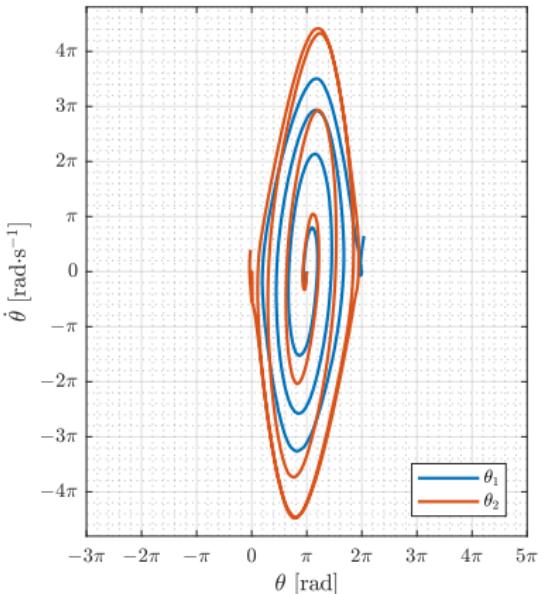
- ▶ Sliding mode attempt at catching both pendulums after swing-up

Twin Pendulum

New Results



► Energy references reached



► Equilibrium reached

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