Bipedal Locomotion by Pneumatic Artificial Muscles

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The aim

Key Technology

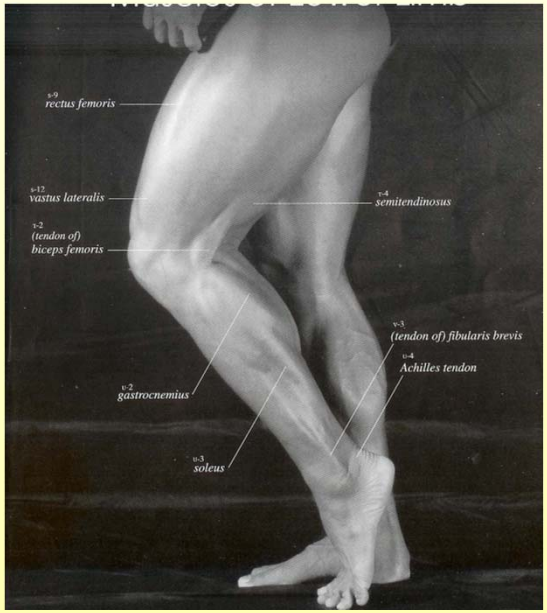
McKibben artificial muscles

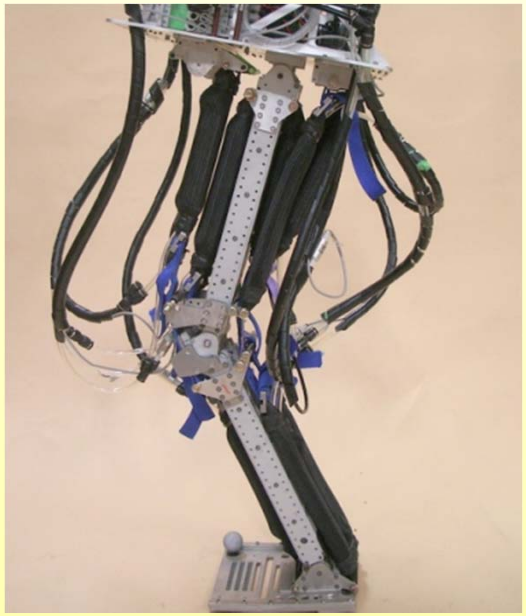
are powerful

cheap and easy to produce

compliant

The Premise

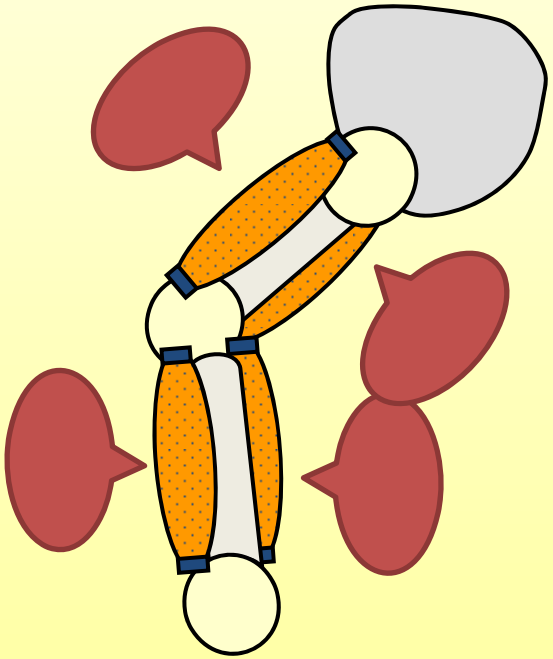




Muscular-skeleton structure
is the key for dynamic locomotion.

Antagonism=Tunable Compliance

Idea



Not to Control Precisely!

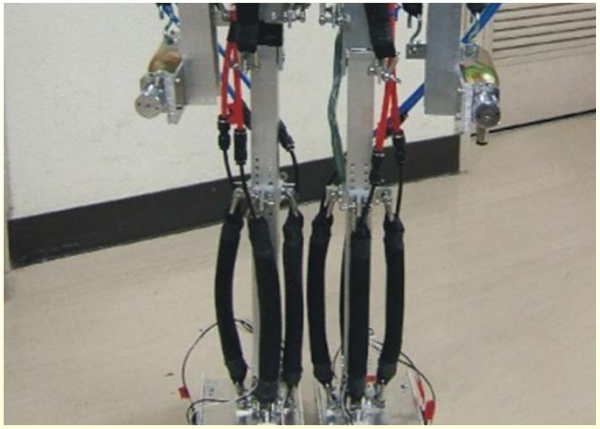
Simple and Less Control

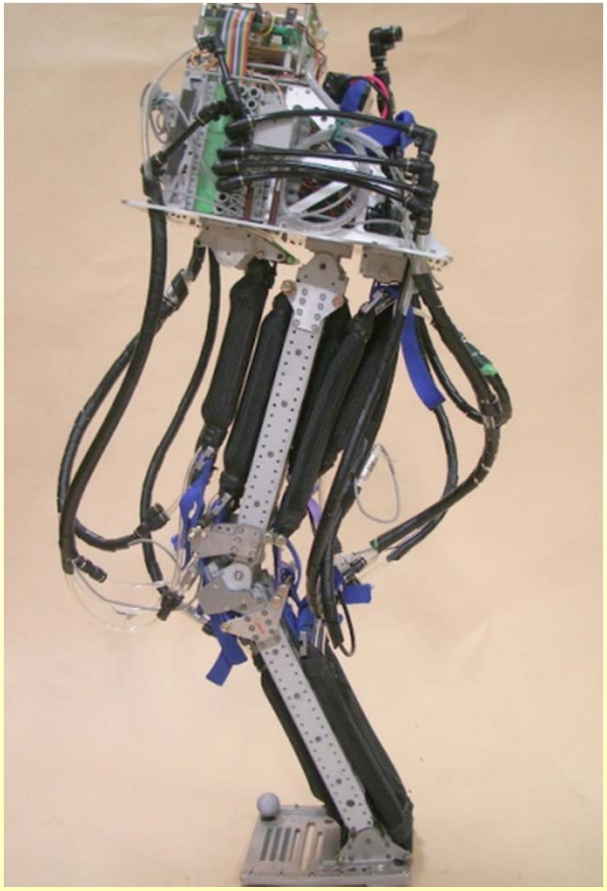
Let Dynamics Do Task

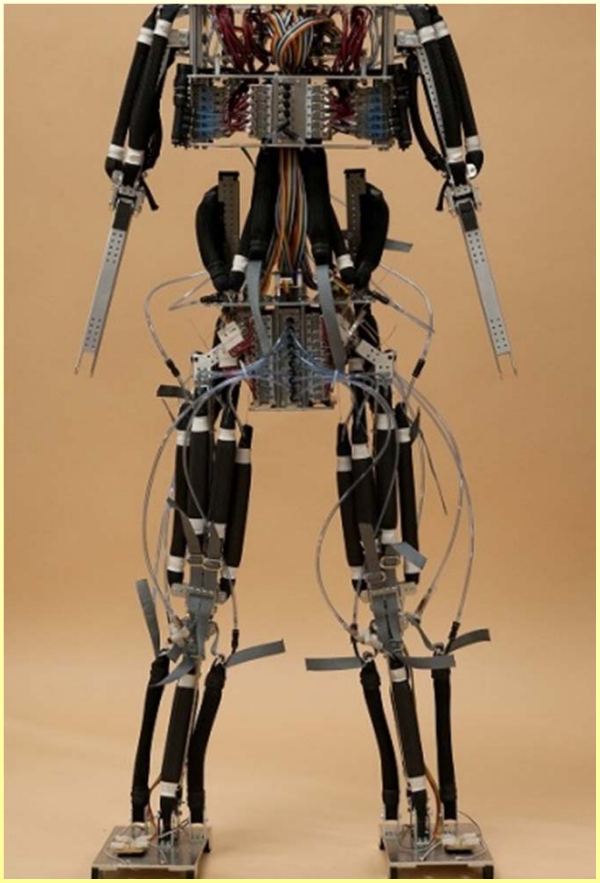
Start Small

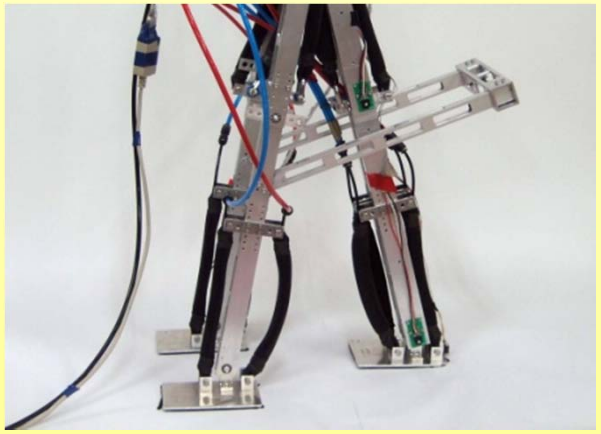
Gradually Increase Complexity

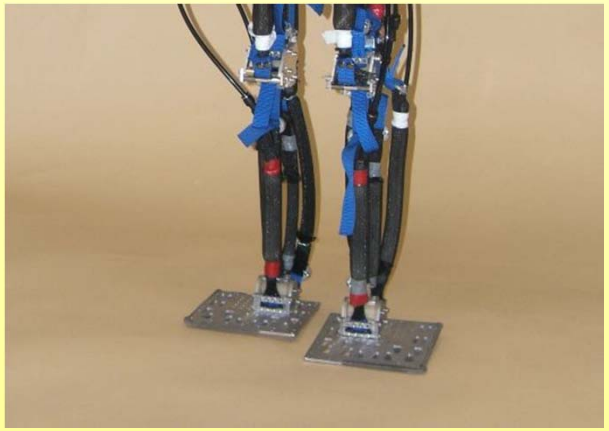
Robots







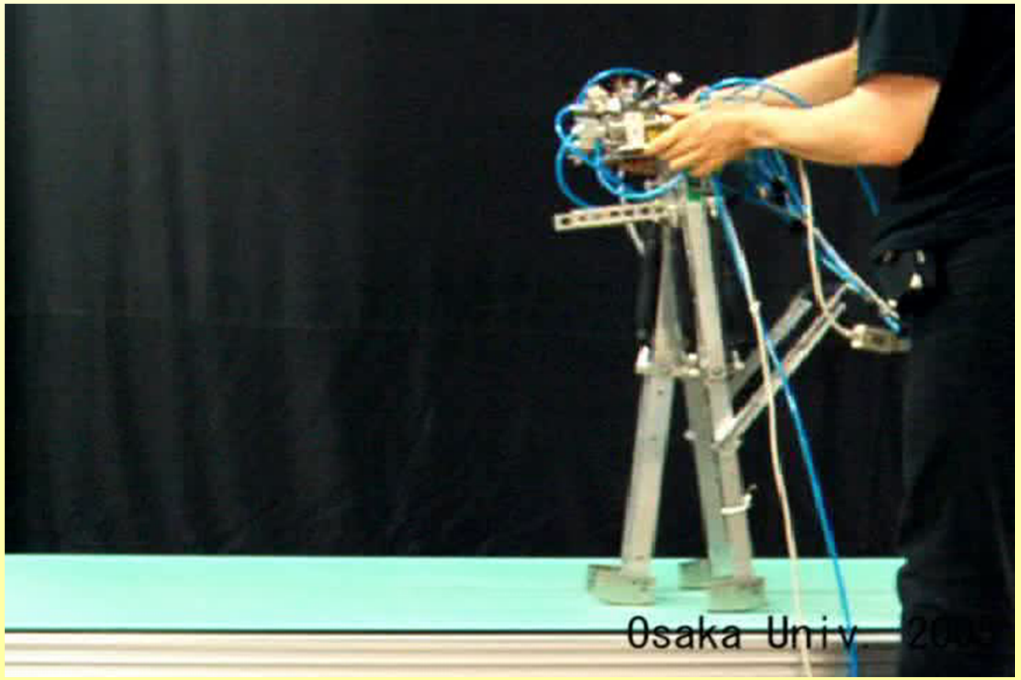




Walking

空脚 (Que-Kaku): 2D limit cycle walker

2003-2005



空脚 (Que-Kaku): 2D limit cycle walker

2003-2005

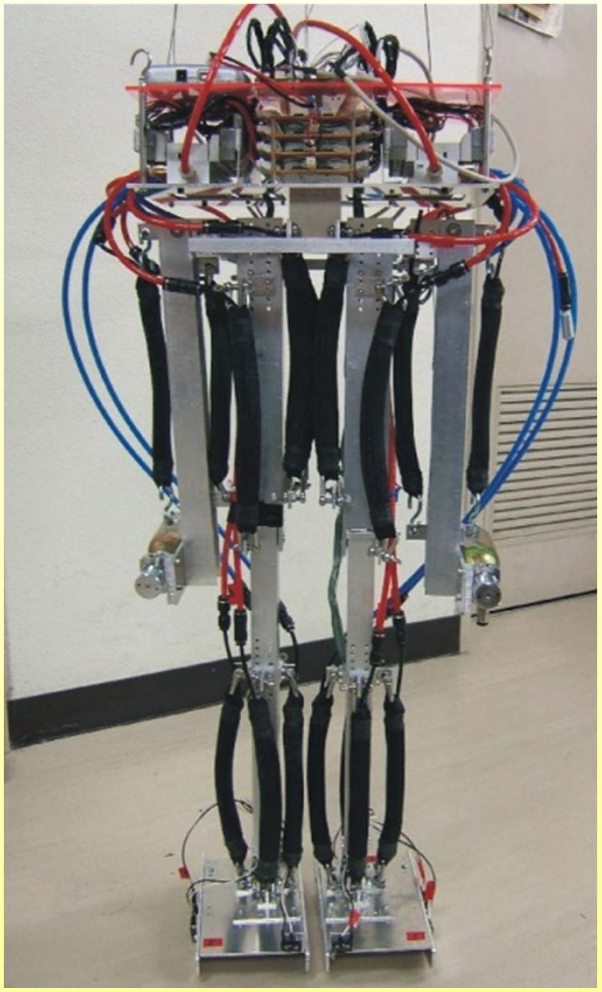
Adding muscles to

Passive Dynamic Walker

Simple control: swing after touch

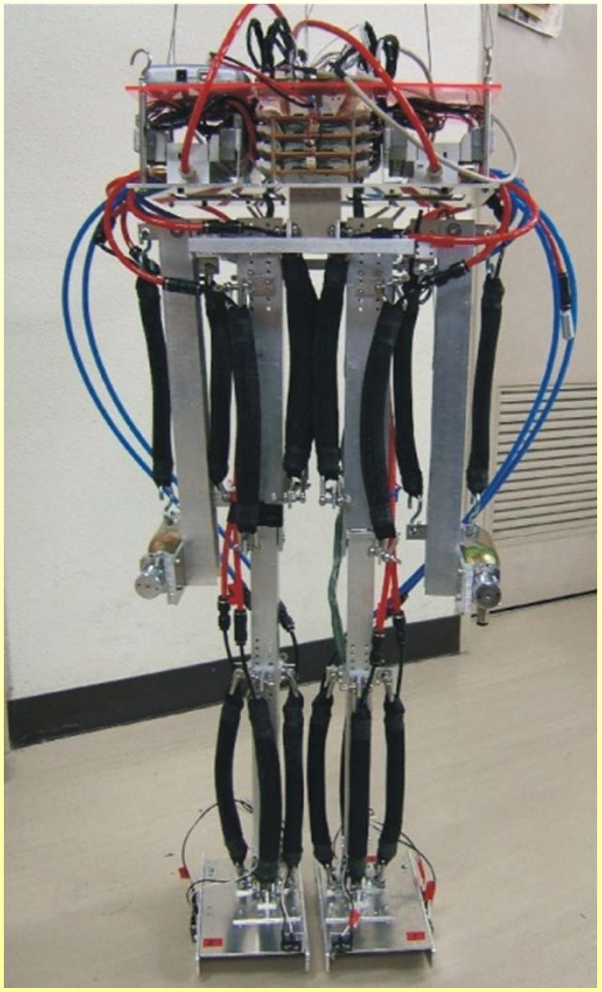
Pneu-man: 3D limit cycle walker

2004-2005



Pneu-man: 3D limit cycle walker

2004-2005



Removing outer legs

Simple control: swing after touch

Pneumat-BT: 3D limit cycle walker w/ torso 2006

Pneumat-BT: 3D limit cycle walker w/ torso 2006

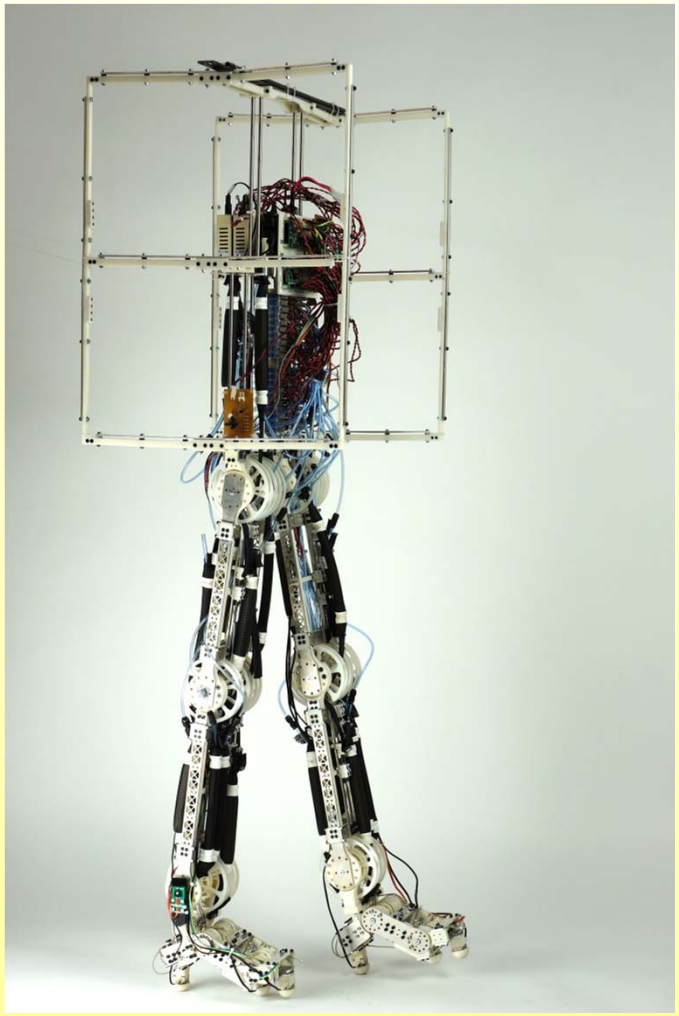
Adding a torso to Pneu-man

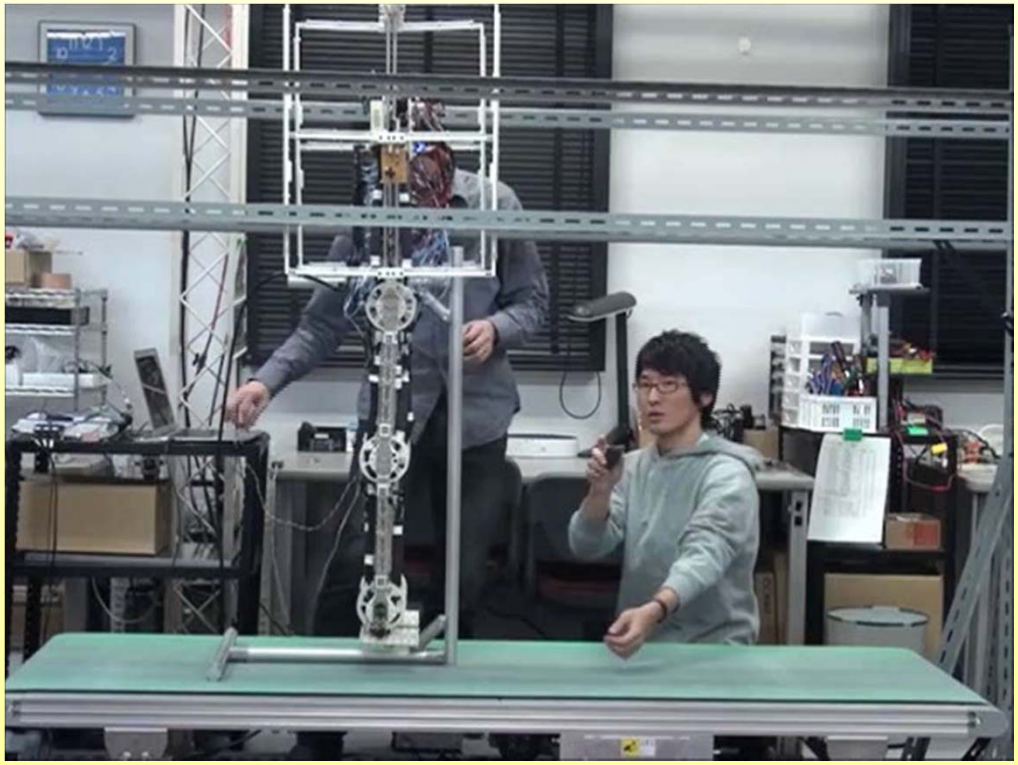
Changing ankle angles

Simple control: swing after touch

Peumat-BB: 2D walker (reprise)

2011





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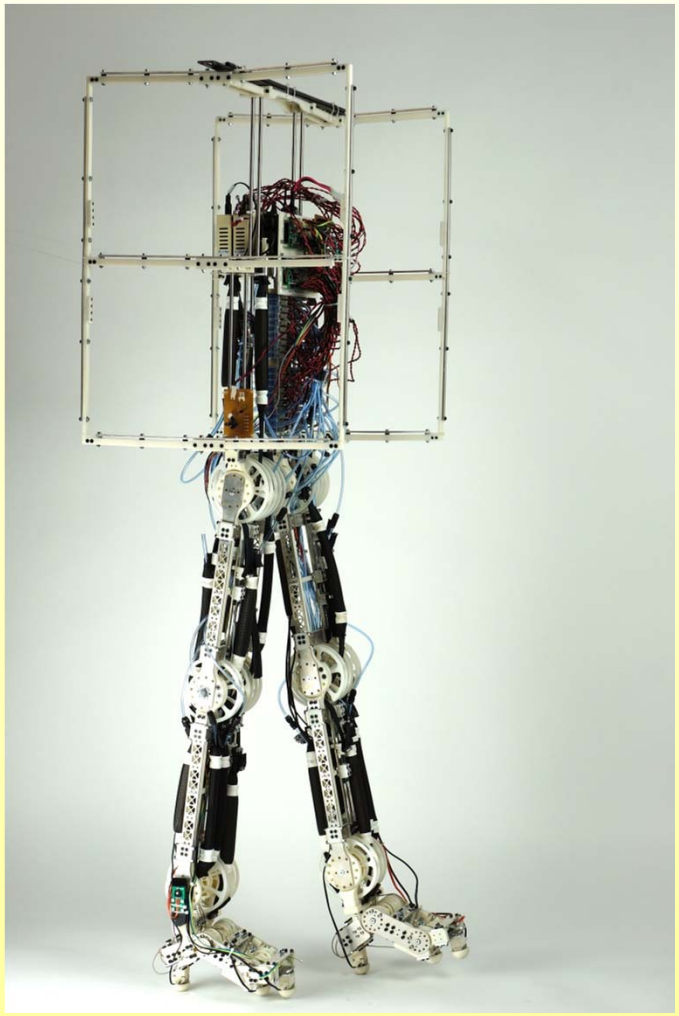


We will see this on Friday!

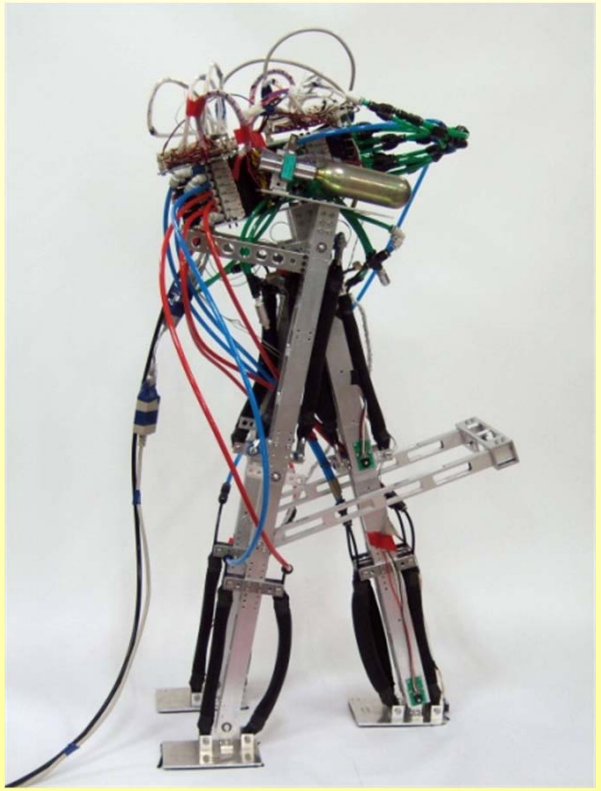
@ “Anthropomorphic Design and Bionic Control”

11:40-12:00

Jumping and Running

空脚 (Que-Kaku) R: 2D jumper/runner

2005-2007



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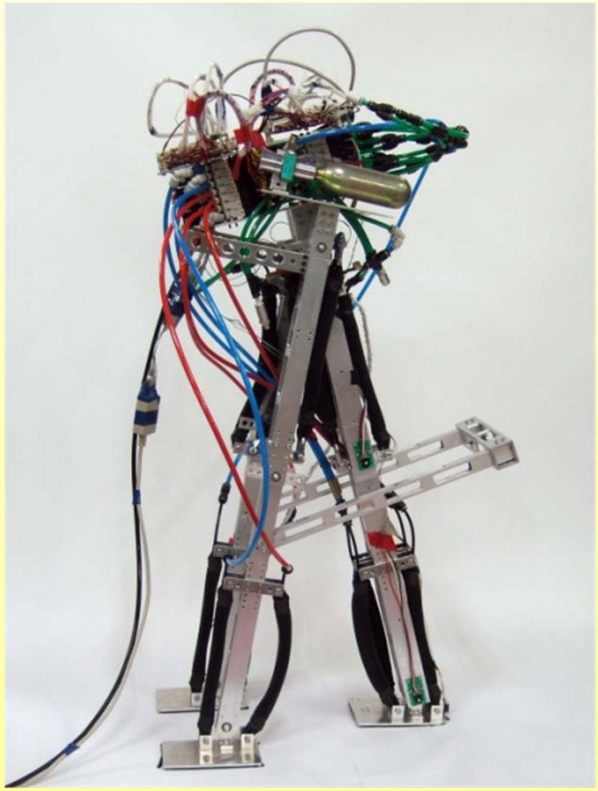
2005-2007



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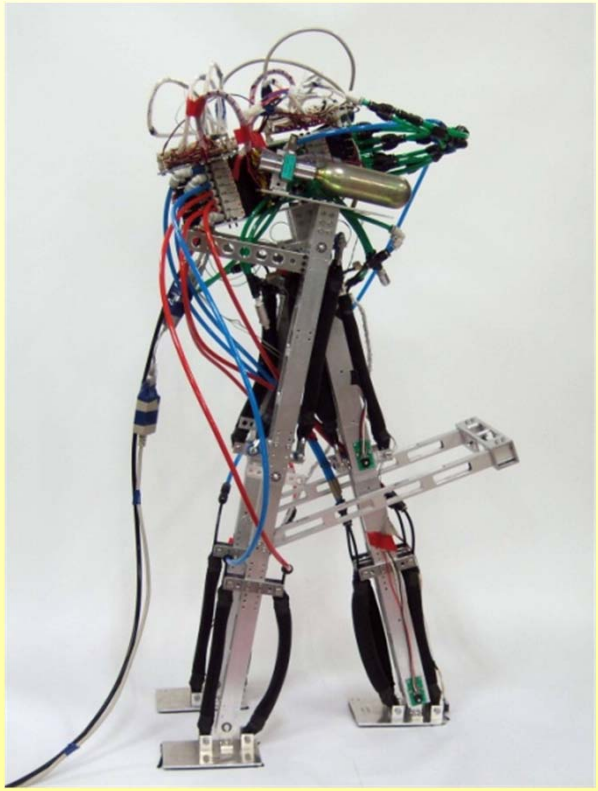


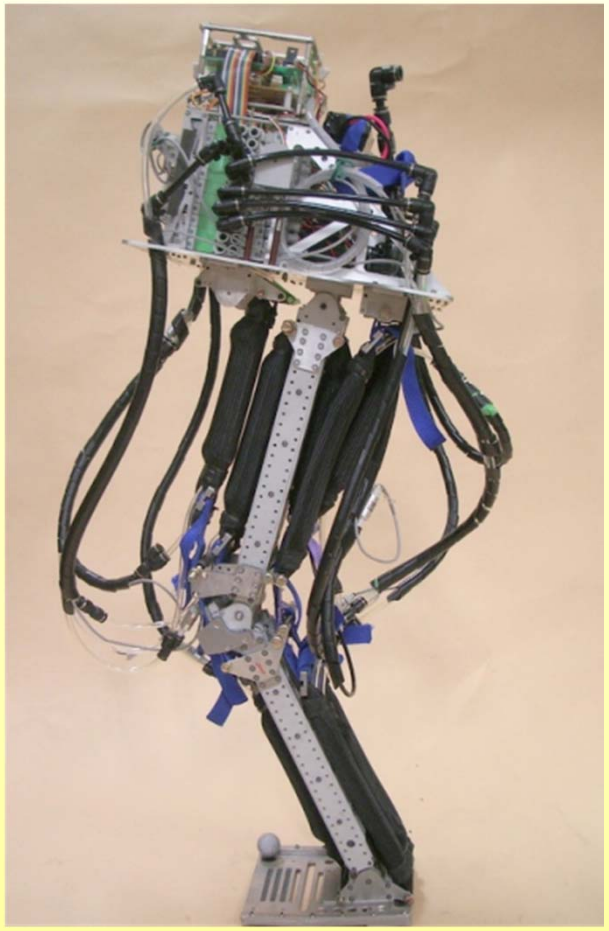
Program valve operations by hand

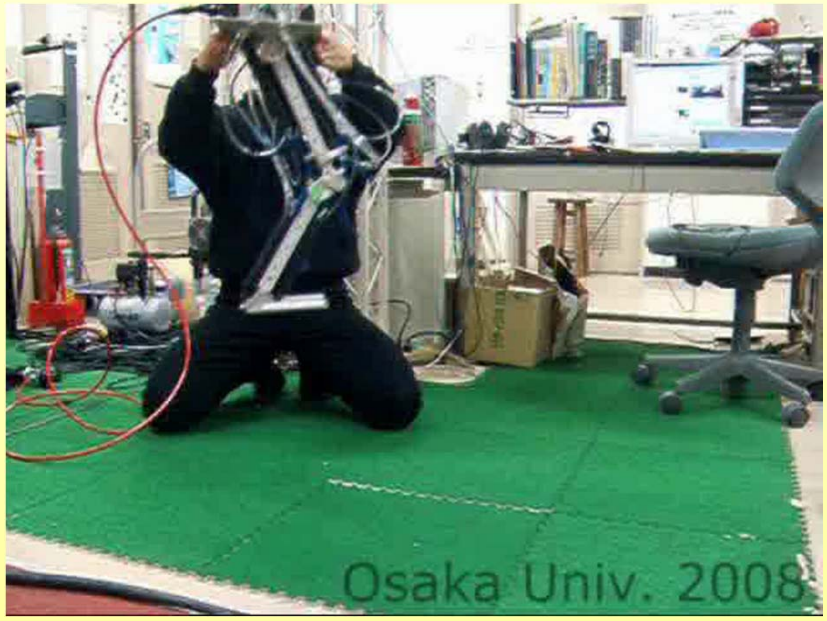
Jumping motion after touch

No balancing control

空脚 (Que-Kaku) K: Monopod
w/ bi-articular muscles

2007-2009





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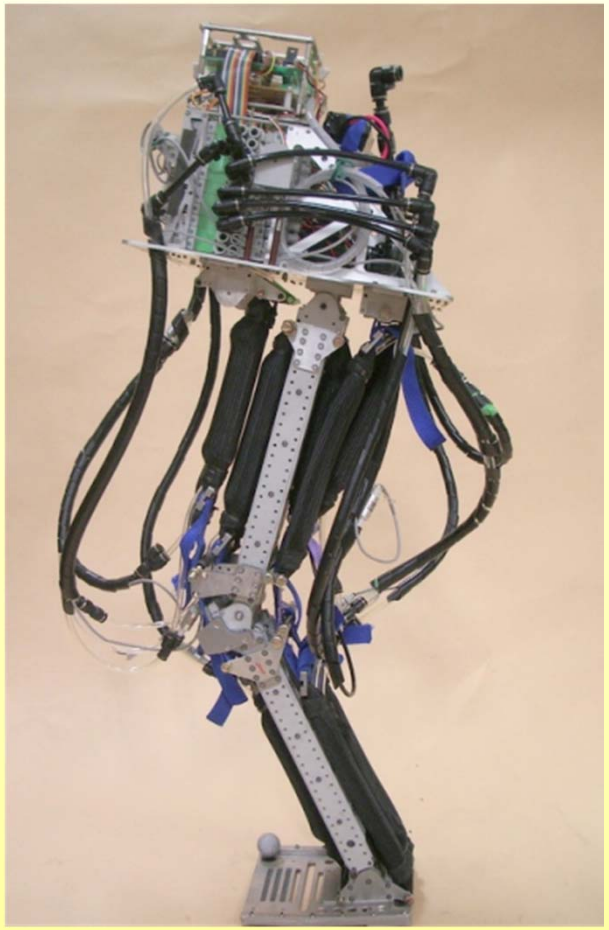

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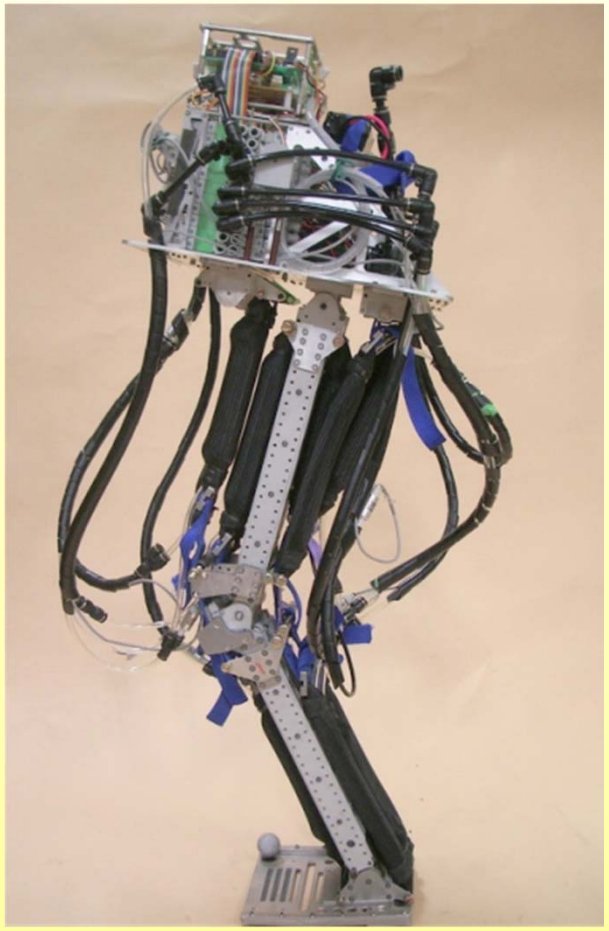
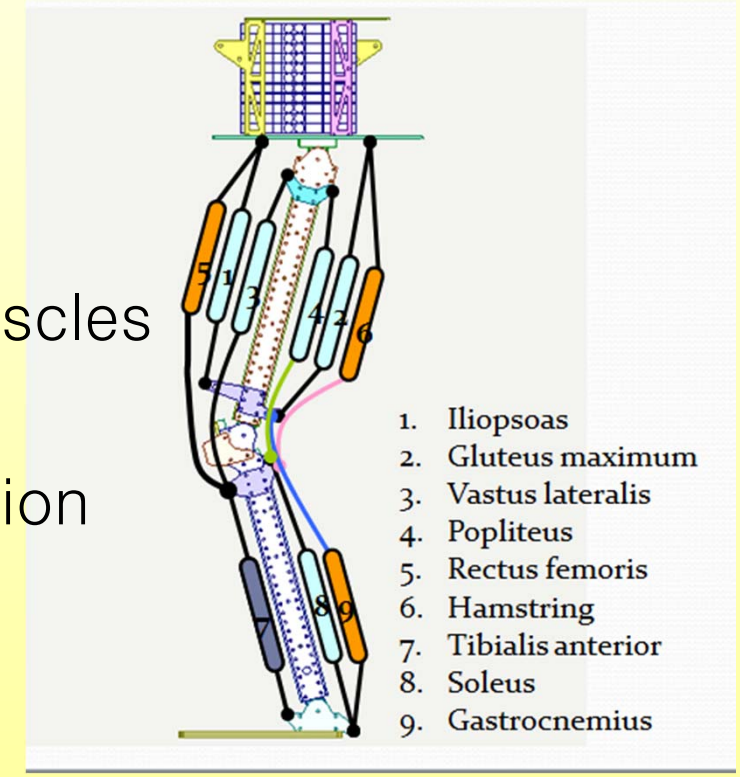
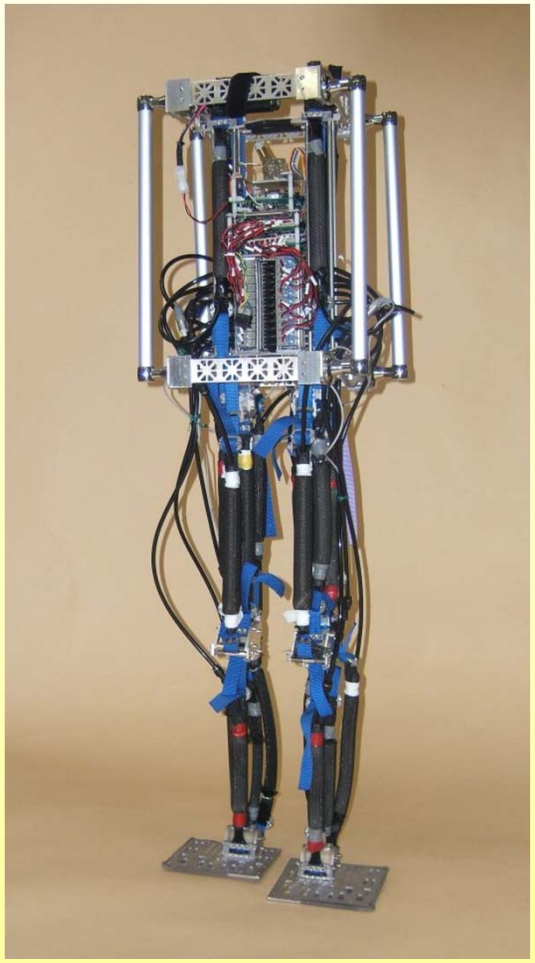


Bi-articular Muscles
for
Joint coordination

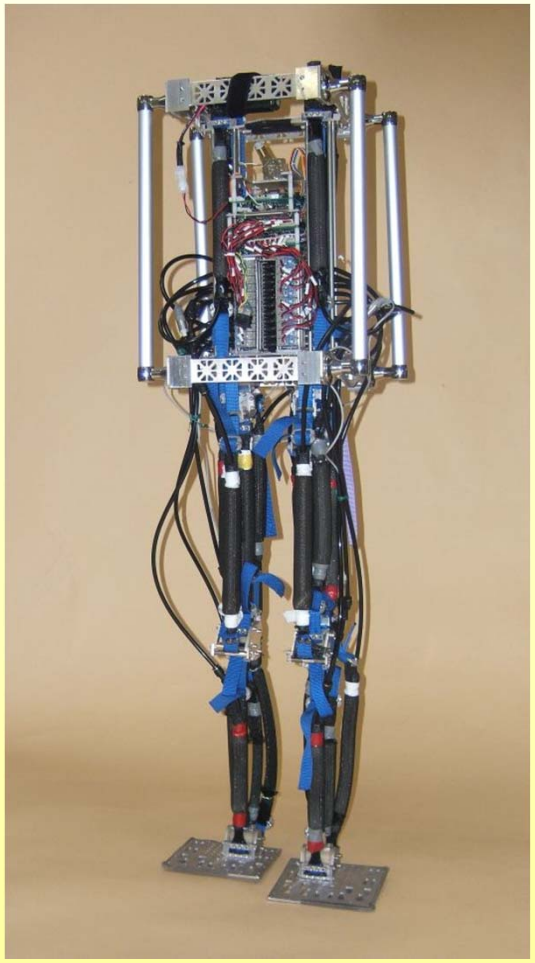
Simple control
wo/balance

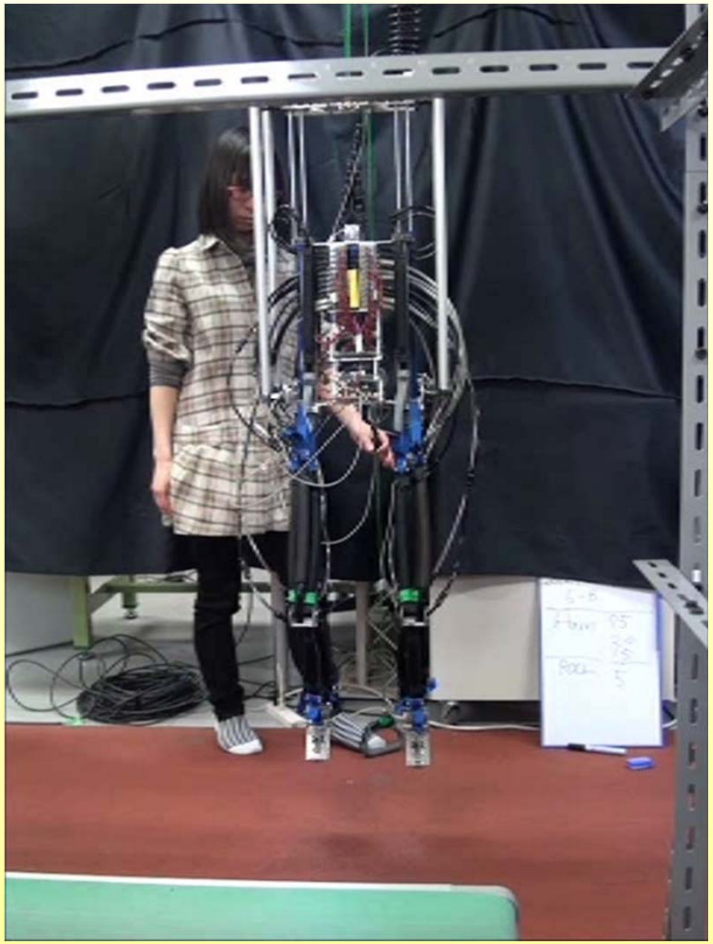


Pneumat-BR: 3D biped walker/jumper

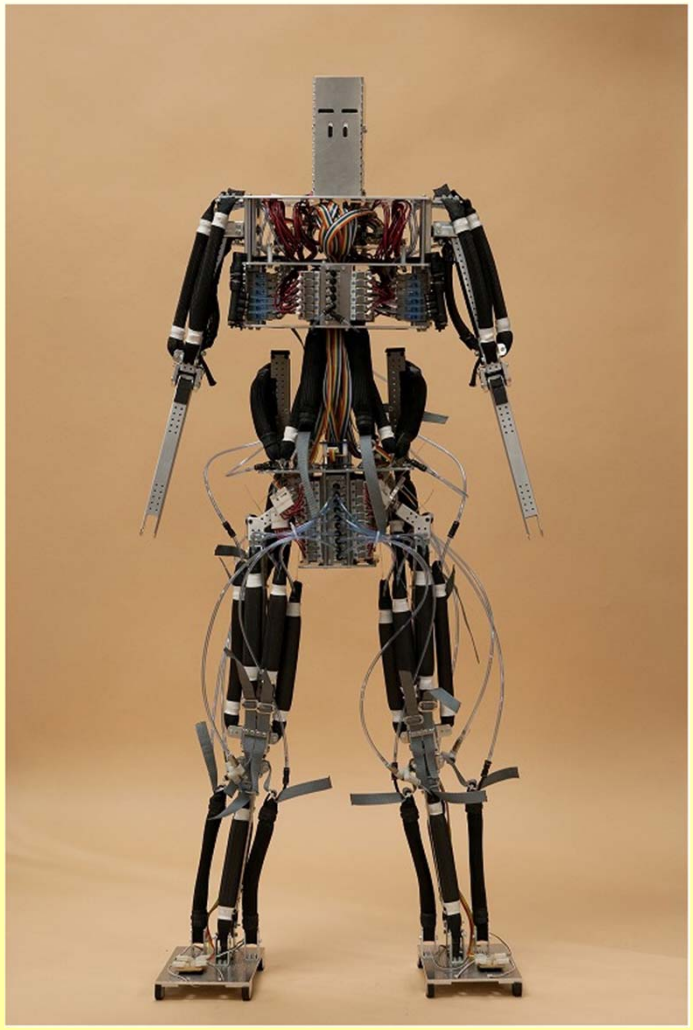


Pneumat-BR: 3D biped walker/jumper





Pneumat-BS: Whole Body Humanoid



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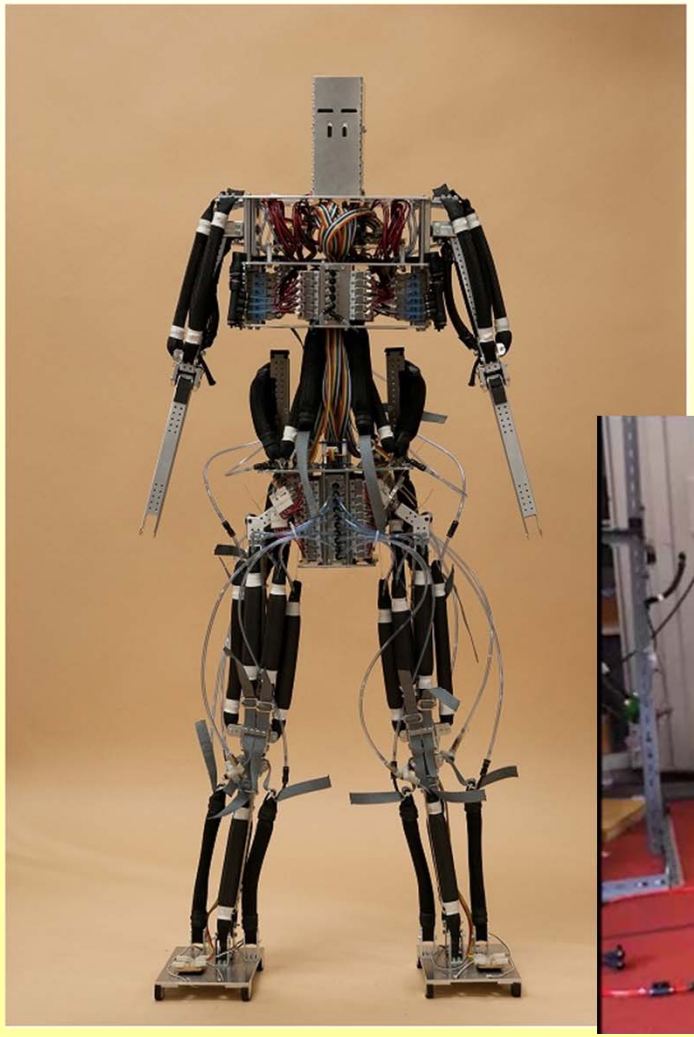

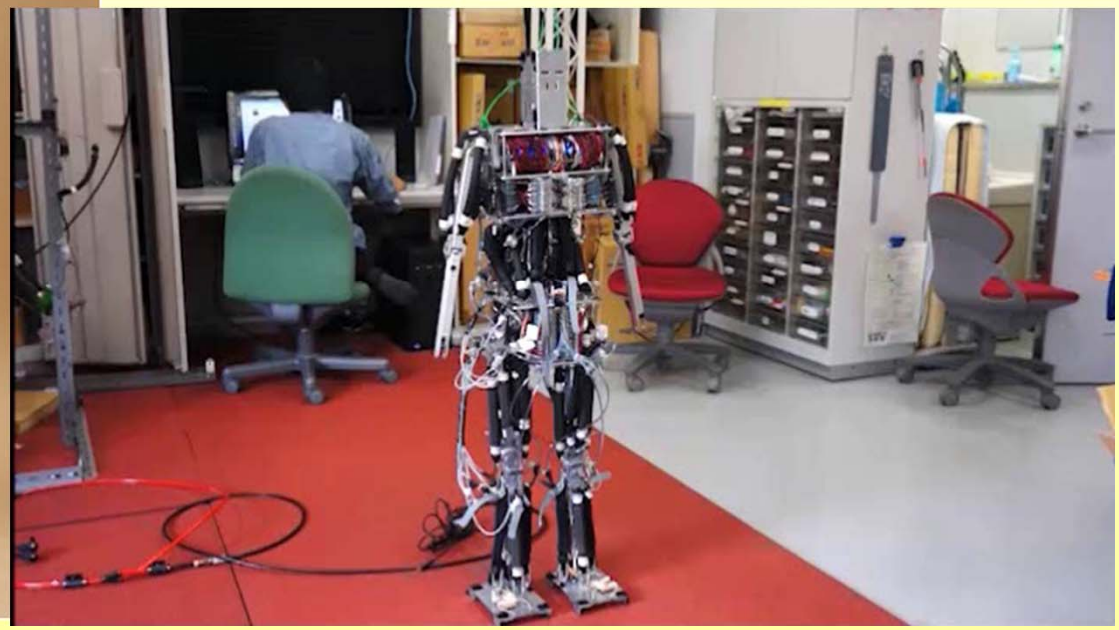

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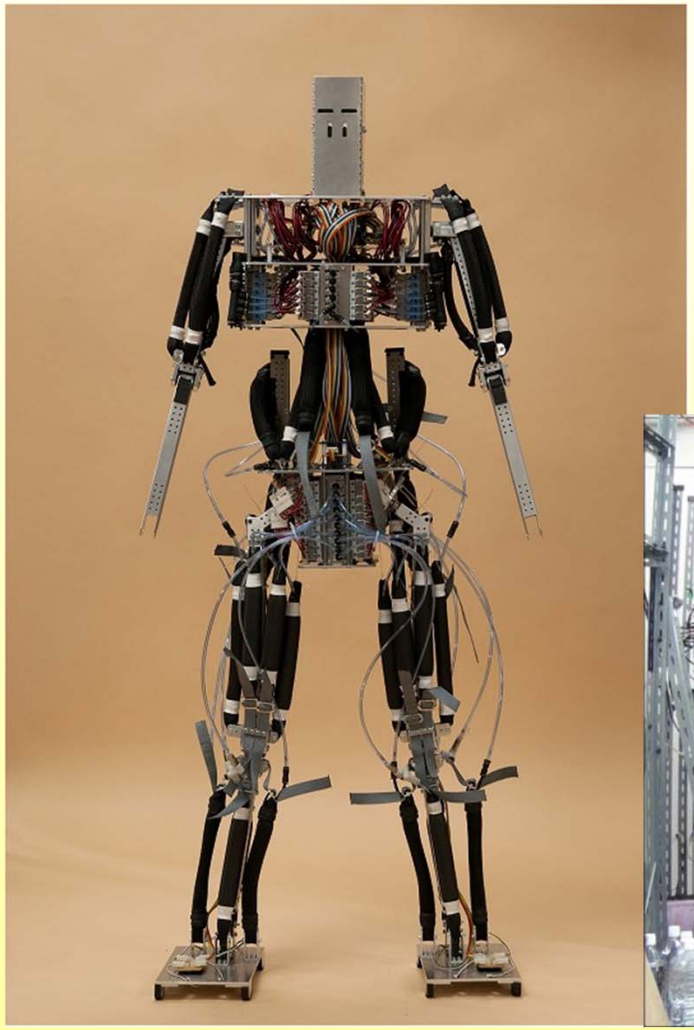

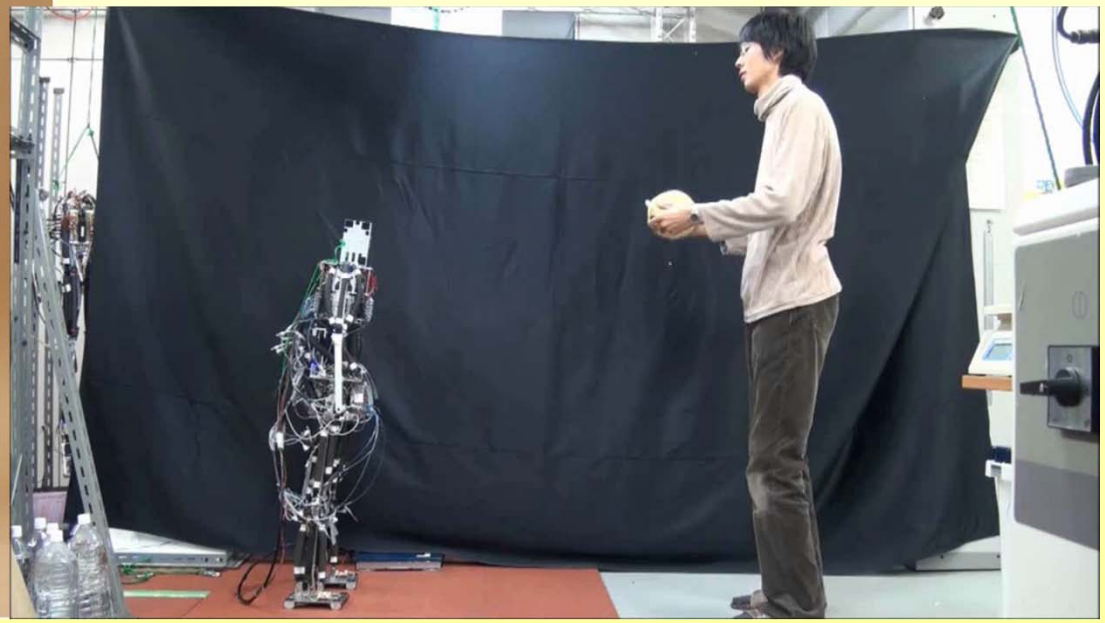

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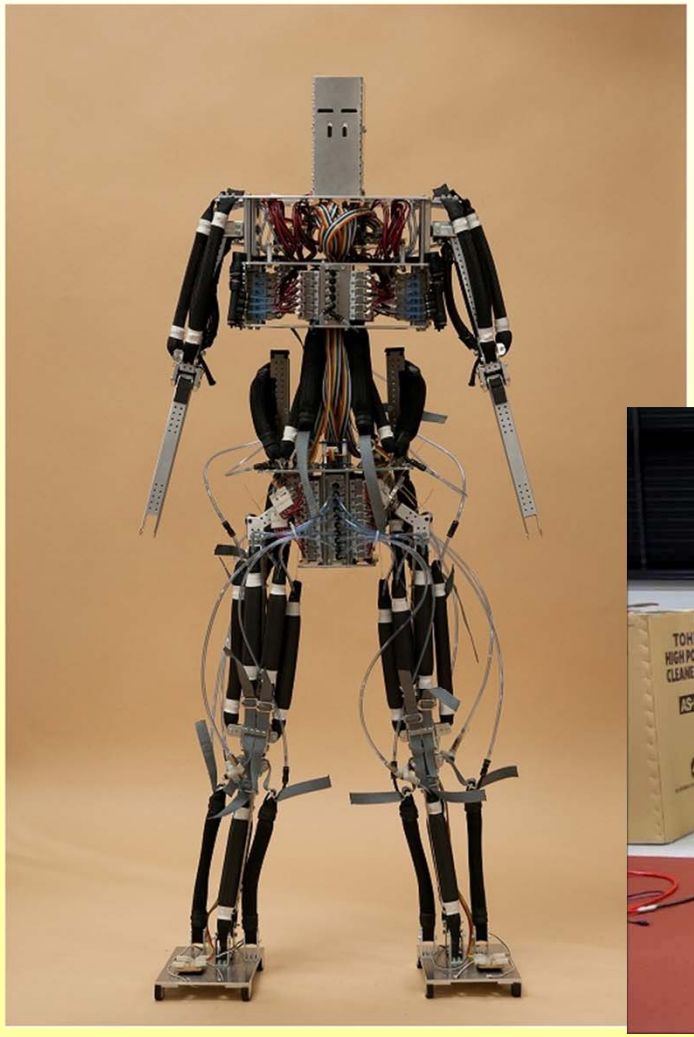
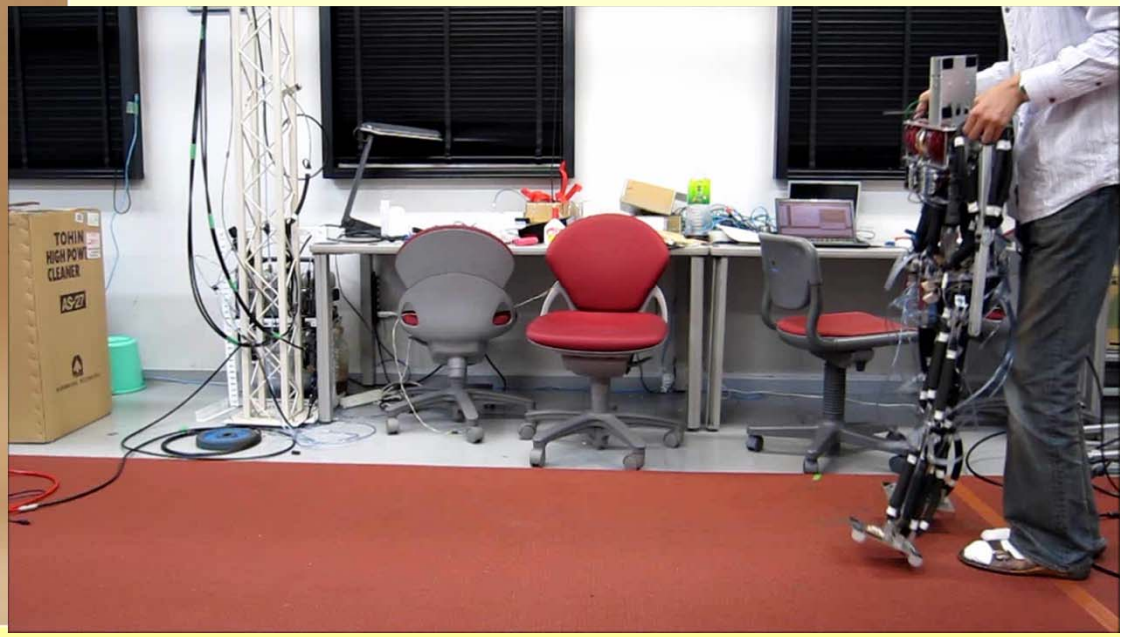
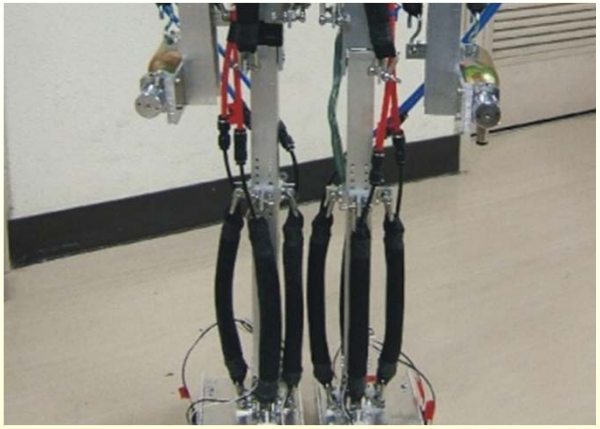
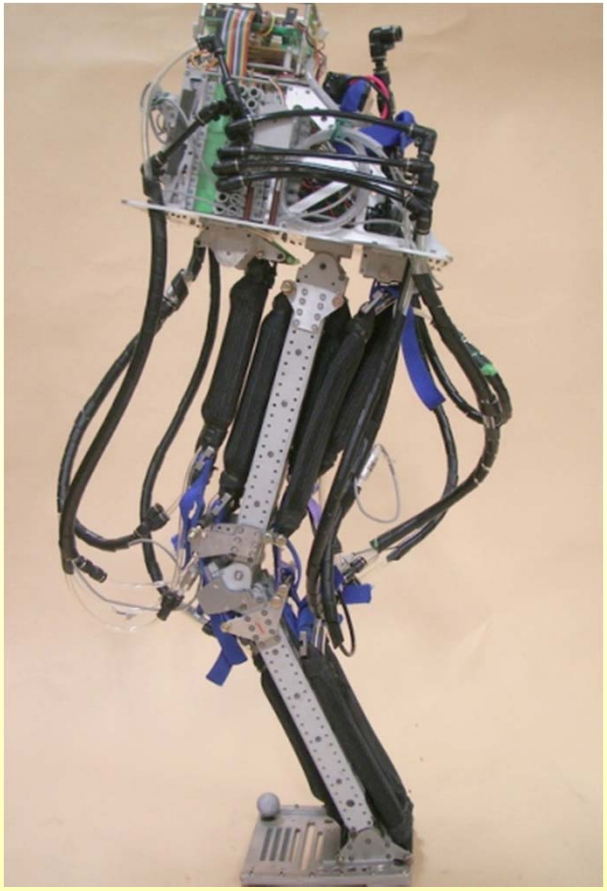
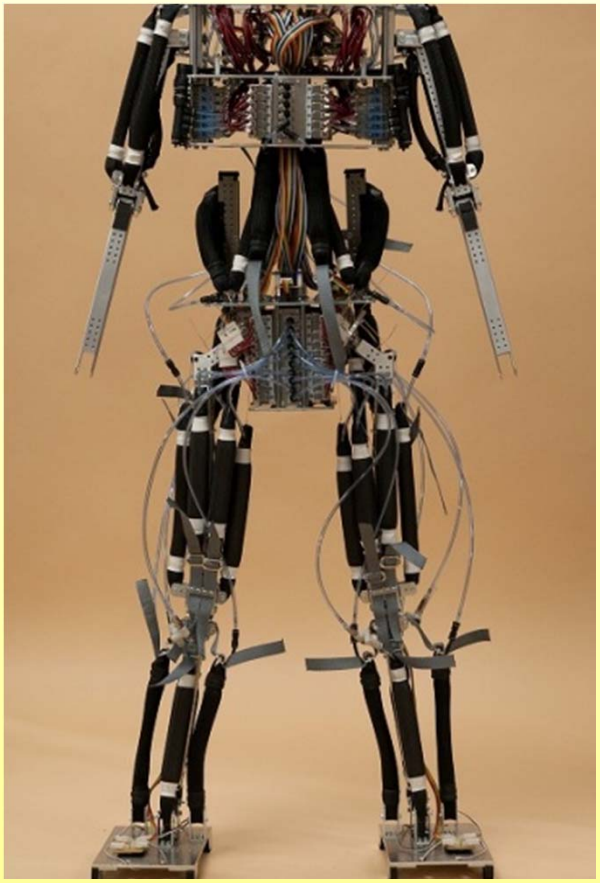


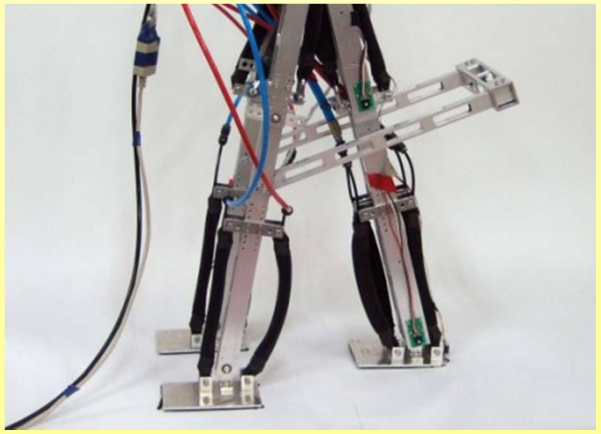


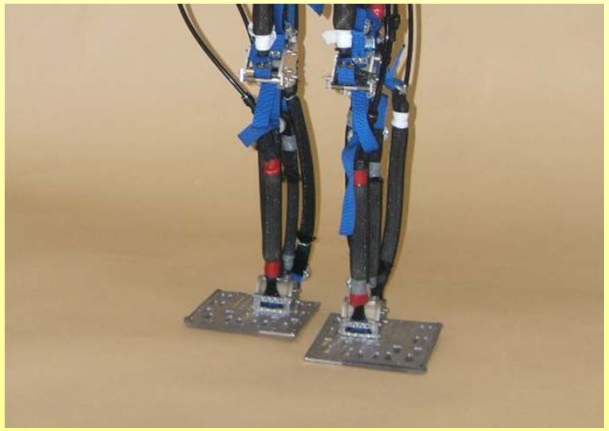
No Conclusion Yet?











We are the Laboratory.