

Motion Control of Hexapod Robot using Model-Based Design

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June 2015

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Introduction

Modelling

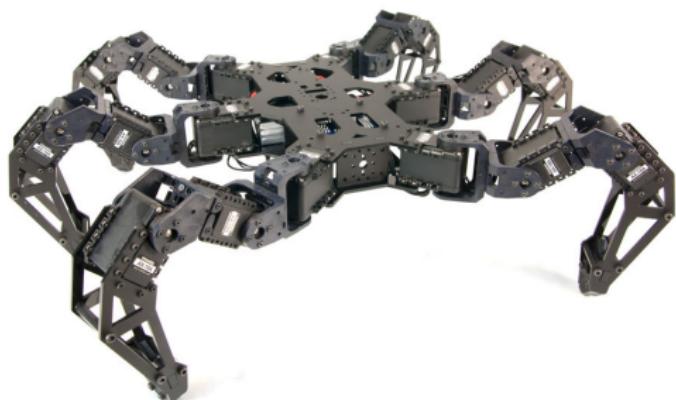
Control

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Hexpods

- ▶ Six-legged robot
- ▶ 18 degrees of freedom
- ▶ Ability to manoeuvre in uneven terrain

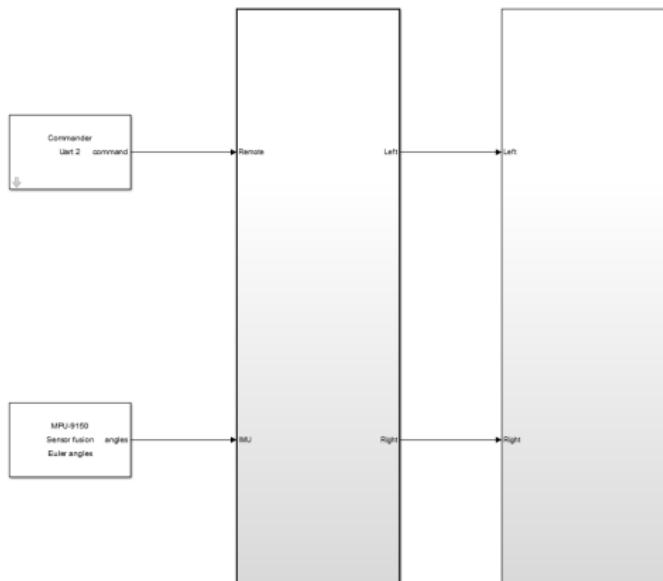


Goals

- ▶ Generation of locomotion pattern using Model-Based Design
- ▶ Walking in uneven terrain while keeping main body stabilized

Model-Based Design

Input Control Model



- ▶ Virtual model
- ▶ Automatic code generation

Introduction

Modelling

Control

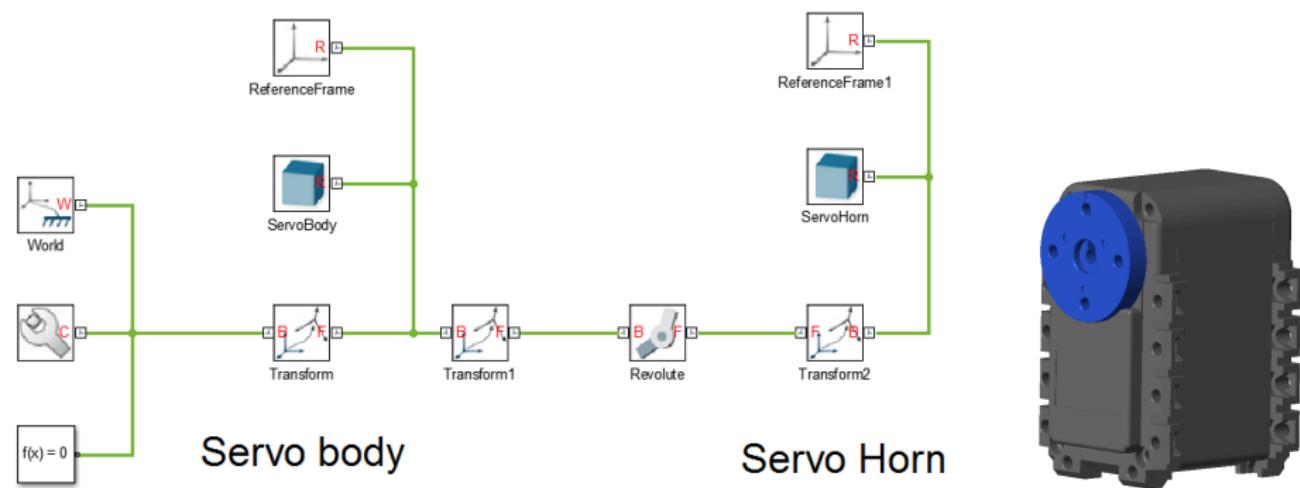
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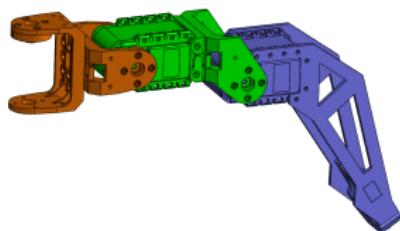
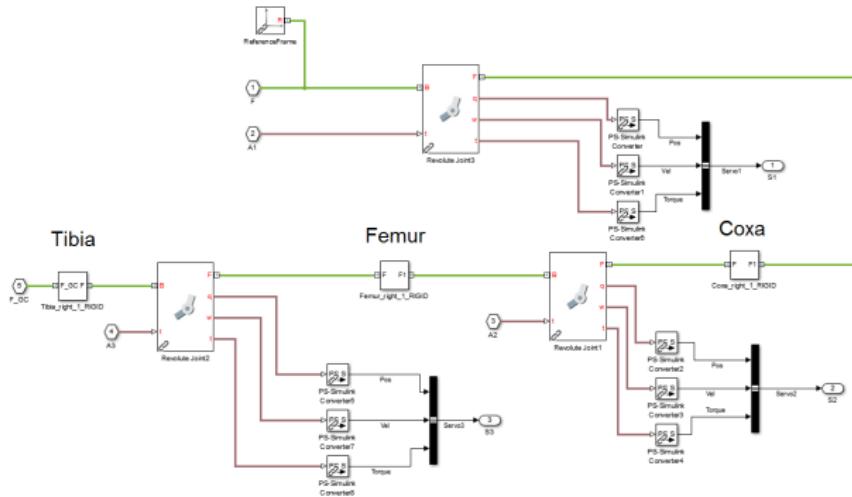
The hexapod kit

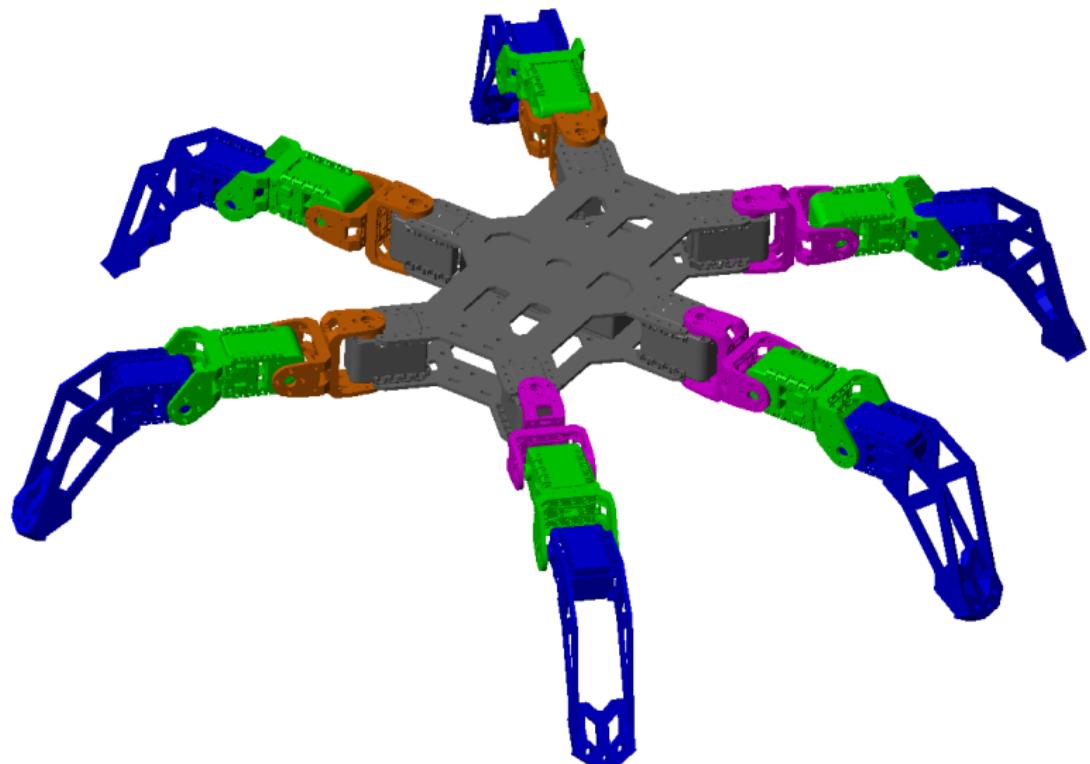


SimMechanics



Model of one leg





Introduction

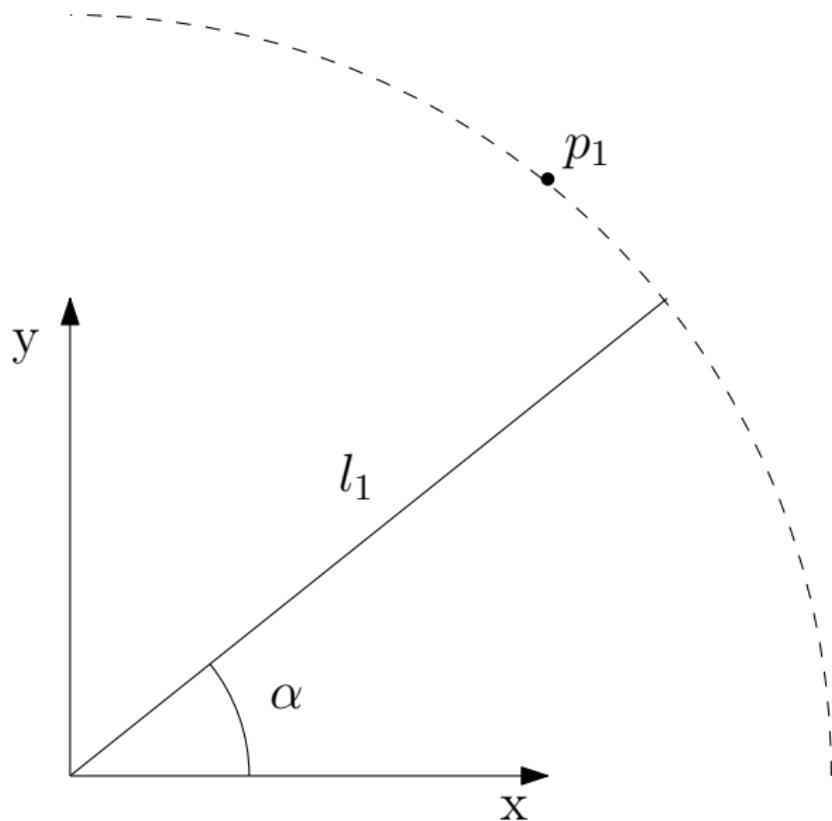
Modelling

Control

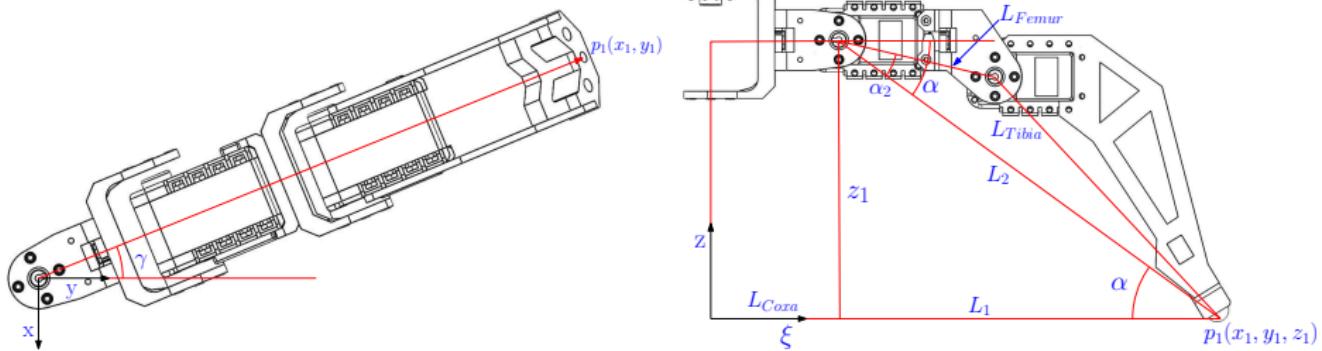
Results

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Inverse kinematics

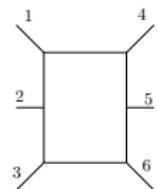
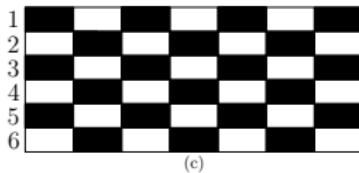
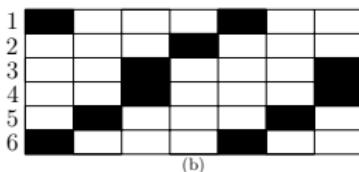
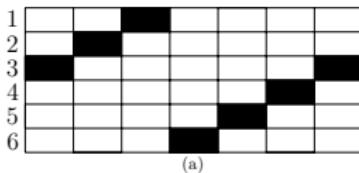


Inverse kinematics for one leg

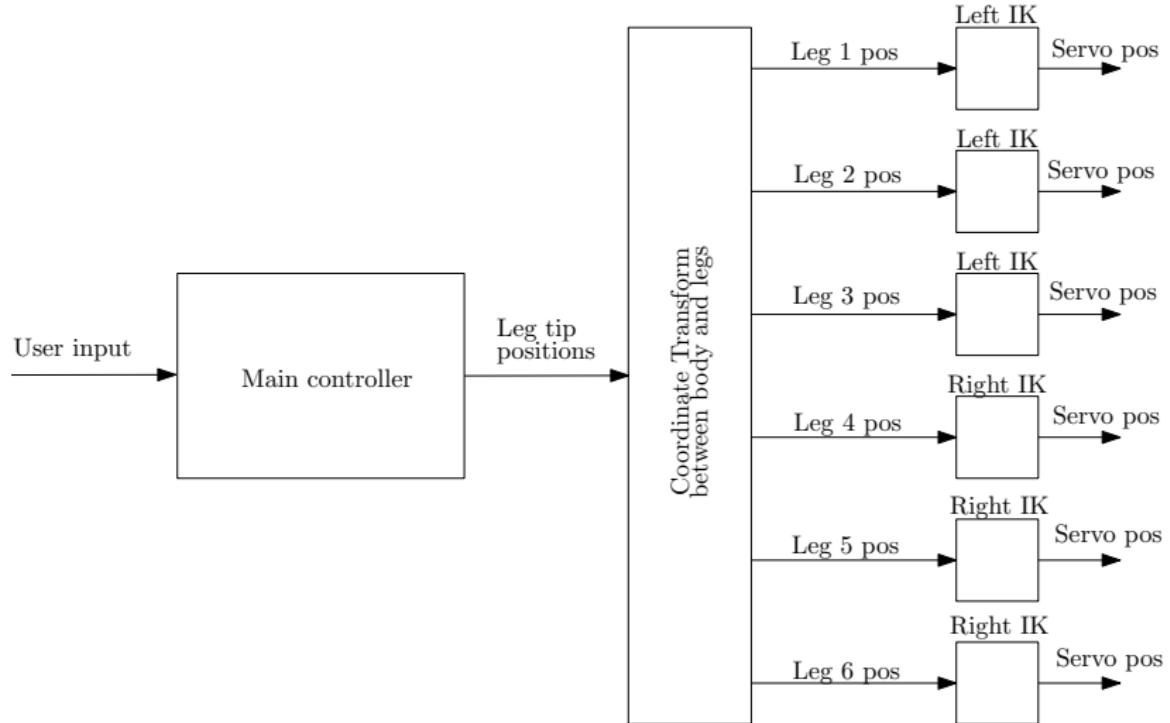


Walking theory

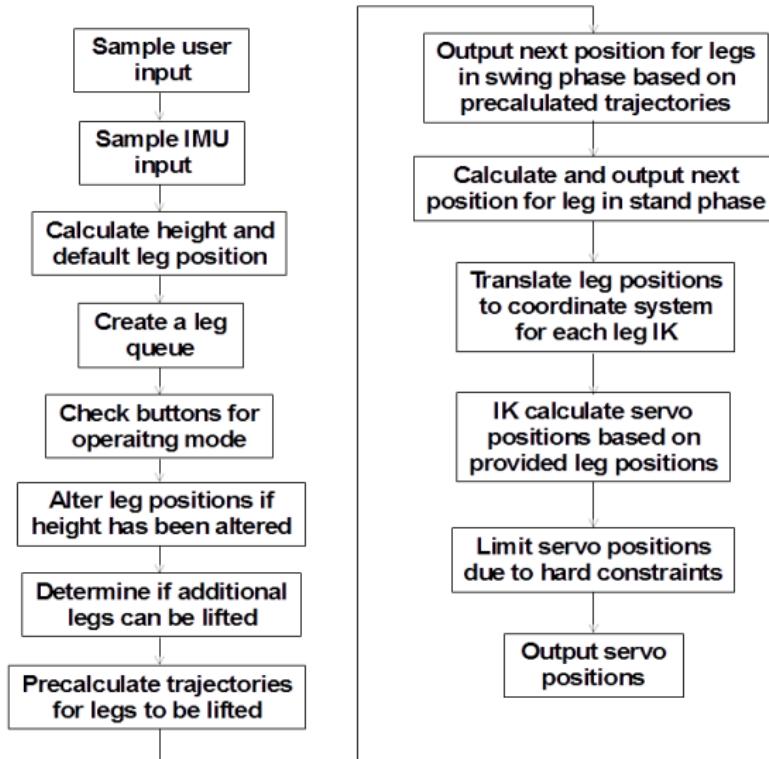
- ▶ Metachronal
- ▶ Ripple
- ▶ Tripod



Control structure

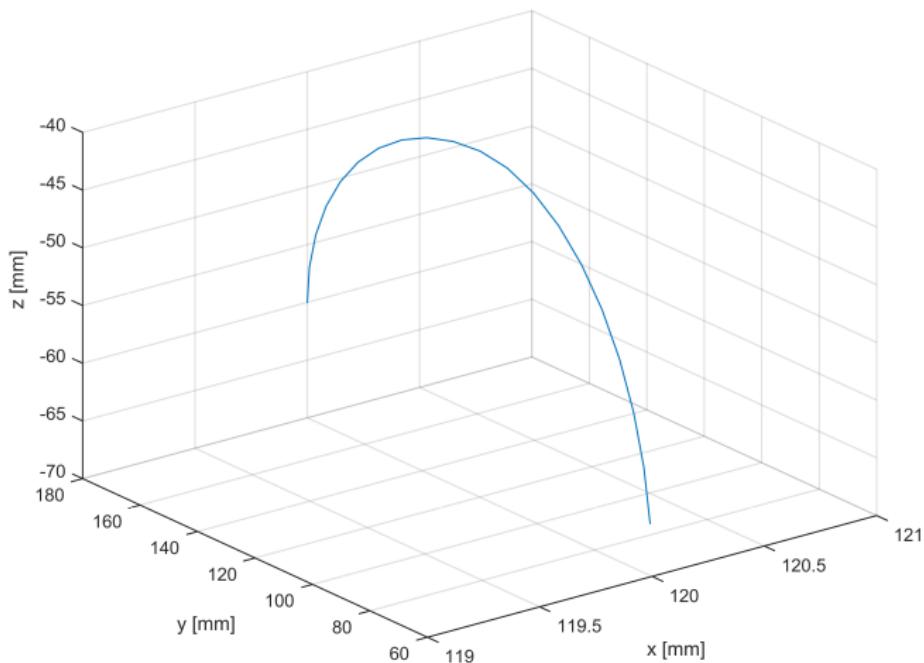


Workflow for controller



Trajectory

$$\begin{cases} y &= a \cdot \cos(\theta) \\ z &= b \cdot \sin(\theta) \end{cases}$$

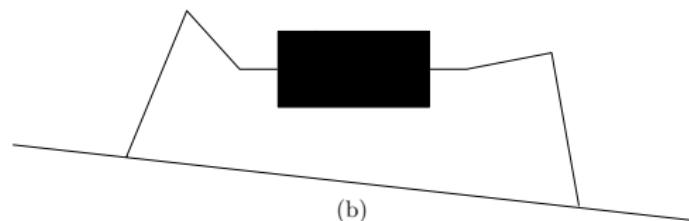


Balancing

- ▶ Use of trigonometric functions to stay level
- ▶ Alter height of leg positions
- ▶ Basic P-regulator

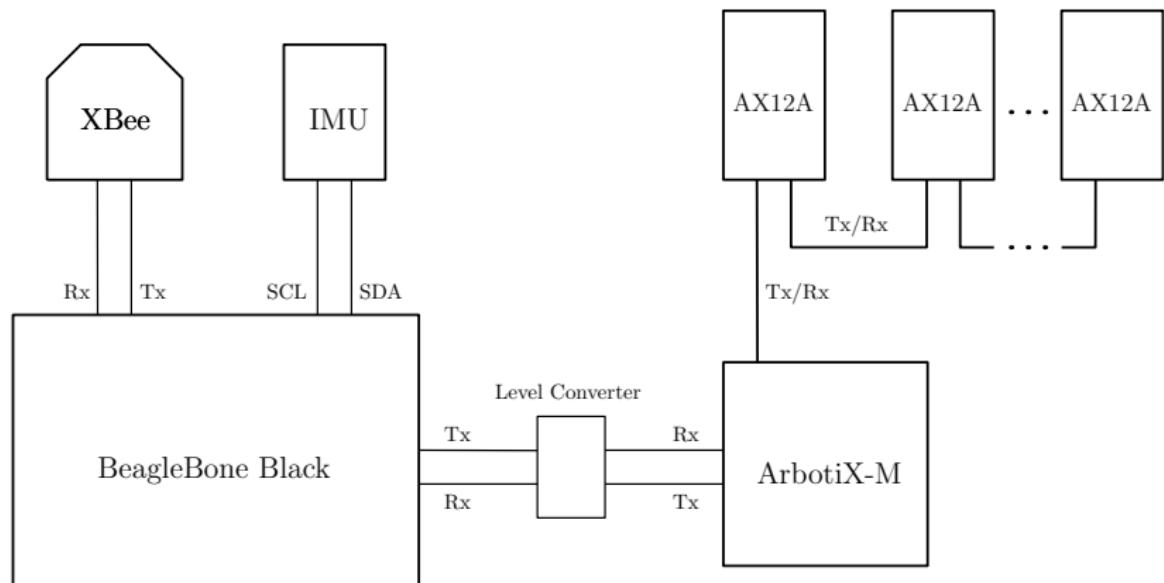


(a)



(b)

Communication and code generation



Introduction

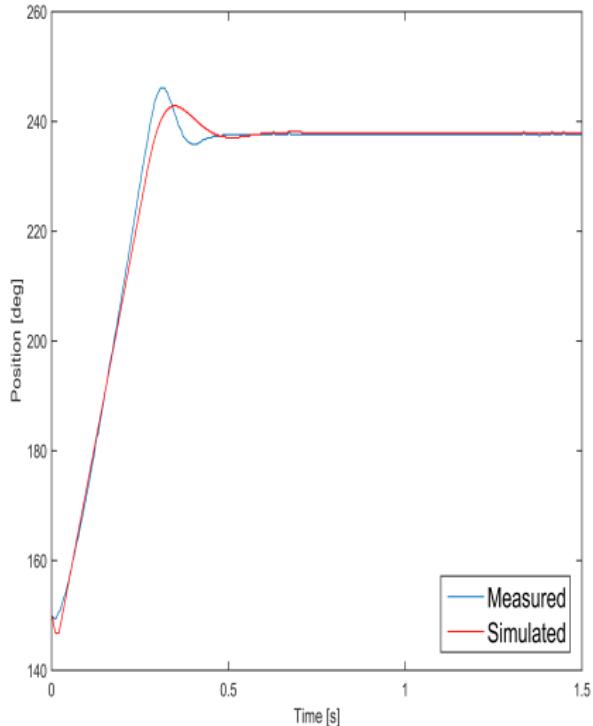
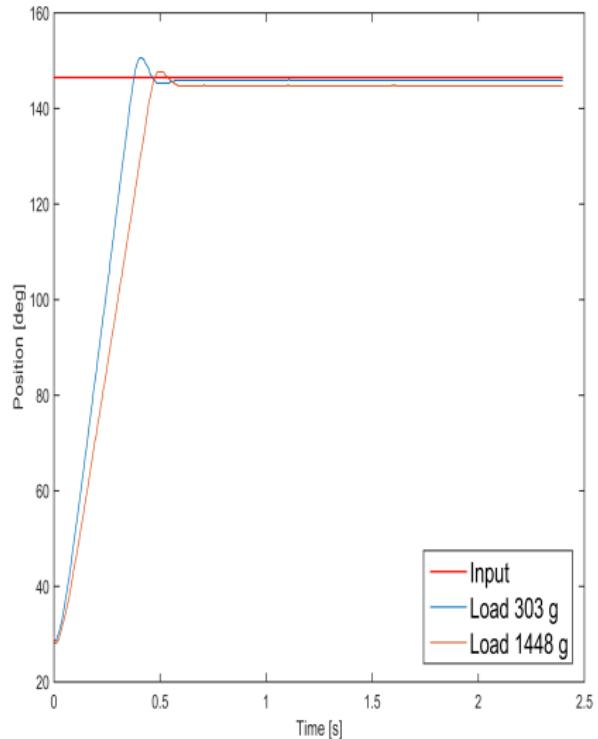
Modelling

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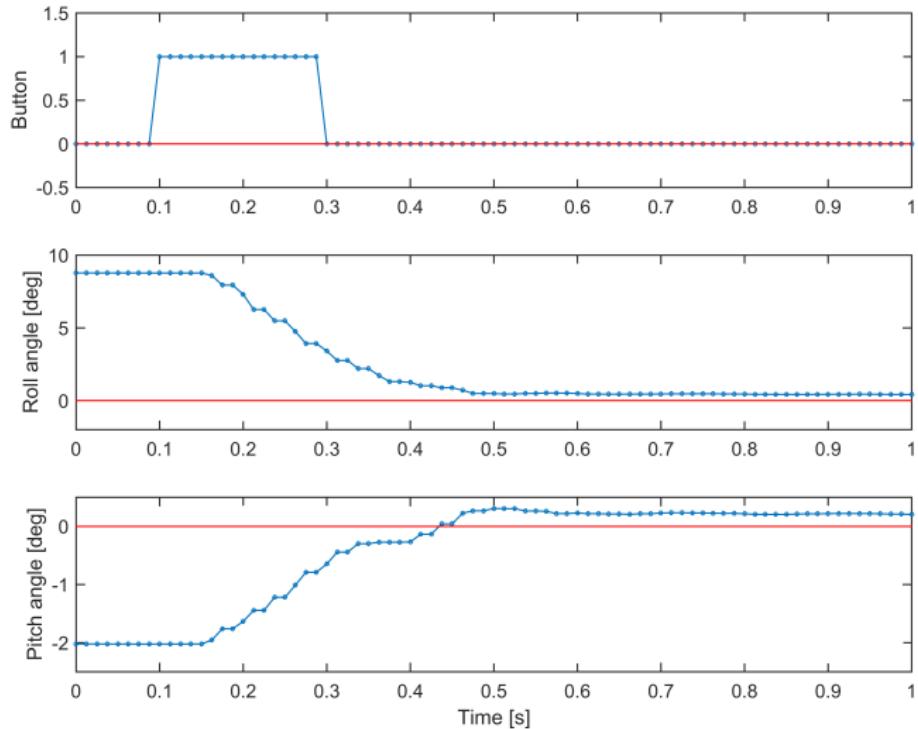
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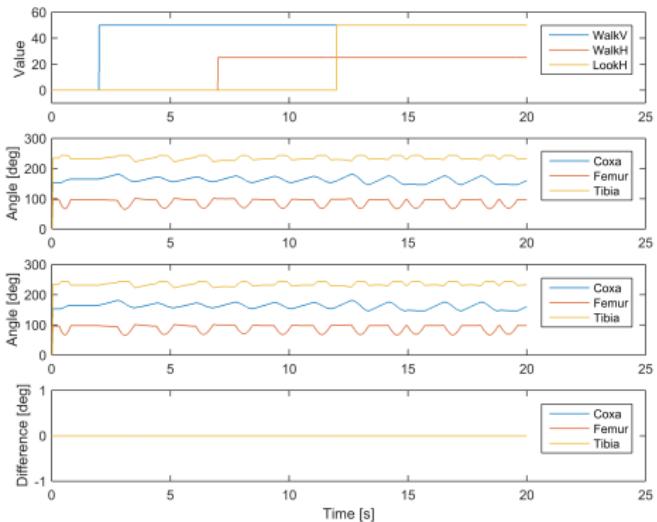
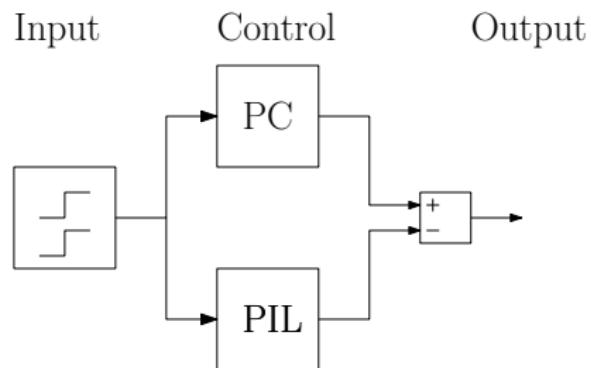
Servo measurement



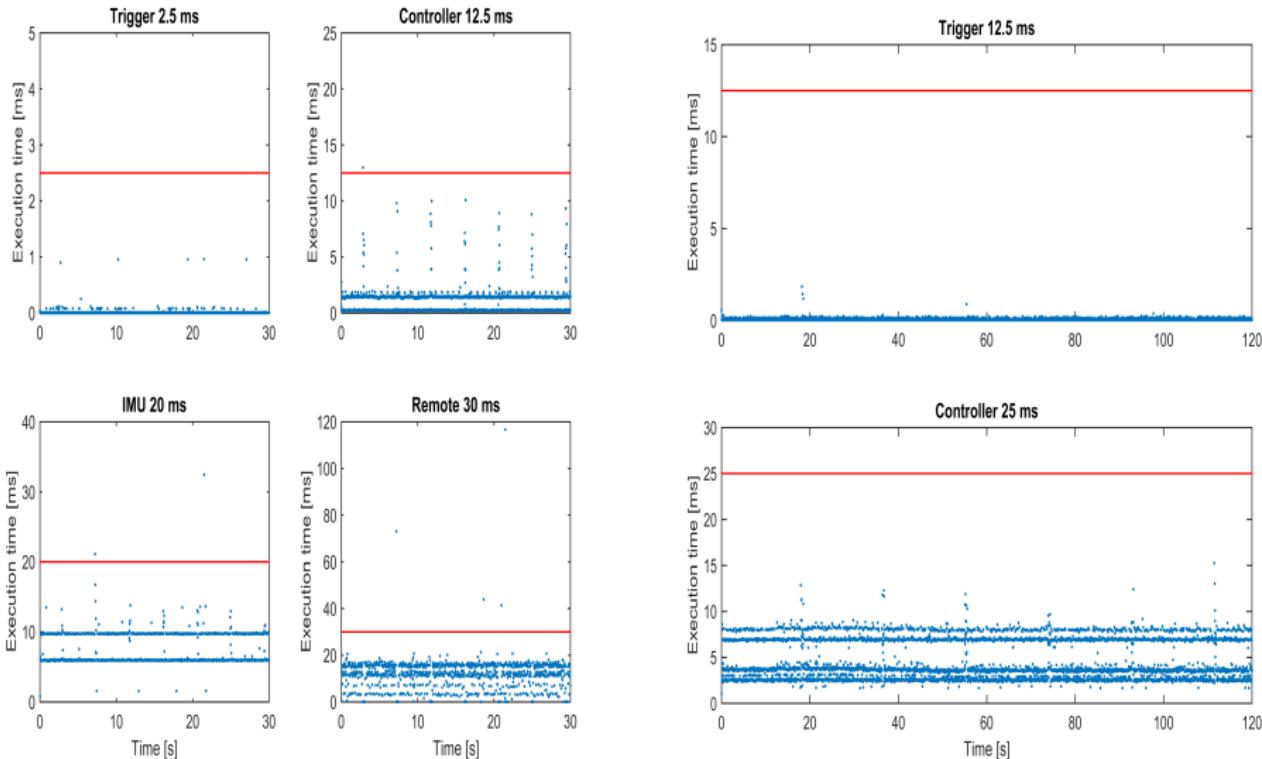
Balancing



Code verification



Execution timing



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Conclusion

- ▶ MBD useful for locomotion patterns
- ▶ Setting up development environment takes time
- ▶ Code generation works well

Future work

- ▶ Future development of locomotion
- ▶ Identifying that legs are on the ground
- ▶ Combine walking and balancing

Thank you supervisors

Anders Robertsson and Simon Yngve