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Brussel

Robots That Care
Los robots llegan para ayudarnos

Bram Vanderborght
Vrije Universiteit Brussel

http://mech.vub.ac.be/robotics.htm

Part of this research is funded by the EU projec t Viactors (www.viactors.org)

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Industrial robots:

3D jobs: dangerous, dull, dirty

KUKA

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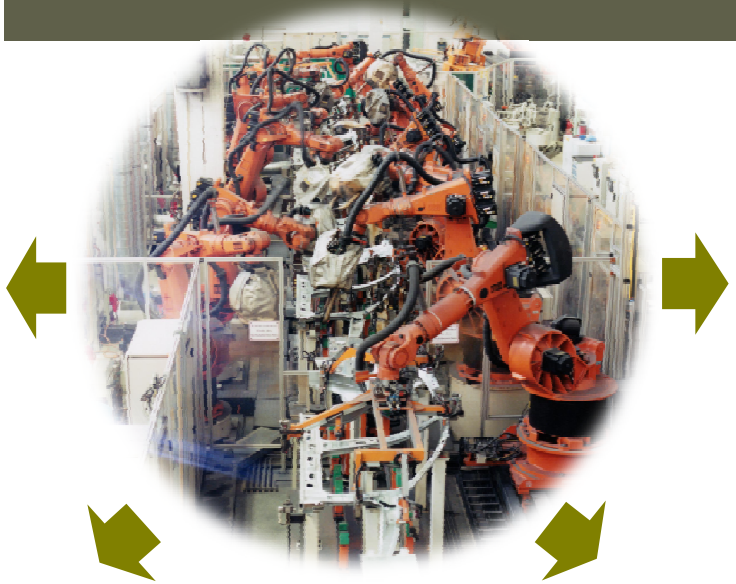
Robots are about to enter our daily life

Aibo



Claudia Mitchell

Willow Garage

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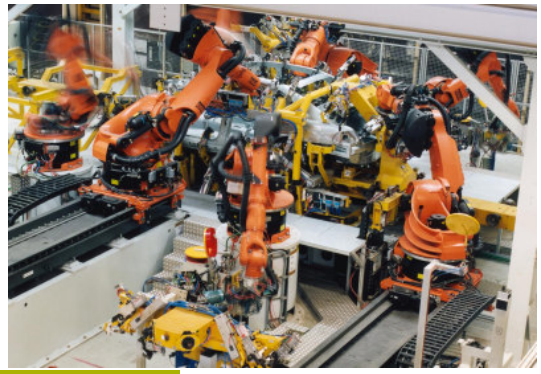
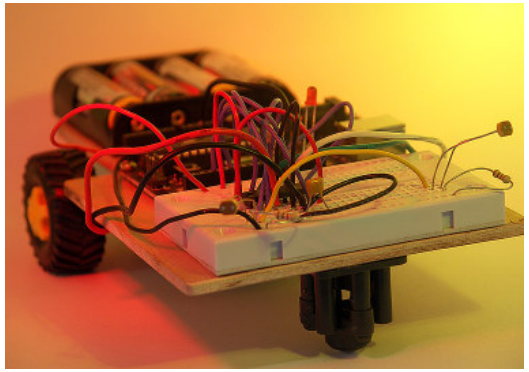
Interesting analogy from Bill Gates *(Scientific American – January 2007)*

Computer industry (1970's): big and expensive mainframes, hobby, first computer games



Robot industry (now): big and expensive industrial robots, hobby, first entertainment robots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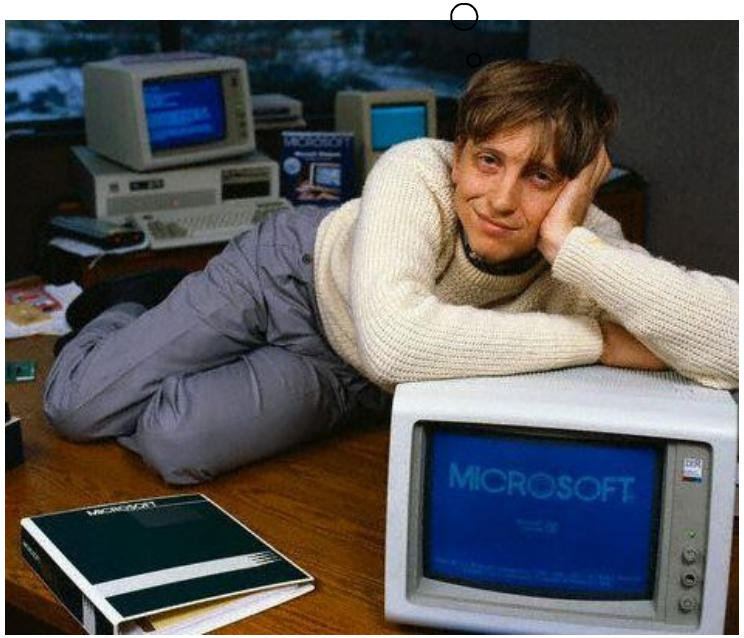
A new dream...

A computer in every house and office



A robot in every house and office

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Same difficulties

- No programming standards
- Little re-use of code
- No standards for hardware

OPEN JAUS

The Orocos Project
Smarter control in robotics & automation!

URBI 2.0

Player

OpenHRP3
Open Architecture Human-Centered Robotics Platform

CLARAty
Reusable Robotic Software

LEGO mindstorms NXT

YARP inside

Microsoft Robotics Studio

ERSP® 3.1
Robotic Development Platform

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Why does it happen now?

- Many cheap and small sensors


Gyroscope


Accelerometer

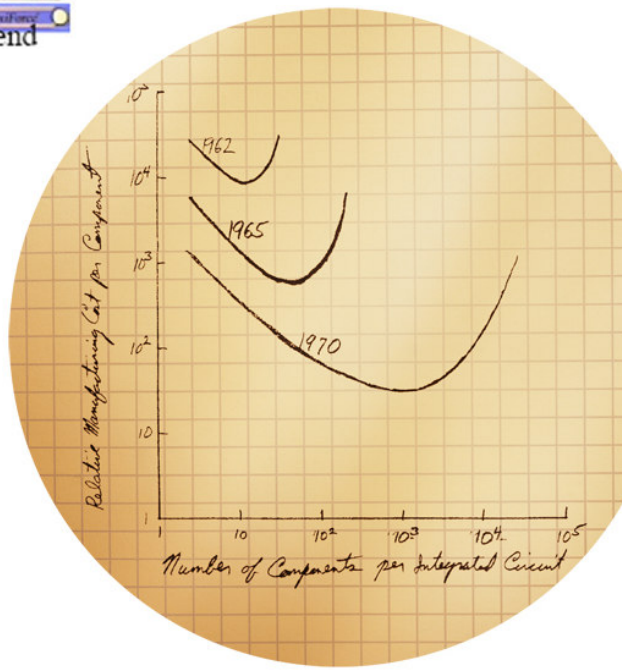

GPS


Piezo Bend


Compass


Resistive Bend

- Computer power continues to increase
- Markets are coming



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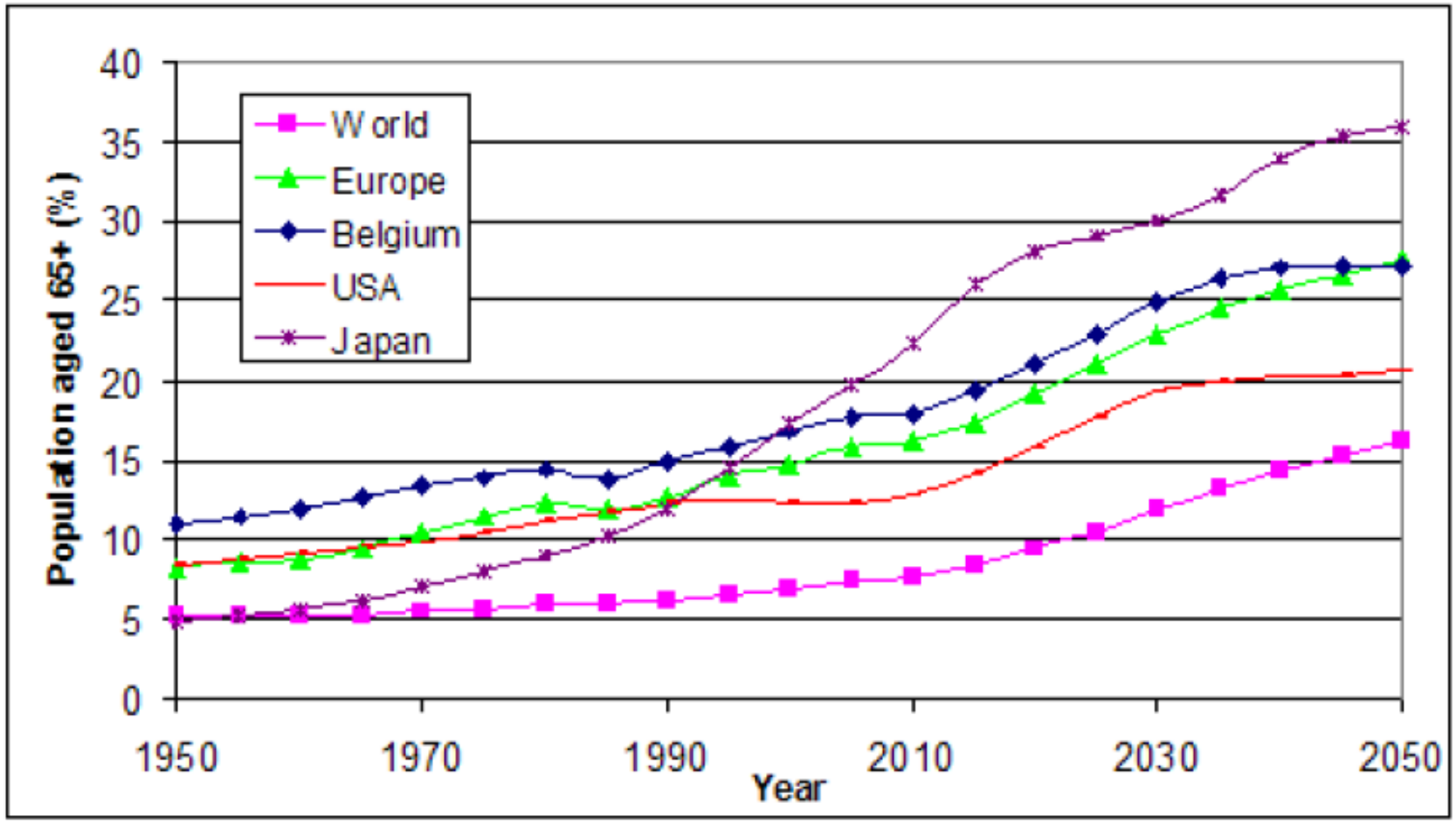
Population above 65+



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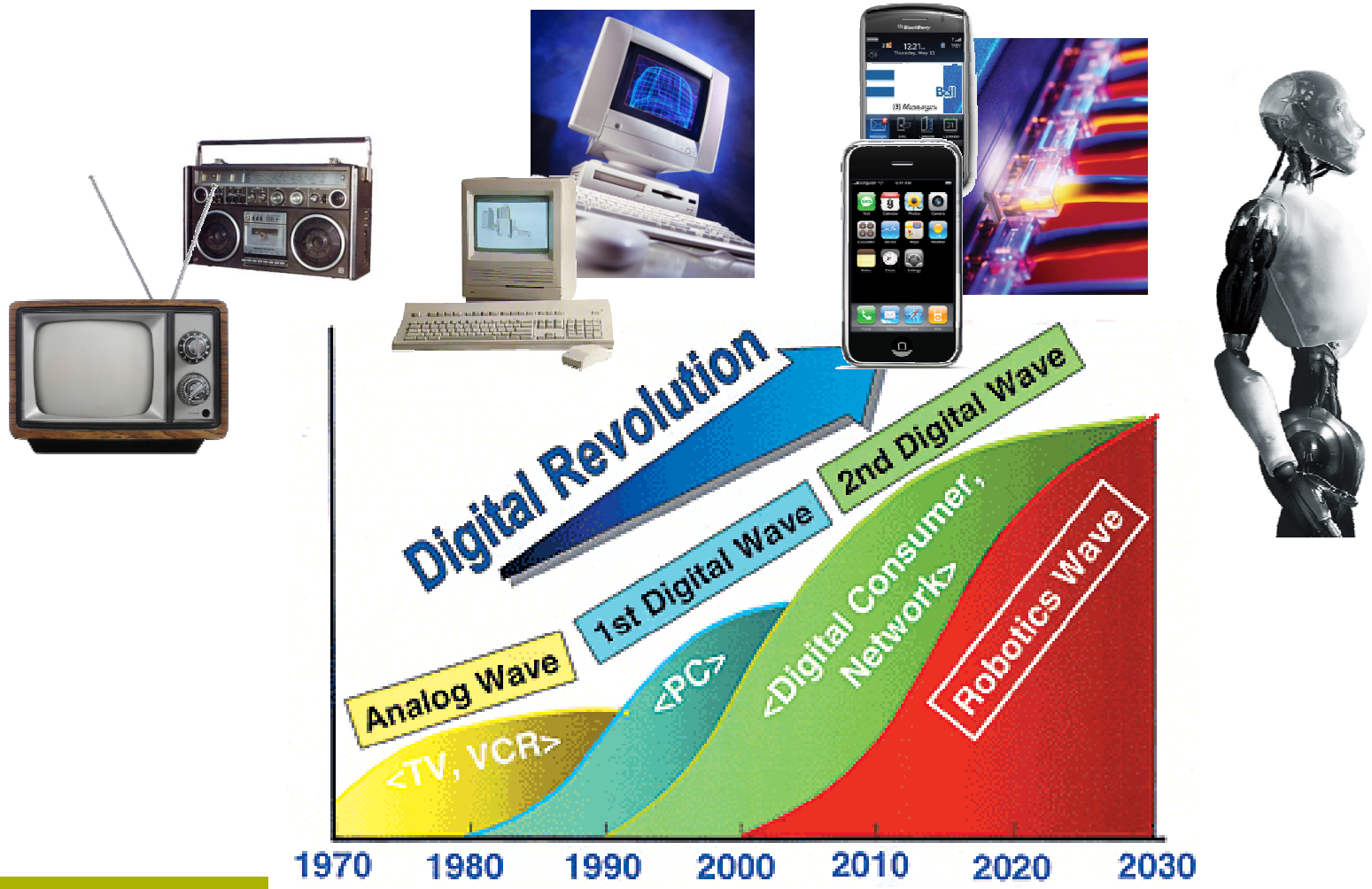
Robotics next revolution?



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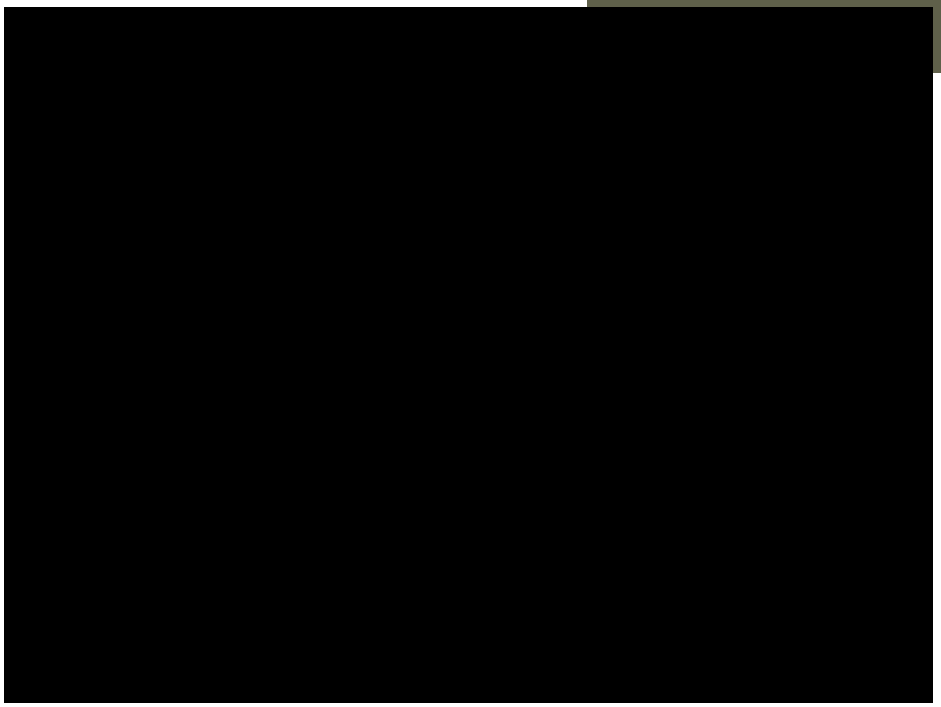
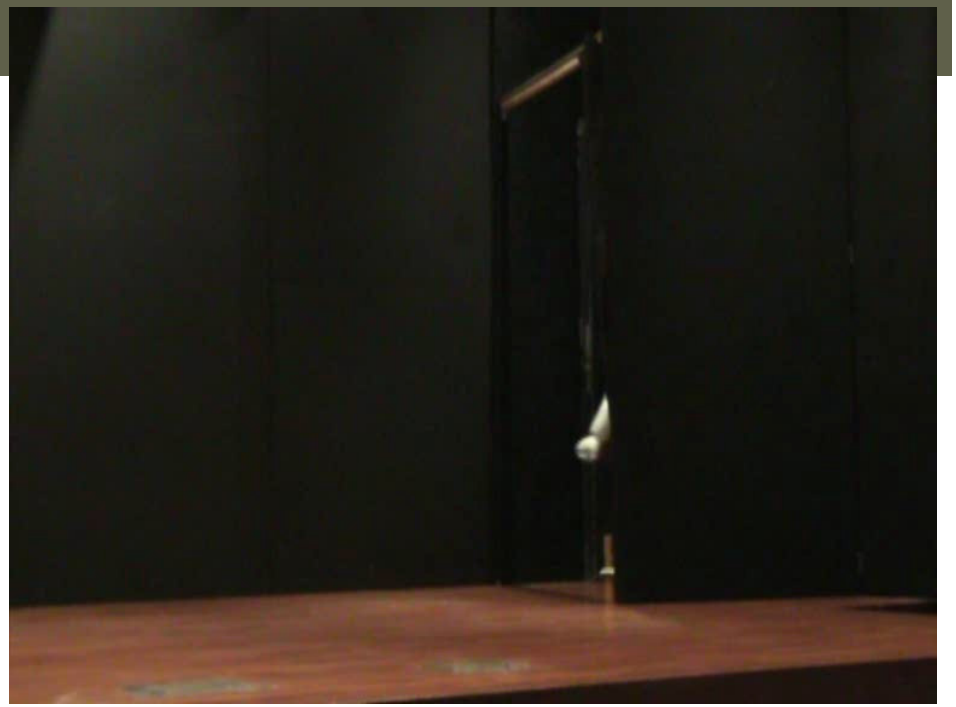
New technology is required!



ABB



Asimo

Industrial robots

- fast
- accurate
- strong

Personal robots

- intelligent
- autonomous
- safe

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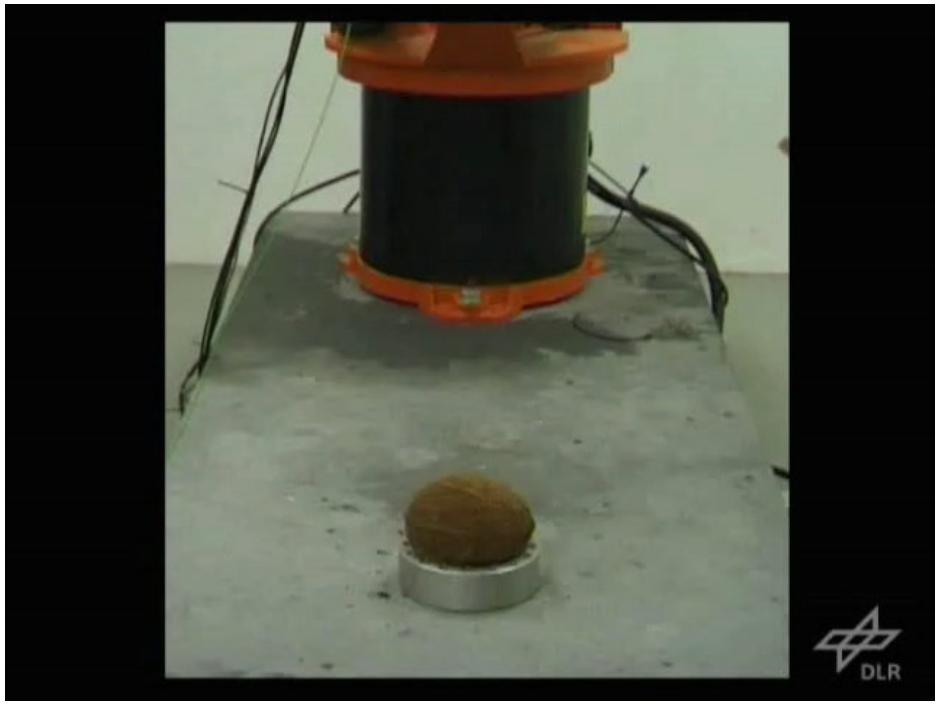
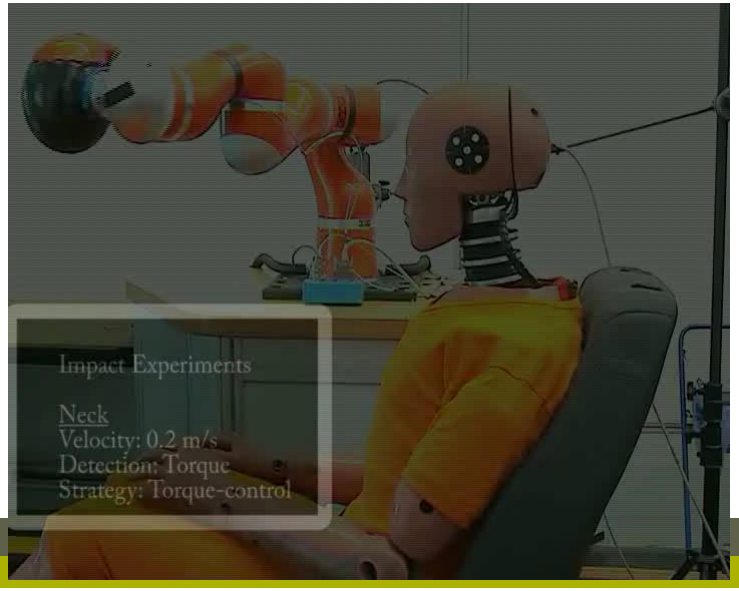
Safety most important



DLR



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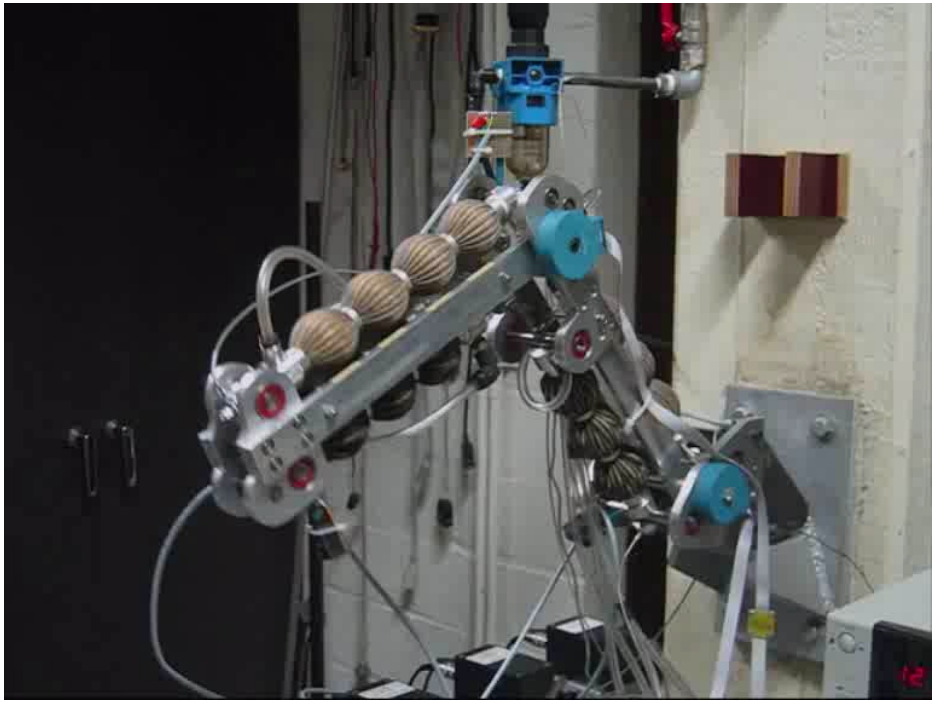
Safety most important

DLR



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New actuators

ASIMO

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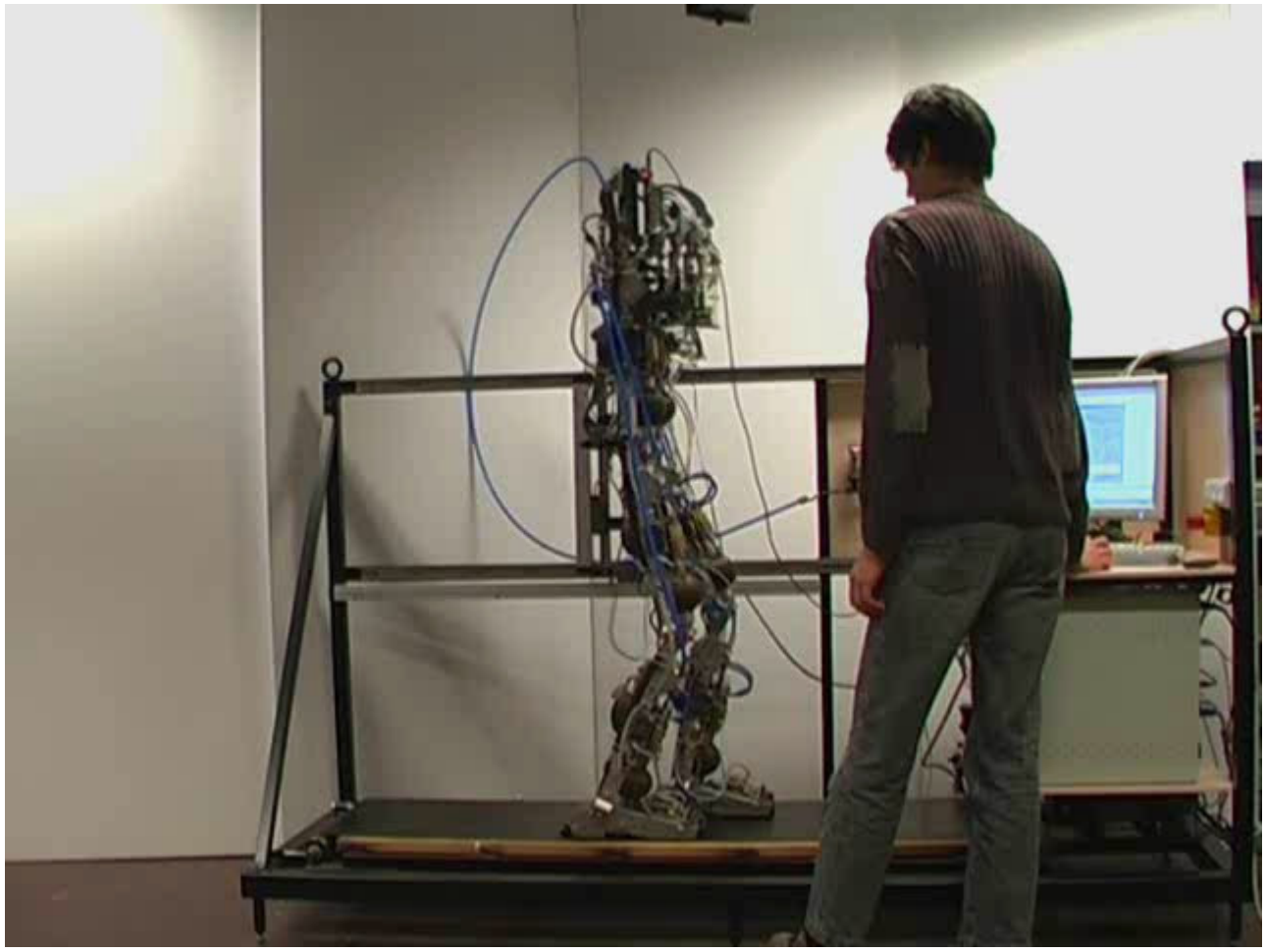
Biped Lucy



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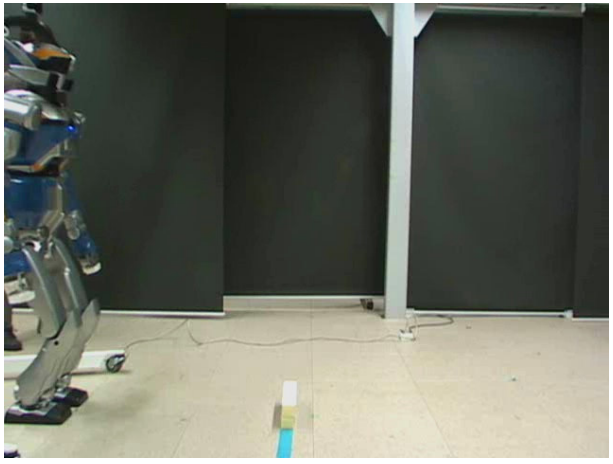
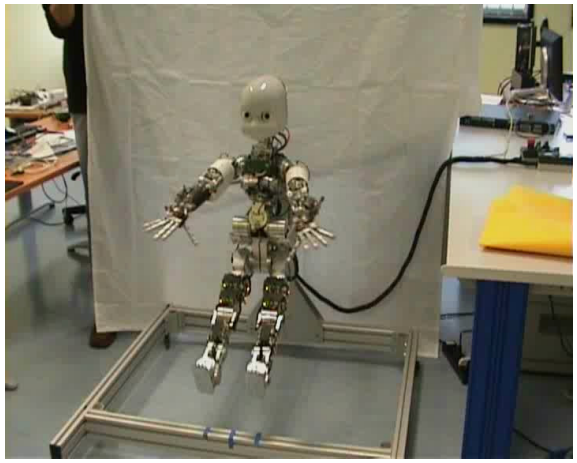
Why humanoid?

A robot that is most suitable to work in a human environment is probably not only a machine with the same appearance, but also the same functionalities so it can use the same tools and do the same tasks as we. → **humanoid robot**

ASIMO



HRP-2



iCub

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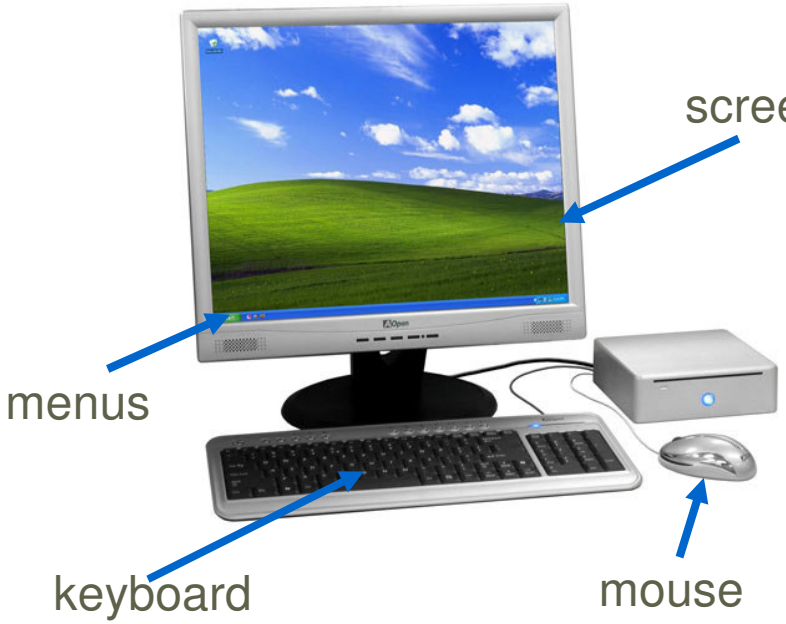
Even emotions...

Machine is central

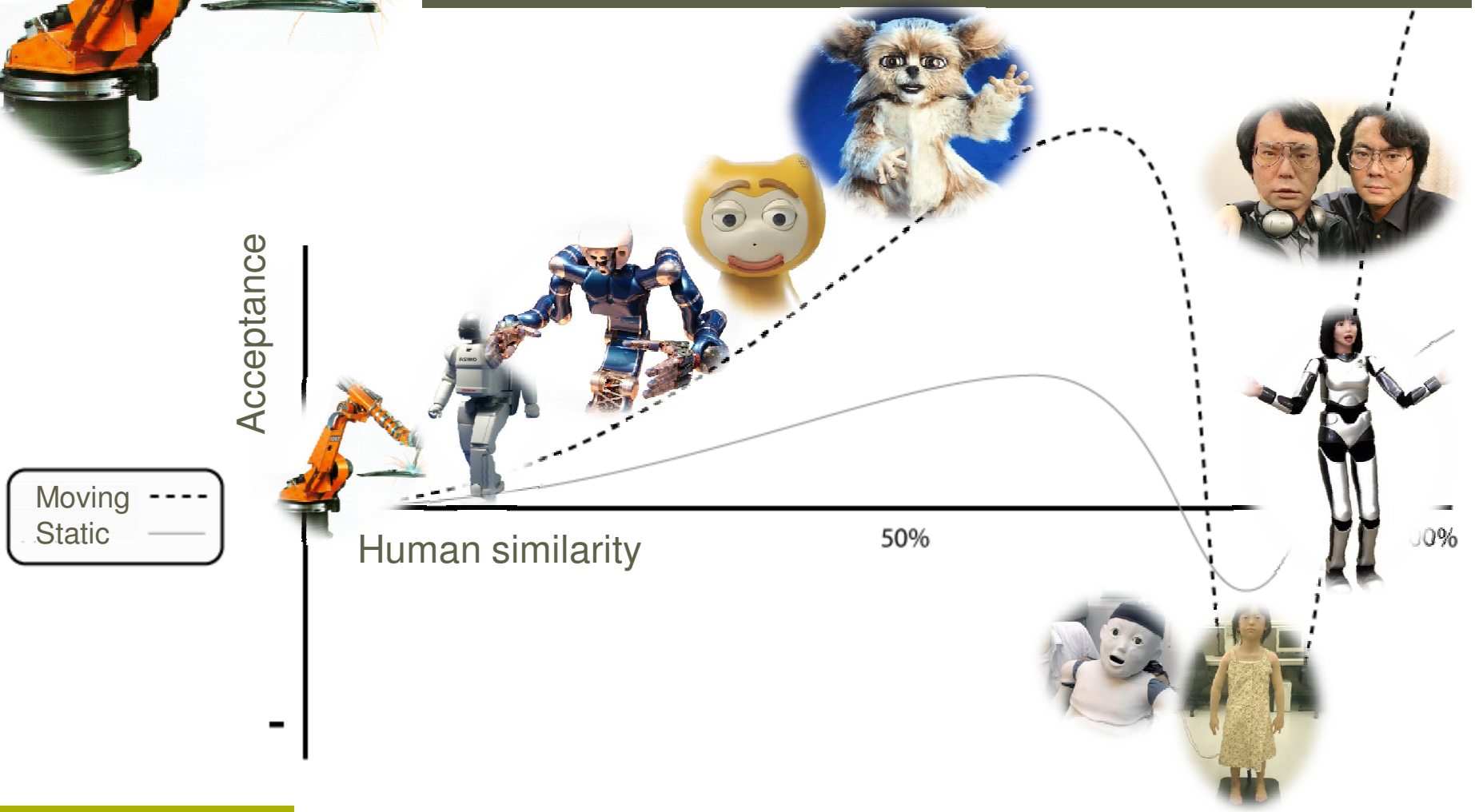


Human has to be central

WALL-E

speech – emotions - gestures

Uncanny valley



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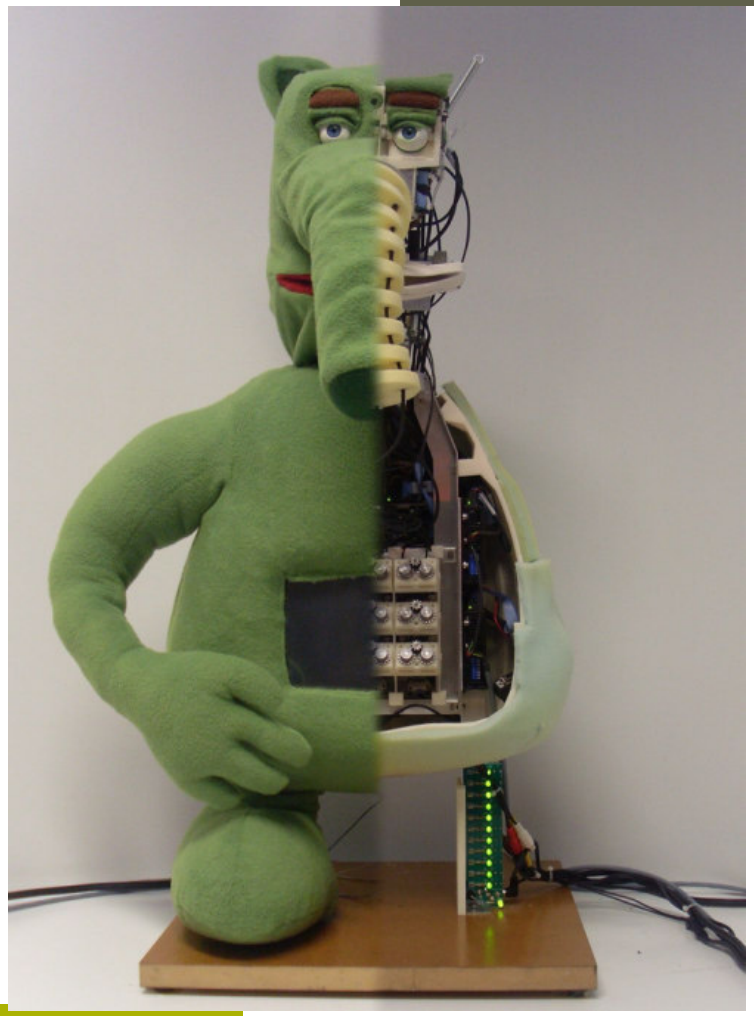
Probo

the intelligent huggable robot



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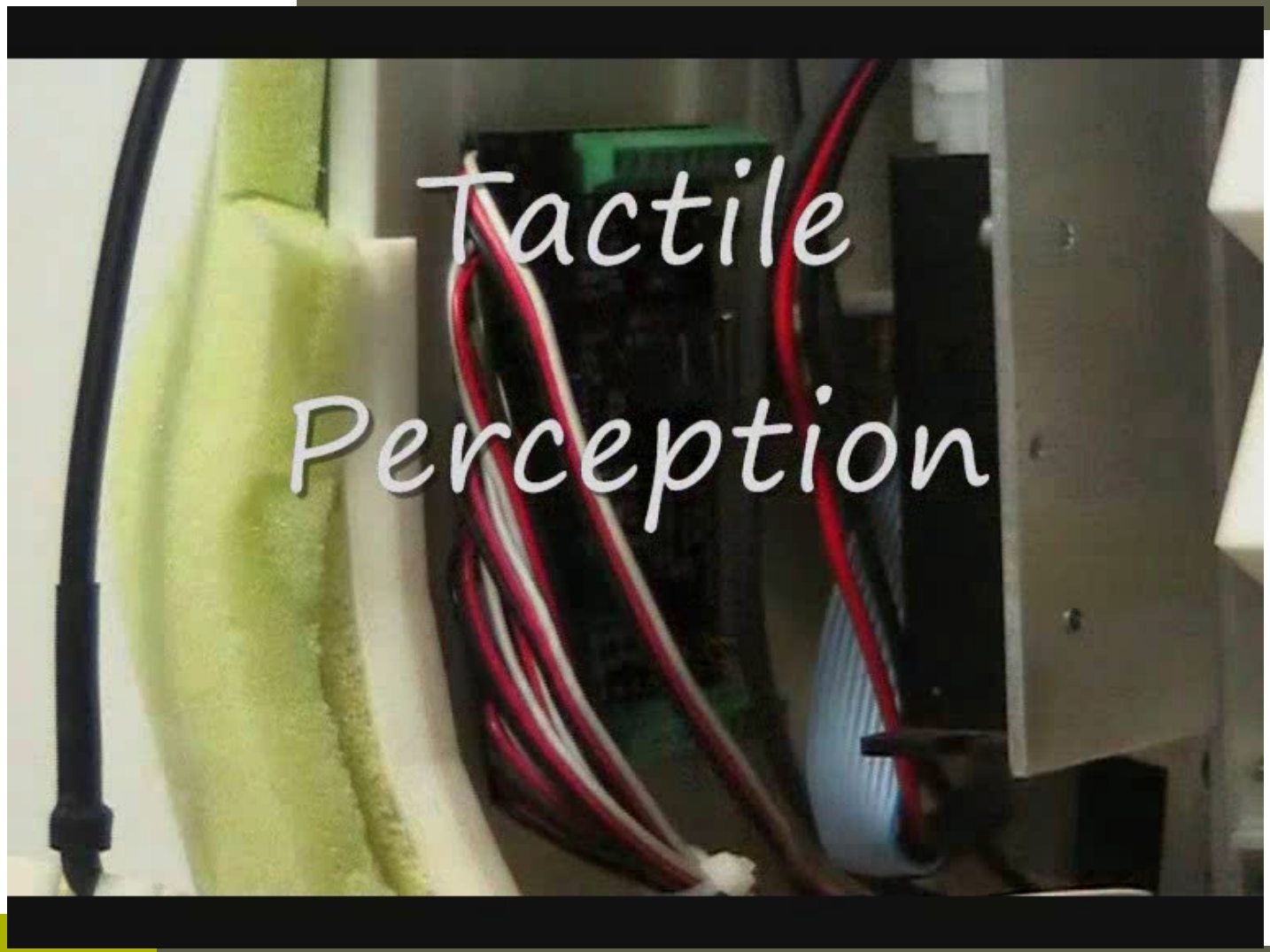
Huggable robot Probo



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Interdisciplinary research

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Probogotchi

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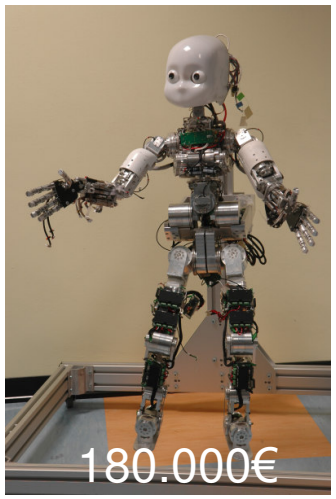
High price


180.000€


400.000€


1.000.000€

≈

Mass production

??€

iCub, HRP-2, Sarcos, Partner robot, Asimo

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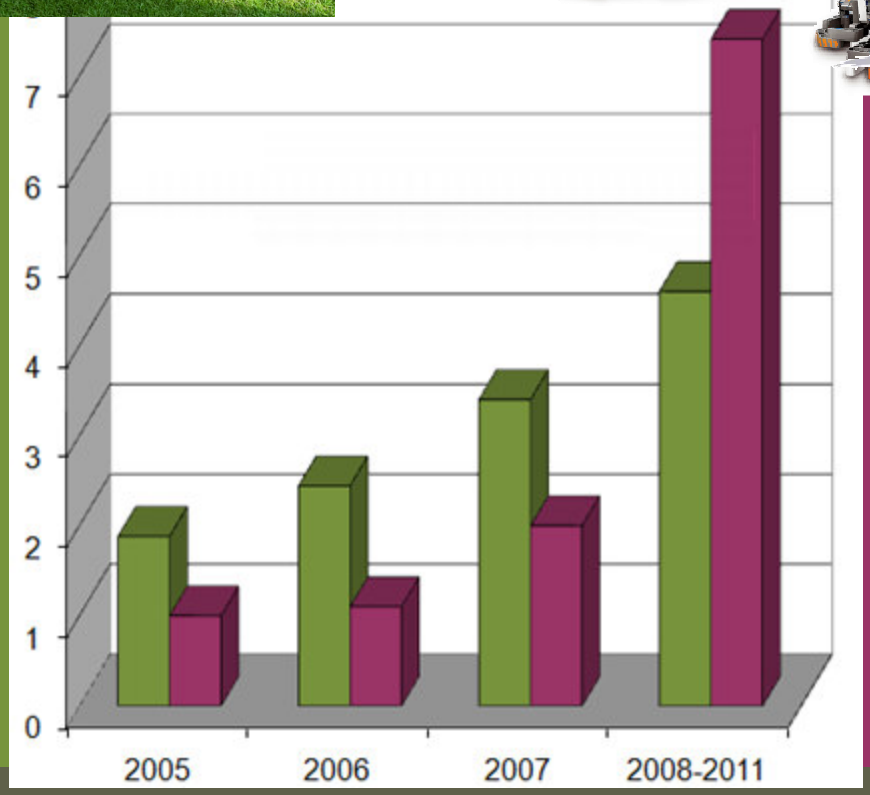
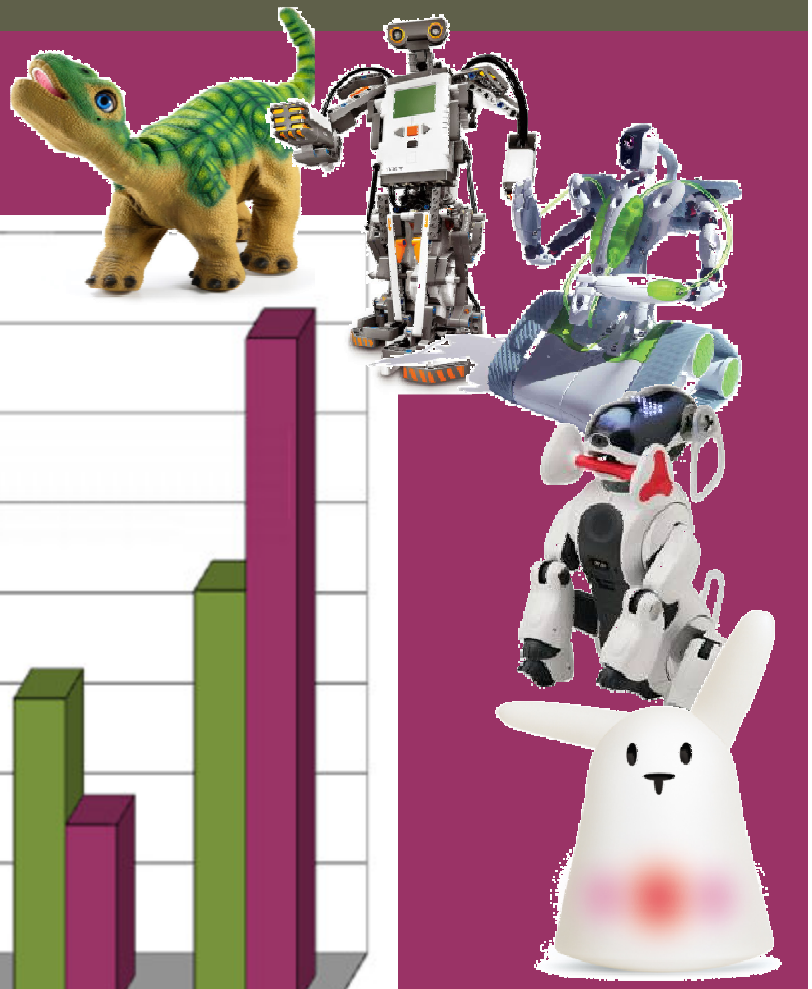
Commercial products





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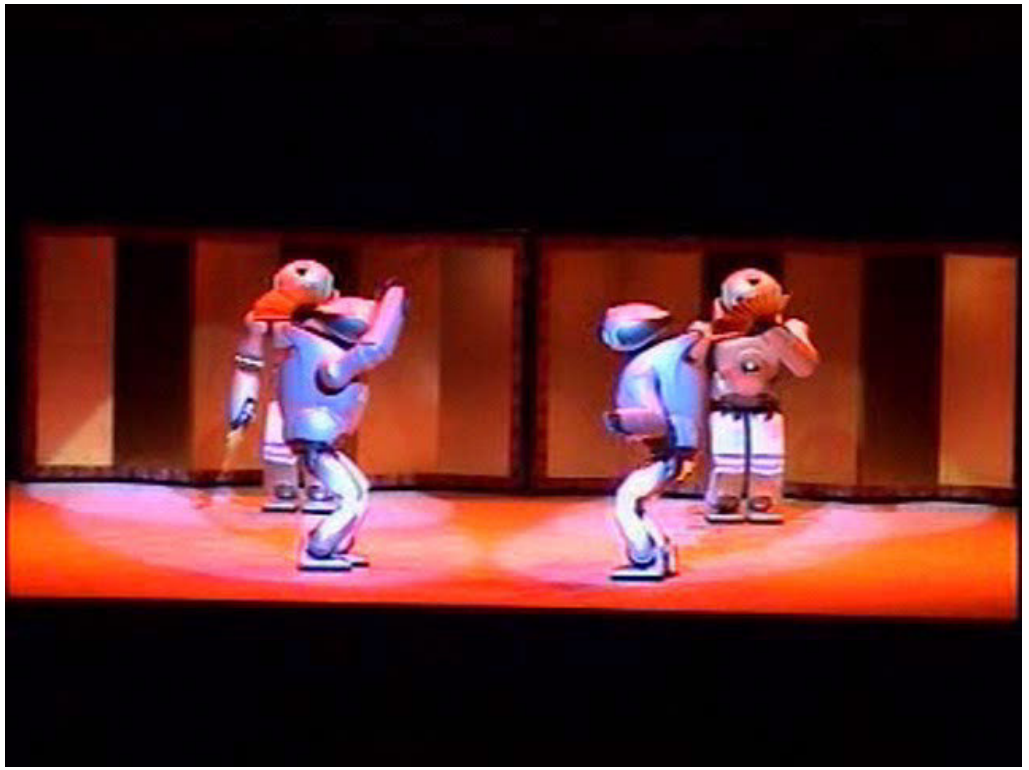
Humanoids now are like...

- 80 year old person for mobility
- 3 year old child for intelligence



QRIO

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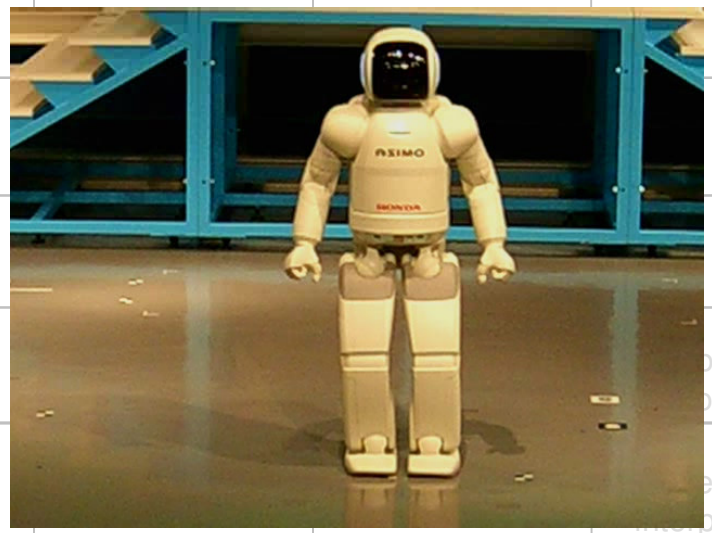
Locomotion

51-100 yrs	
21-51 yrs	
11-20 yrs	
6-10 yrs	Running
3-5 yrs	Dynamic walking
1-2 yrs	
Today	Flat terrain walking
	Locomotion



Asimo

ZMP based walking
- Versatile
- Lot of control
- High energy cost

Delft University

Limit cycle walking
- Only 1 walking speed, cannot start and stop
- No control
- Energy efficient

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Manipulation

51-100 yrs						Human-like intelligence
21-51 yrs						
11-20 yrs		Autonomous task planning				
6-10 yrs	Running					
3-5 yrs	Dynamic walking	Human-like gripping				
1-2 yrs						
Today	Flat terrain walking	Arm positioning	1 hour work duration	Command interpretation	Feature recognition	Command interpretation
	Locomotion	Manipulation	Power	Sensor fusion	Perception	Intelligence

Miniature Dexterous Hand for the iCub

1st Prototype Testing

IIT

Justin

- Arm positioning well known
- Artificial hand difficult to produce
- Gripping difficult
- Tactile perception necessary

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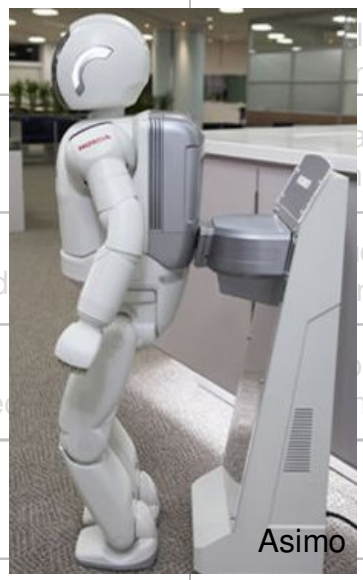
Energy

51-100 yrs						
21-51 yrs						
11-20 yrs		Autonomous task planning	24 hour work duration			
6-10 yrs	Running					
3-5 yrs	Dynamic walking	Human-like gripping	6 hour work duration	Speech recognition		
1-2 yrs				Gesture		
Today	Flat terrain walking	Arm positioning	1 hour work duration			Command interpretation
	Locomotion	Manipulation	Power	Communication	Perception	Intelligence


Asimo

- Decrease power consumption
- Better energy sources
- Pushed by technology in consumer electronics

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Communication

51-100 yrs

21-51 yrs

11-20 yrs

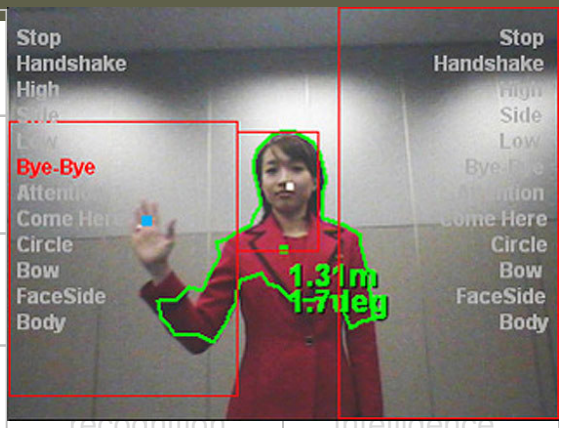
6-10 yrs

3-5 yrs

1-2 yrs

Today

- Interpretation basic commands possible
- Still very difficult to understand full text and its meaning
- Must be able to understand non-verbal communication and able to express



Speech recognition		
Gesture interpretation		
Command interpretation	Feature recognition	Command interpretation
Communication	Perception	Intelligence

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Perception

51-100 yrs			Human-like intelligence
21-51 yrs			Reasonable thinking
11-20 yrs		Scene understanding	Autonomous task planning
6-10 yrs		Object recognition	Behavior based intelligence
3-5 yrs	Speech cognition		
1-2 yrs	Gesture erpretation		
Today	ommand erpretation	Feature recognition	Command interpretation
	munication	Perception	Intelligence

- Ability to understand environment by sensors
- Factory know environment, house or street dynamic and unknown

Darpa urban challenge

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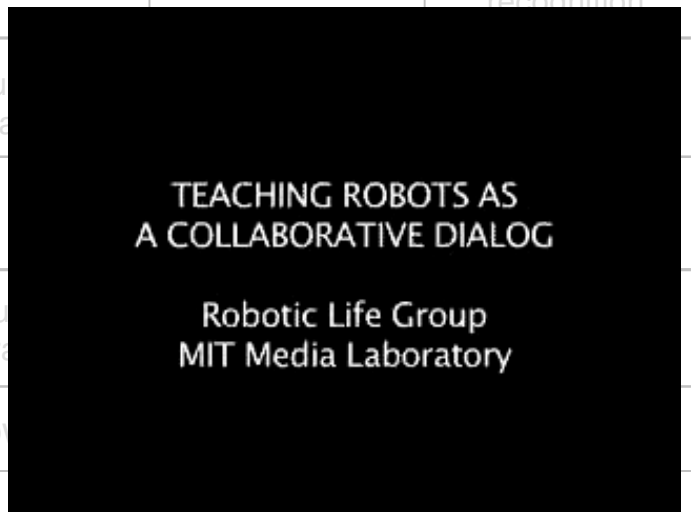
Intelligence

51-100 yrs		Human-like intelligence
21-51 yrs		Reasonable thinking
11-20 yrs		Autonomous task planning
6-10 yrs		Behavior based intelligence
3-5 yrs		
1-2 yrs		
Today		Command interpretation
		Intelligence

- Look at intelligence as an onboard system that controls the different components to fulfill an imposed task
- Path is still long and slow
- Robot must be able to learn
- Much can be learn from gaming industry

Hoap EPFL



Leonardo

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Applications

	Locomotion	Manipulation	Power	Communication	Perception	Intelligence
51-100 yrs						Human-like intelligence
21-51 yrs						Reasonable thinking
11-20 yrs		utonomous sk planning	24 hour work duration		Scene understanding	Autonomous task planning
6-10 yrs					Object recognition	Behavior based intelligence
3-5 yrs	Dynamic walking	Human-like gripping	6 hour work duration	Speech recognition		
1-2 yrs				Gesture interpretation		
Today	Flat terrain walking	Arm positioning	1 hour work duration	Command interpretation	Feature recognition	mmand retation

Robot health care

Entertainment humanoid

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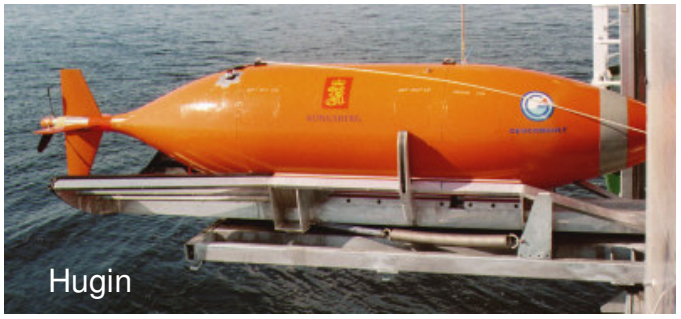
Military robots

Predator

Packbot

Talon Swords



Hugin

Packbot

The Hurt Locker

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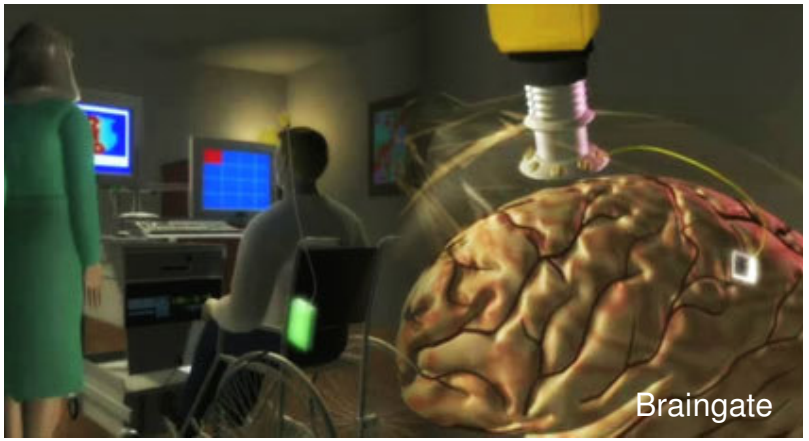
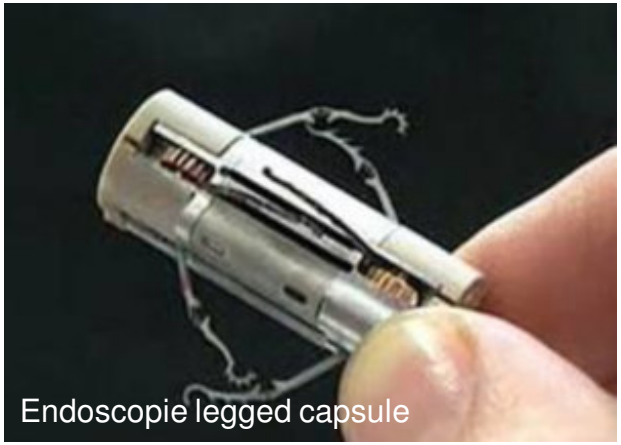
Medical robots

Da Vinci



Braingate



Endoscopie legged capsule

Technion

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Traditional prosthesis

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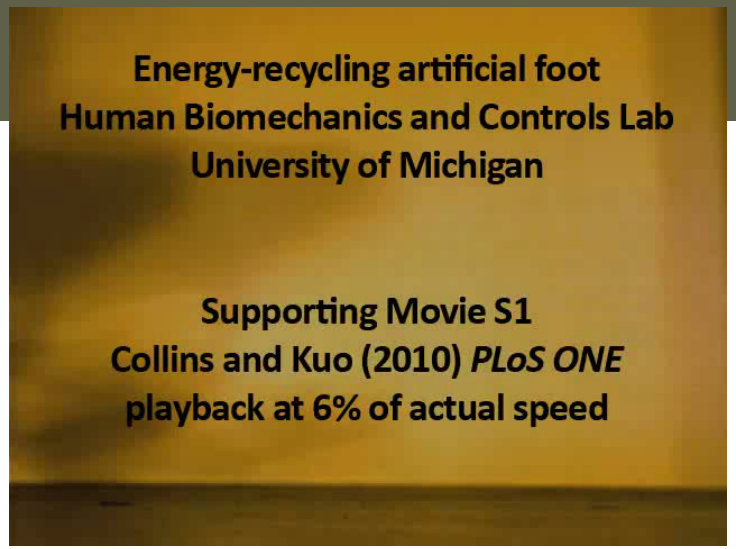
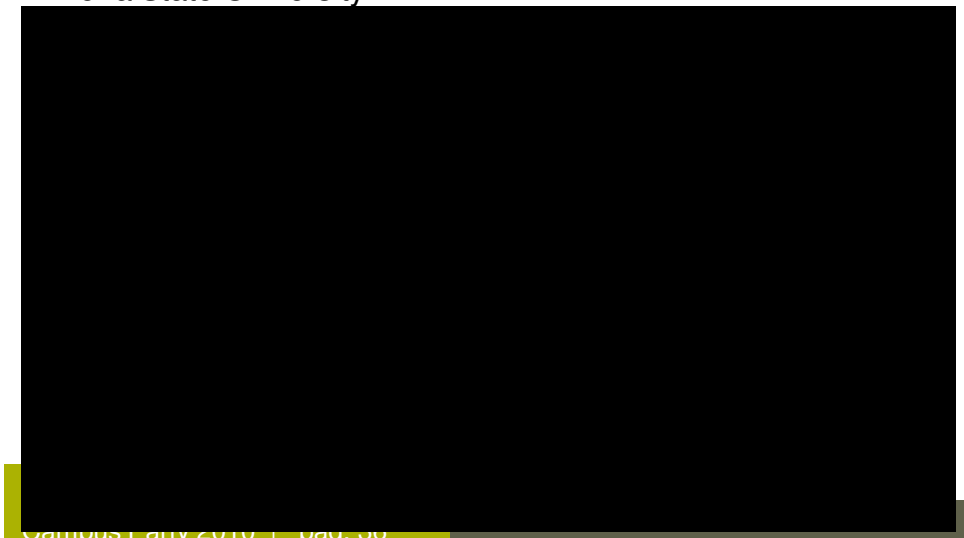
Using robotics to enhance walking

MIT

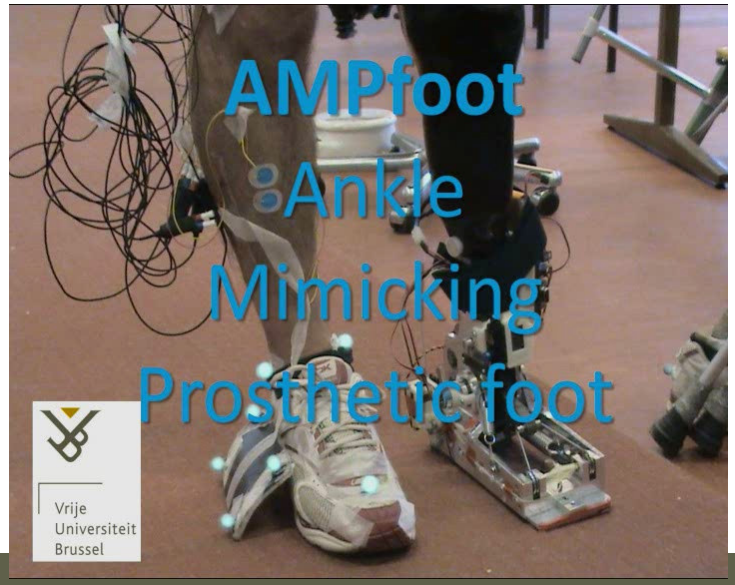


University of Michigan

Arizona State University



VUB



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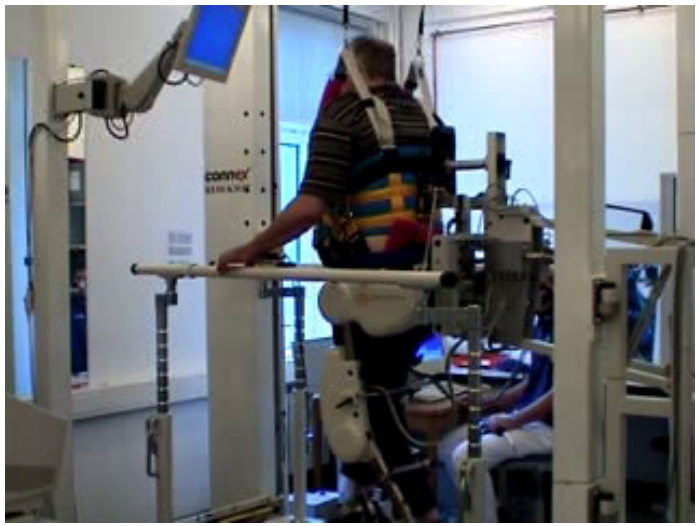
Gait rehabilitation

Lokomat



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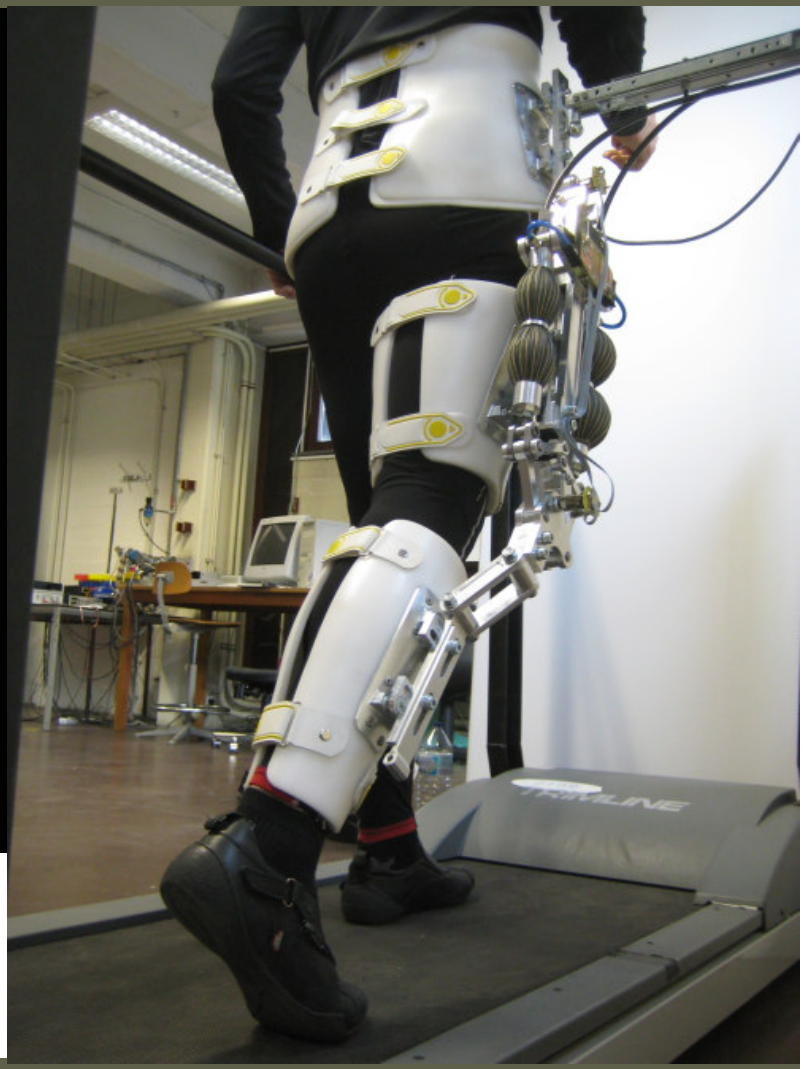
Exoskeleton



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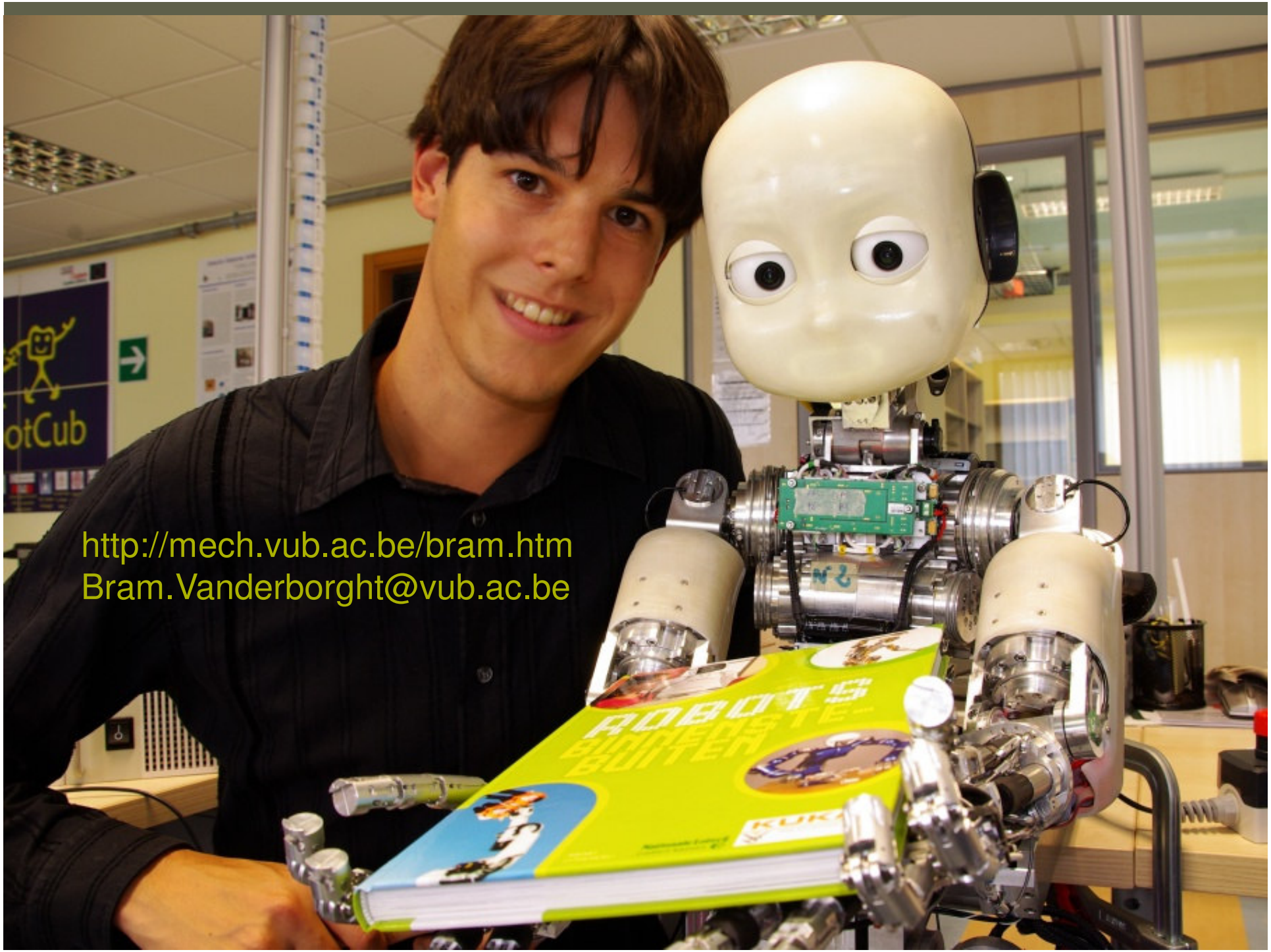
Robot in charge → patient in charge

Conclusions

- Robots are about to enter our daily life
- Robots will be everywhere in different forms and applications
- But still much research necessary
- Have to think about ethical problems as well



http://mech.vub.ac.be/bram.htm
Bram.Vanderborght@vub.ac.be