# *Using LEGO in Control Education*

# *Demonstrations and Projects*

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Centre for Systems & Control

University of Glasgow

# *Phrases from yesterday's plenary*

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  - Control & software
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- IEEE Control Systems Magazine, October '04

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  - History
  - Using Lego – details and examples

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- Stand up for Control!

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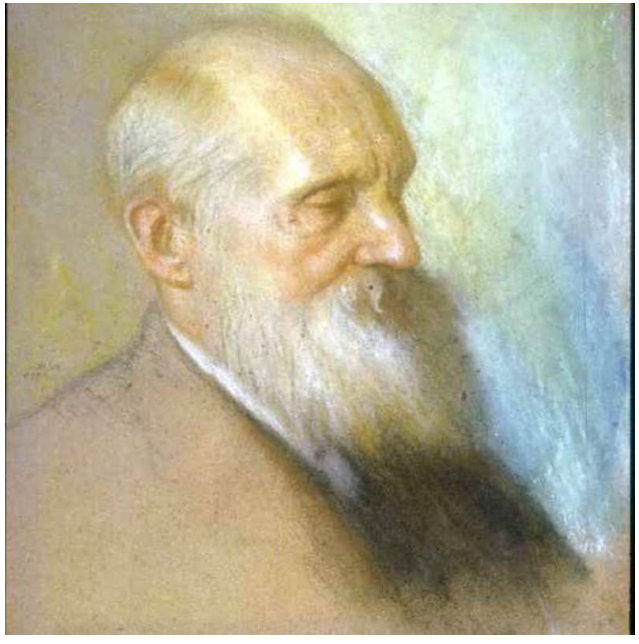

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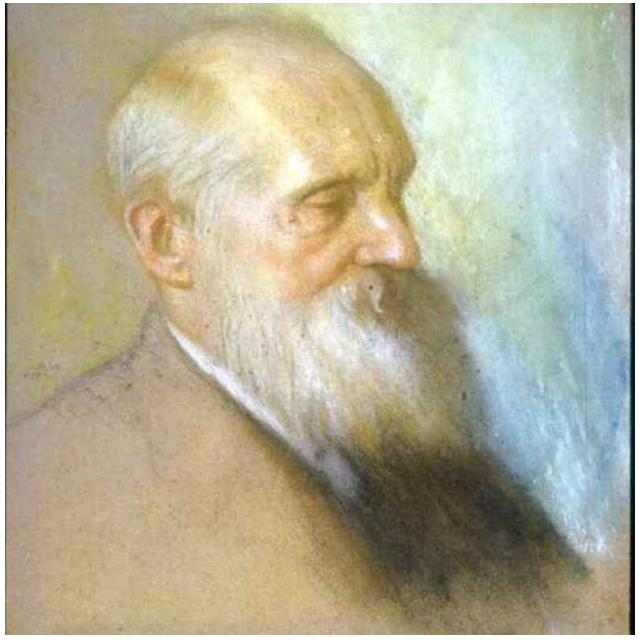

Equipment

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- Disadvantages

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  - Poor gearing (under load).

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- Download programs from laptop via USB/IR

# New Sensors

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## Angle sensor

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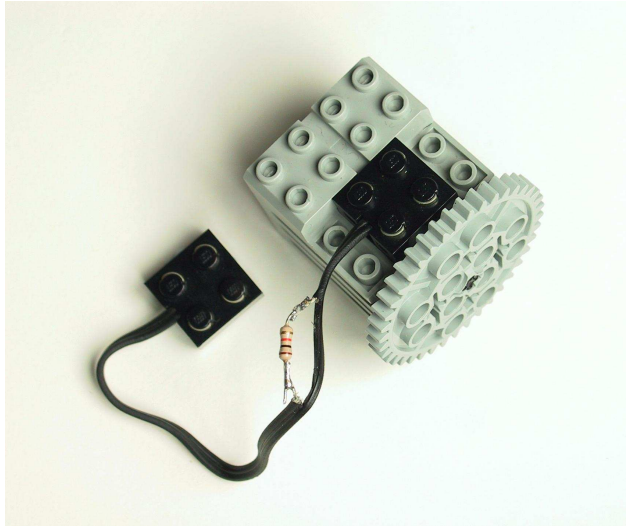
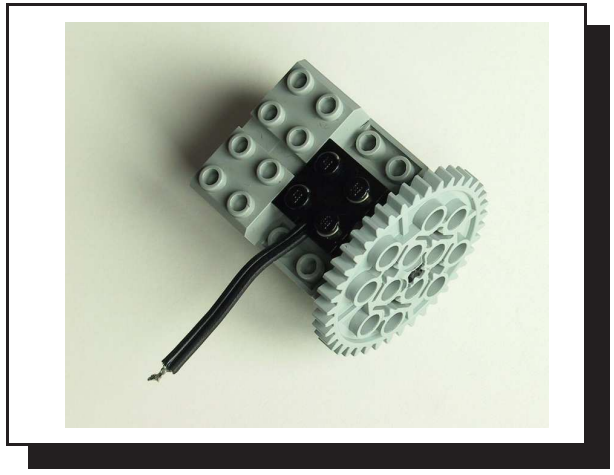
## Velocity sensor



# *Linearisation using a brake*



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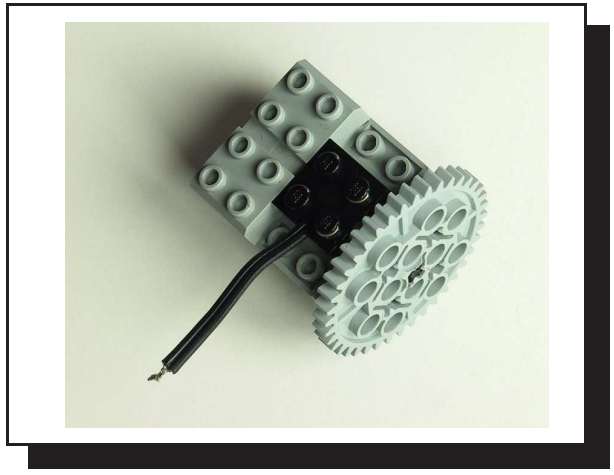

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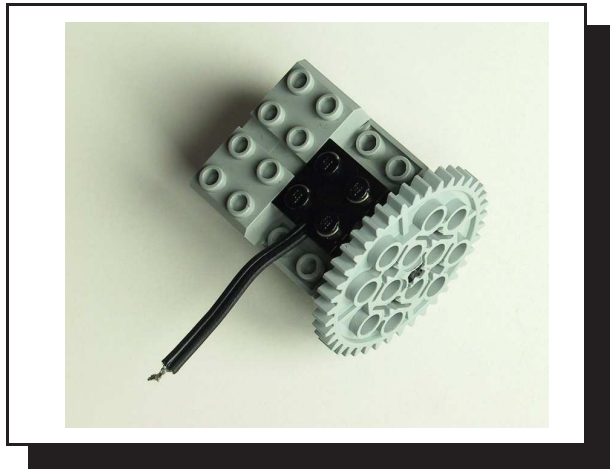

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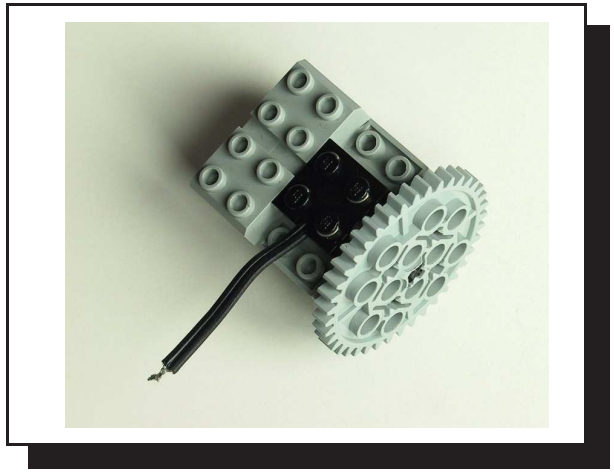
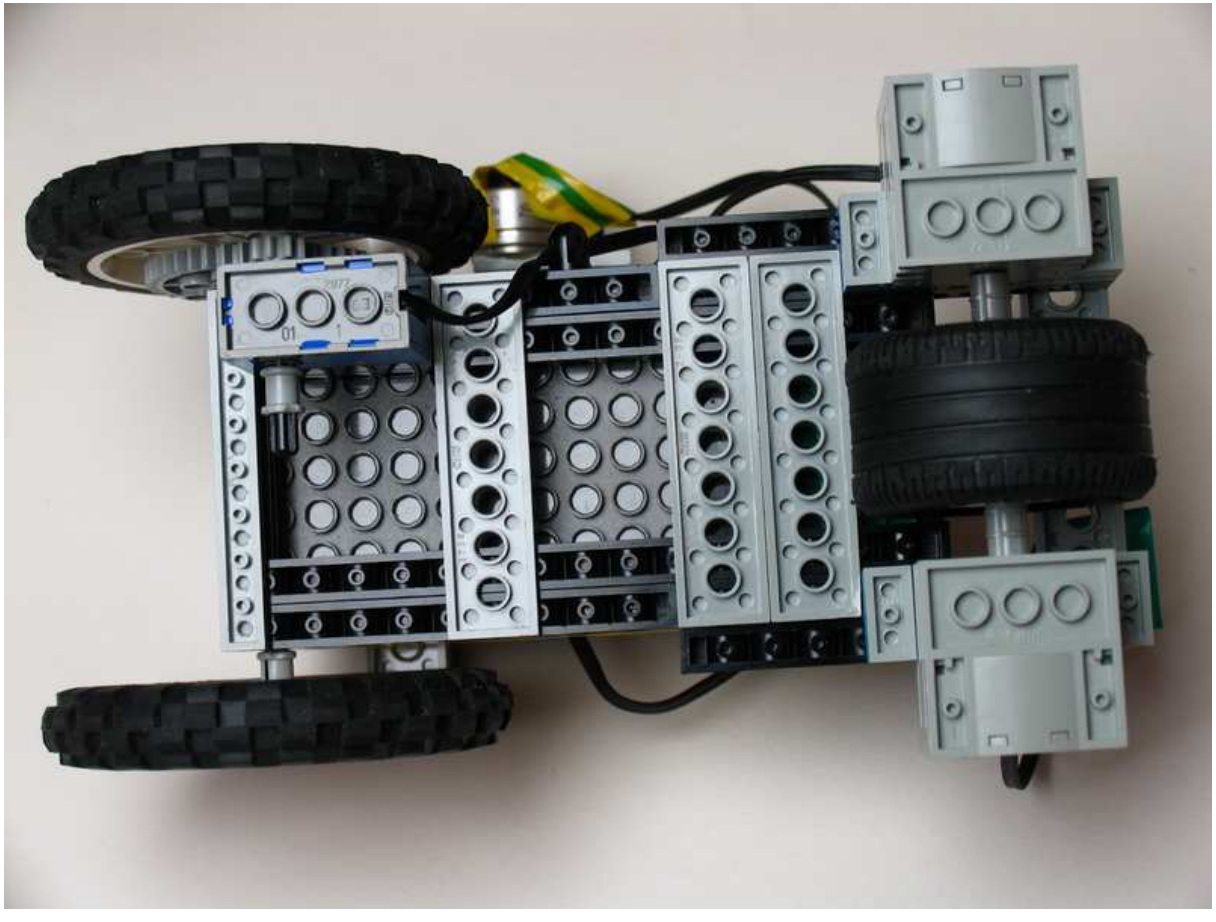


- Acts as brake when coupled to motor
- Makes motor appear more linear
- Use resistor to vary brake effect
  - and provide sensor

# Direct-drive – Cart detail from below



# *Pendulum on a cart*

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2004

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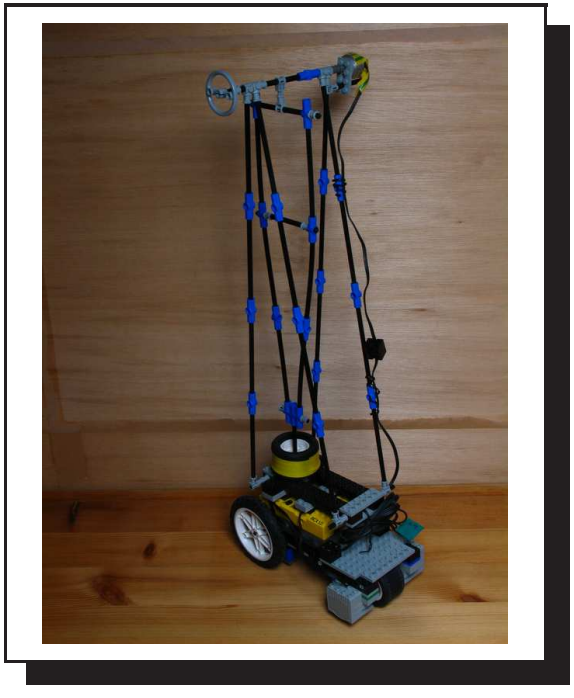
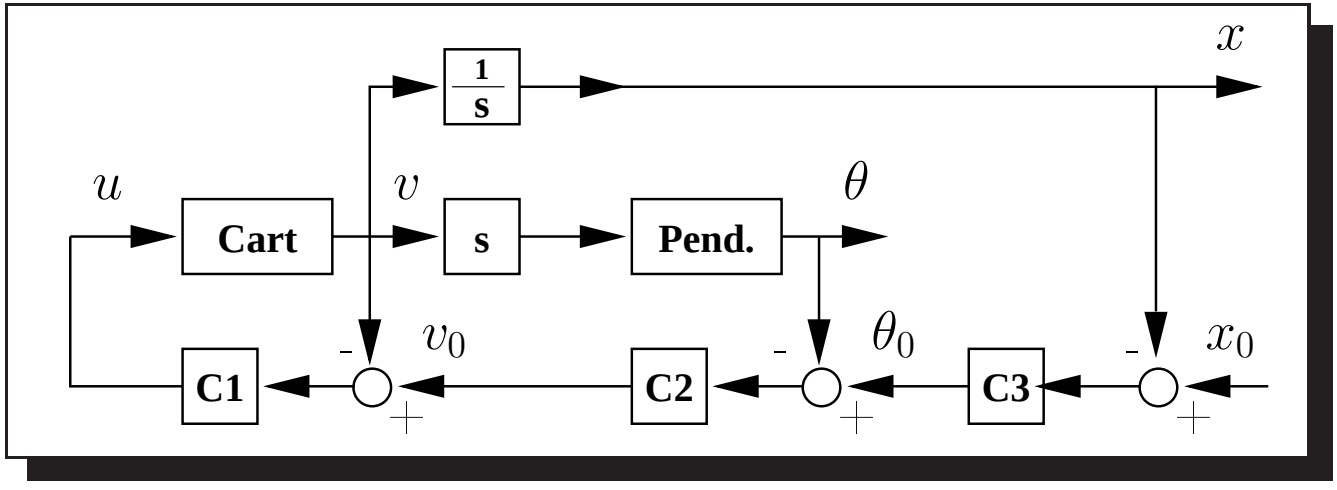
Current



# Control Structure




**C1** Cart velocity control

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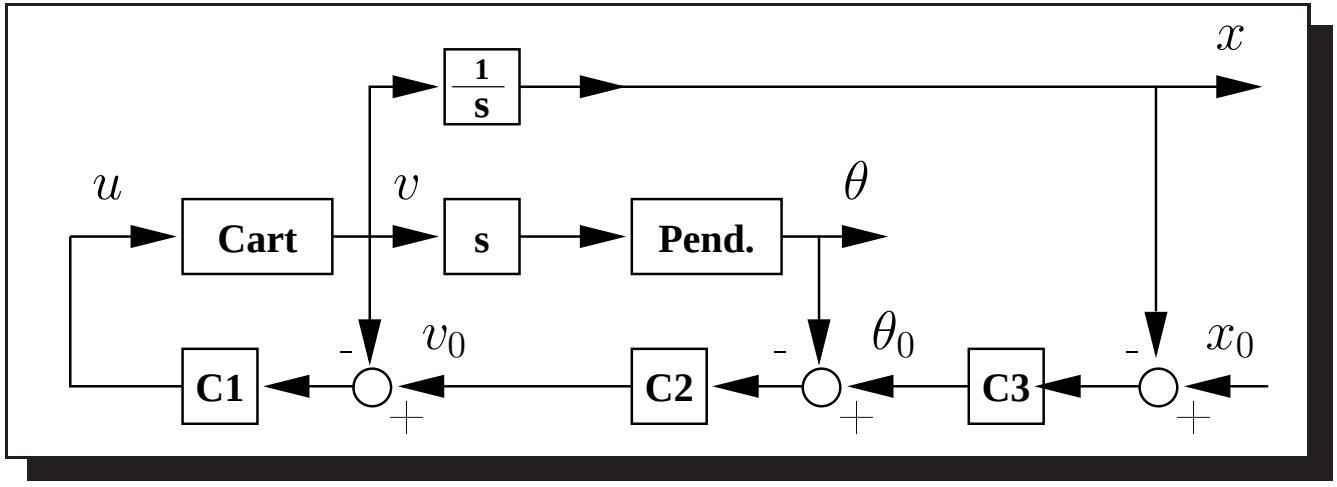


**C1** Cart velocity control

**C2** Pendulum control

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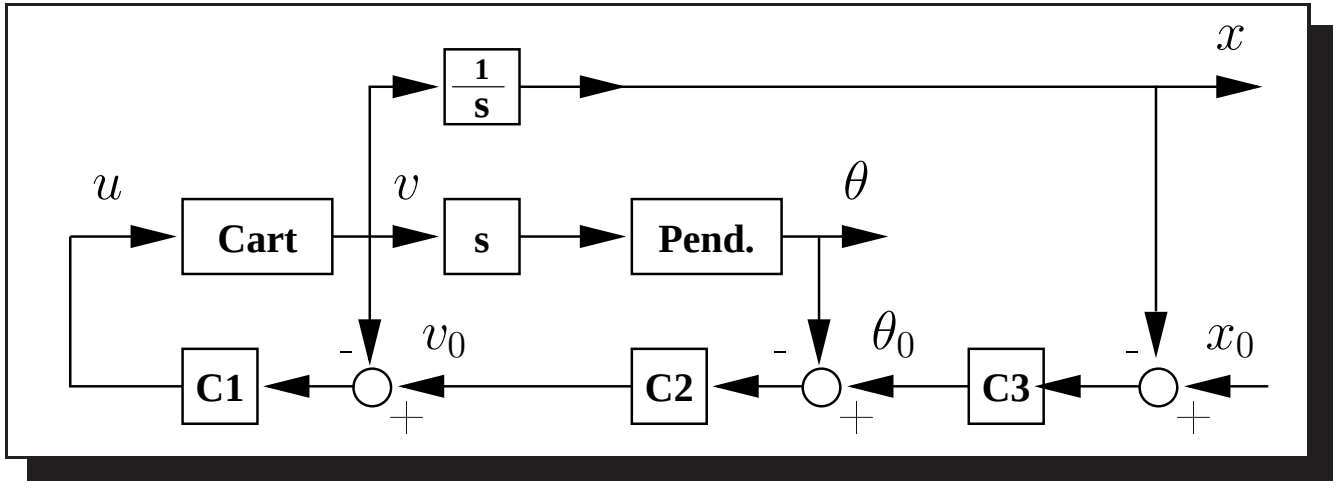
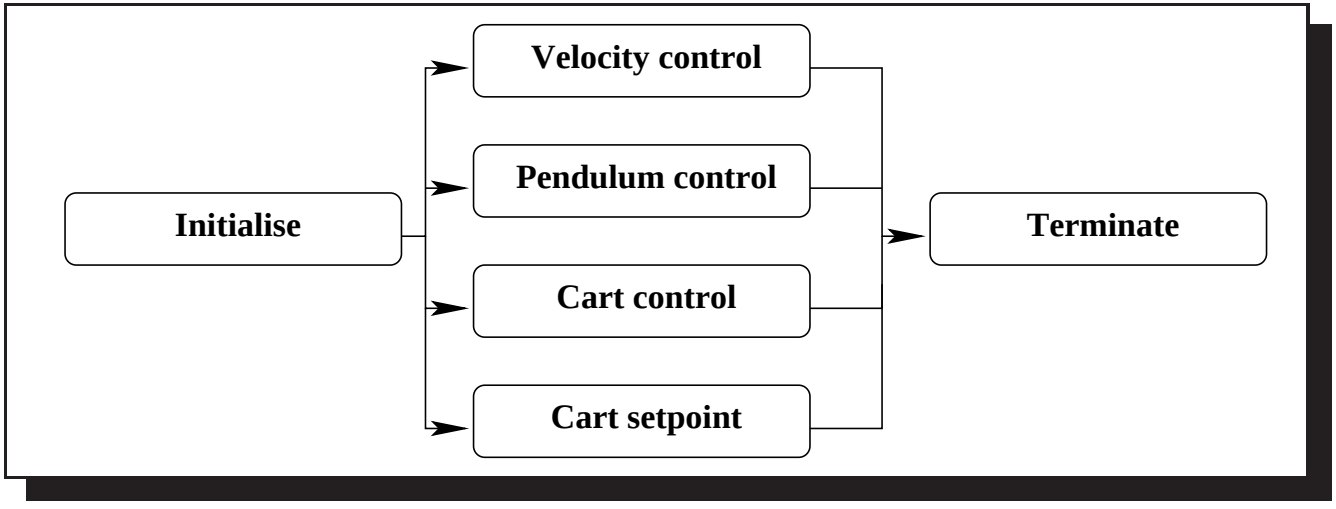



**C1** Cart velocity control

**C2** Pendulum control

**C3** Cart position control

# Software structure



# *Pendulum angle*

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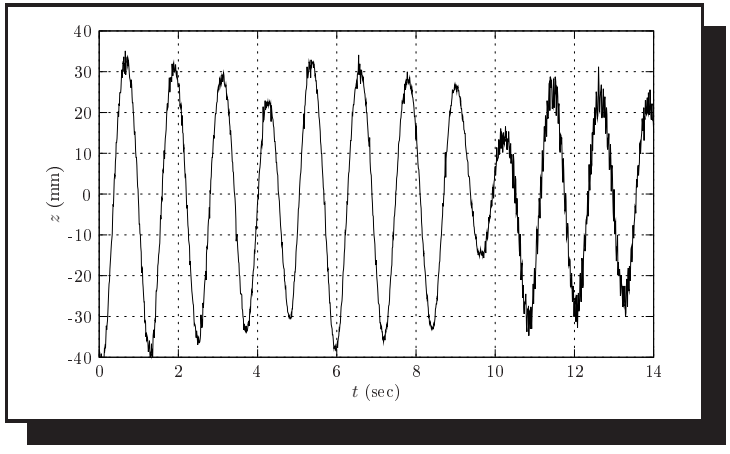
Without pendulum control



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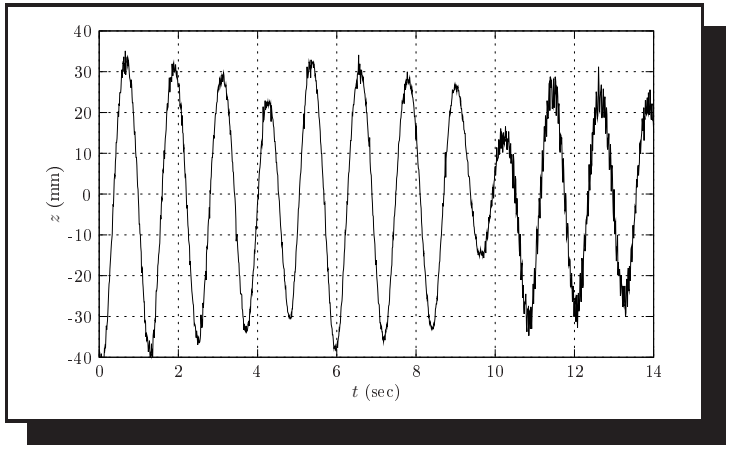


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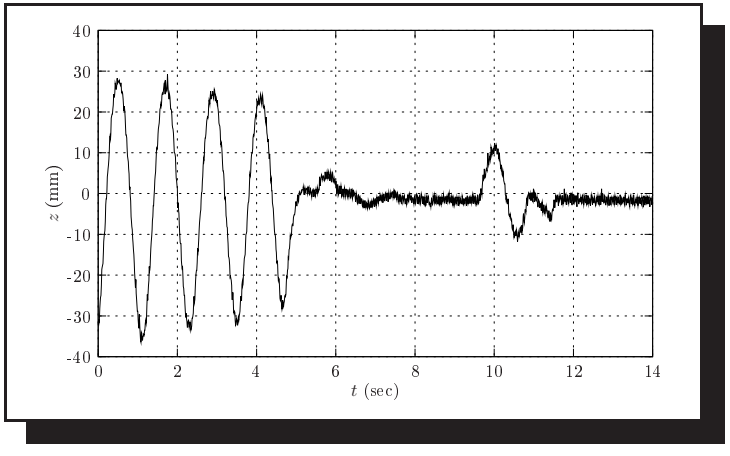

# Robot Warrior

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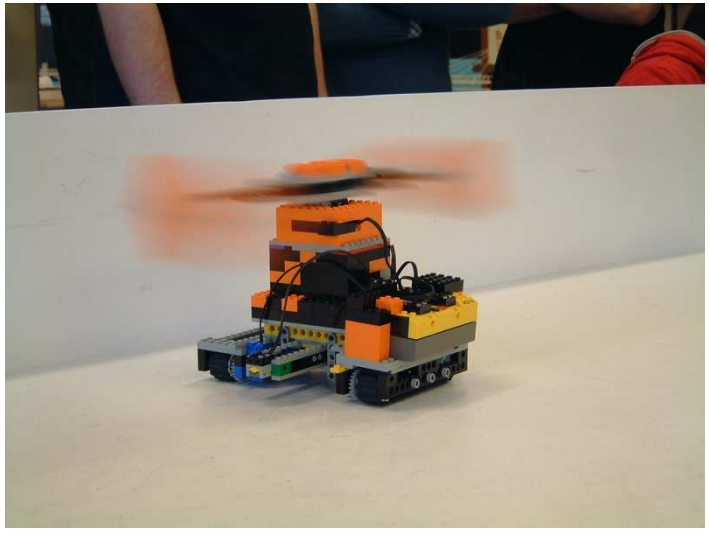
## Design 1



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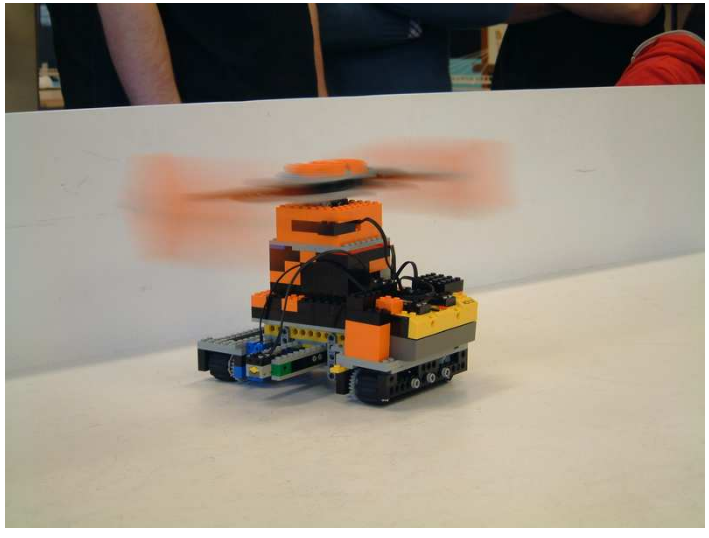
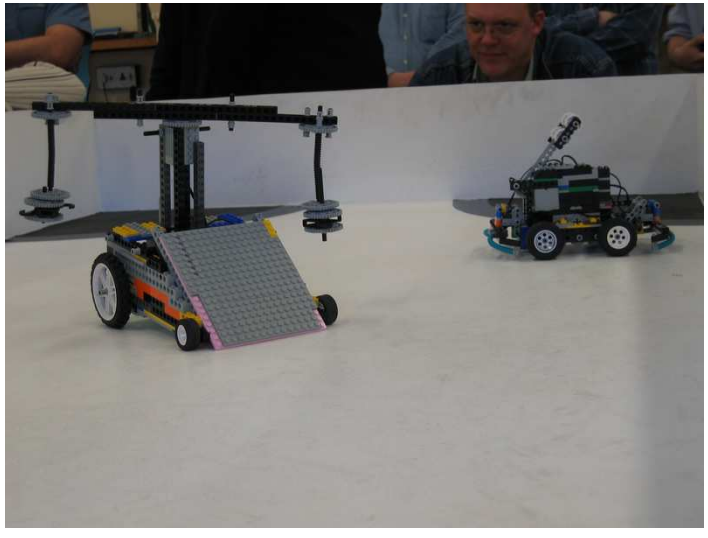


Design 2



# *Walking Robots*

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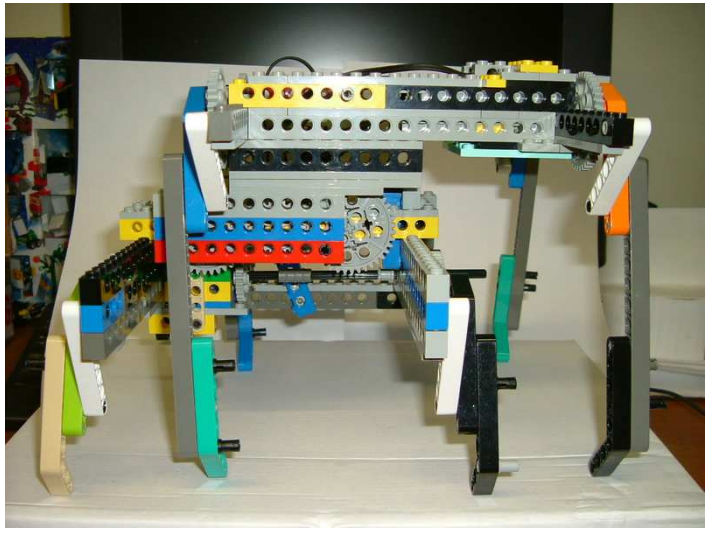
Front view



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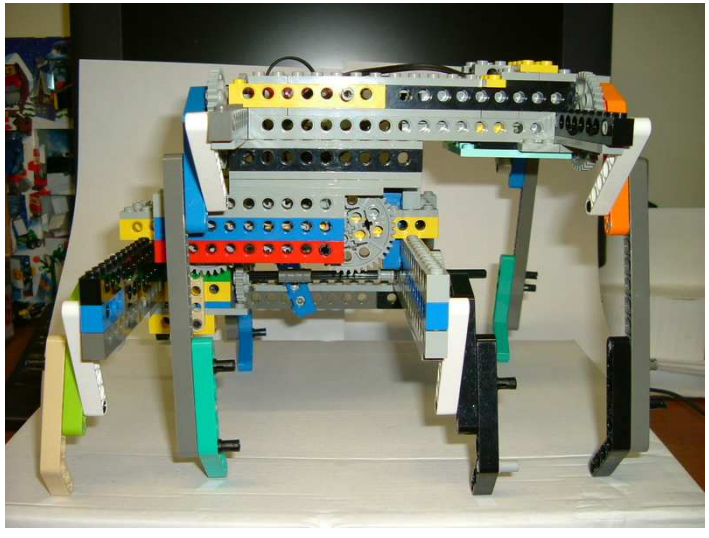
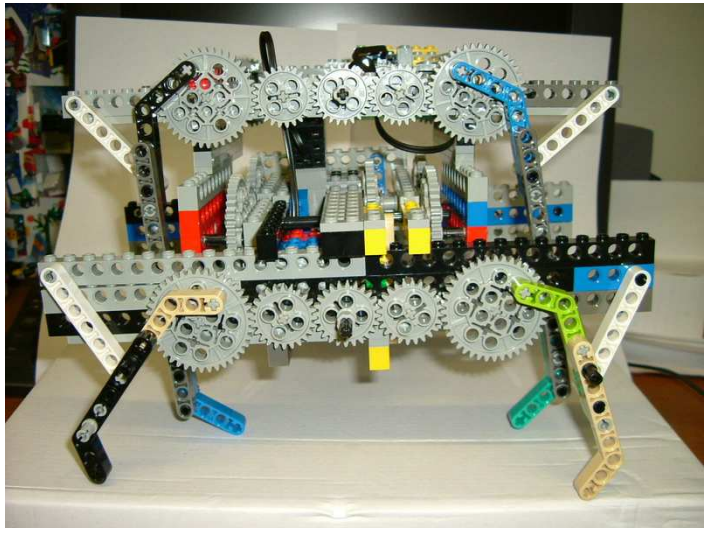


Side View



# Swimming robot

# Advanced Robots

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## Segway in Madrid

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Legway in Madrid