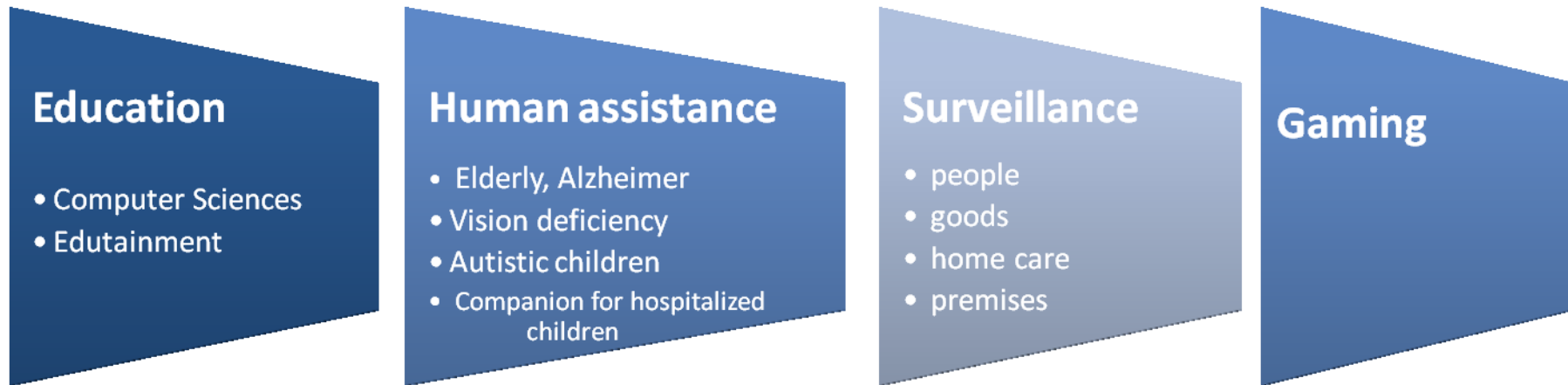


# **ICRA 2011 – A New Generation of Educational Robots**

**Recent developments in Humanoids for  
Education and Research – Rodolphe Gelin**



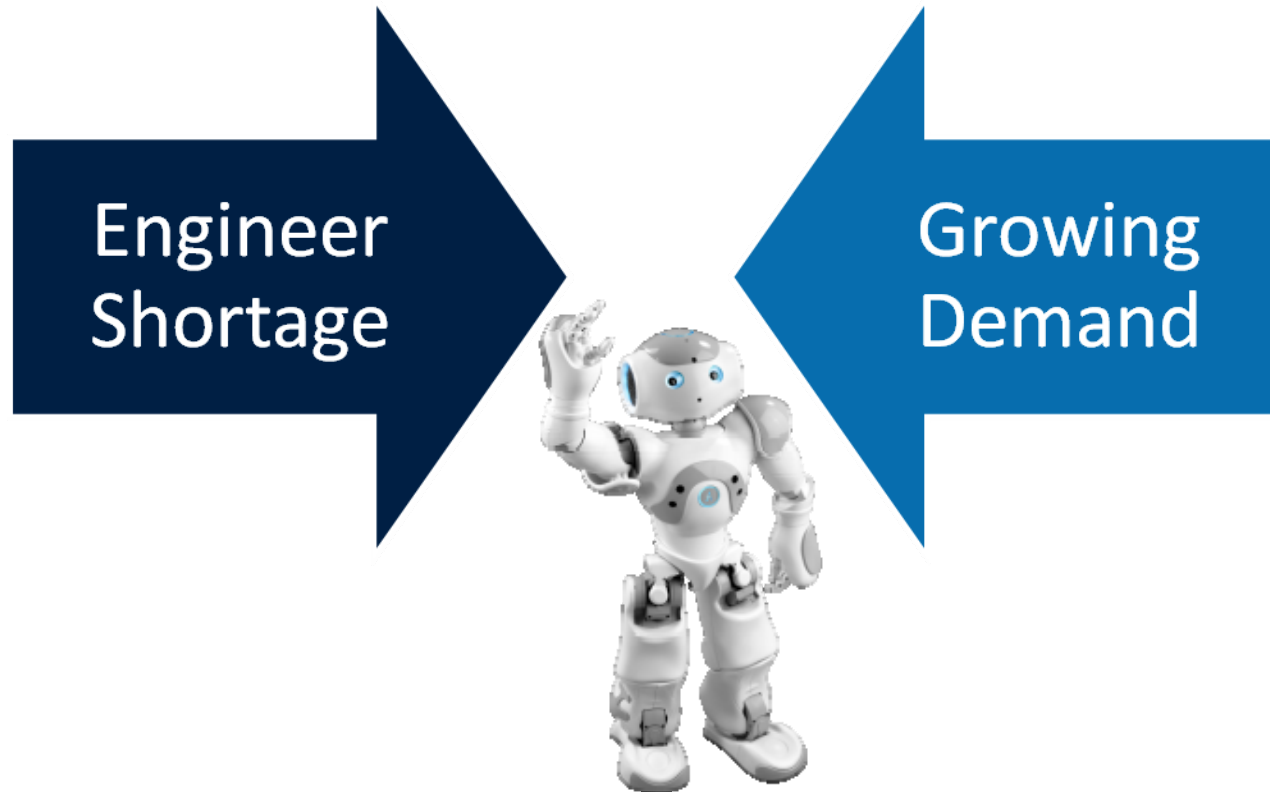


**ROBOTS helping the well being of humanity**

**Millions of jobs in the countries producing robots  
(hardware, software and services)...**

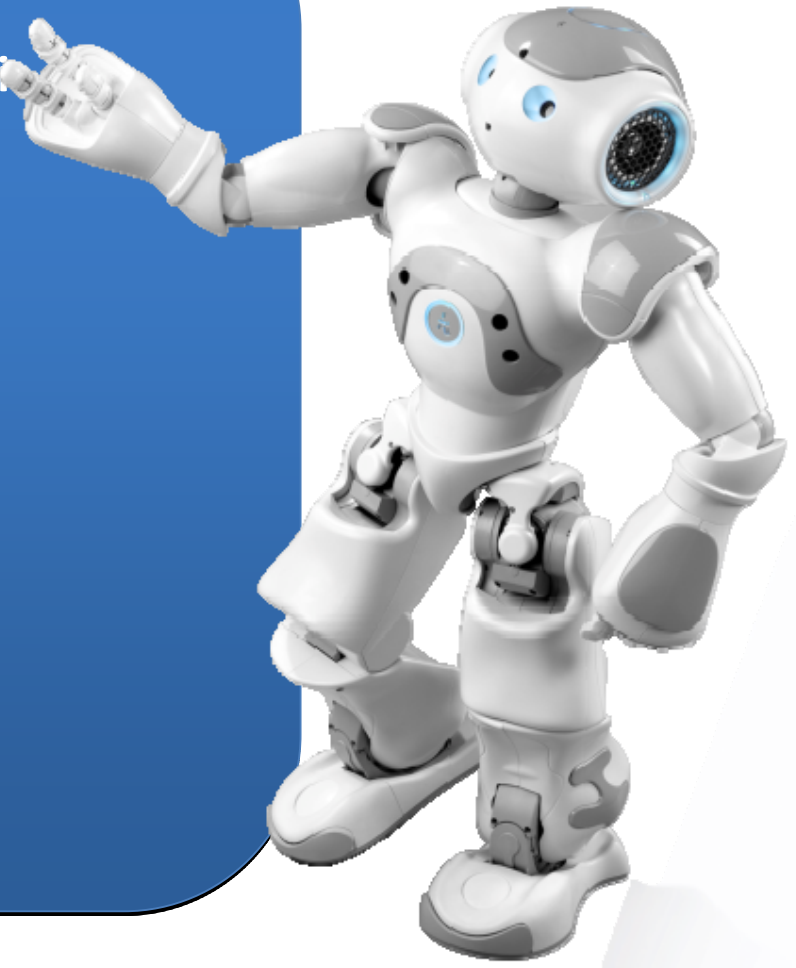
**...we need to train the next generation!**

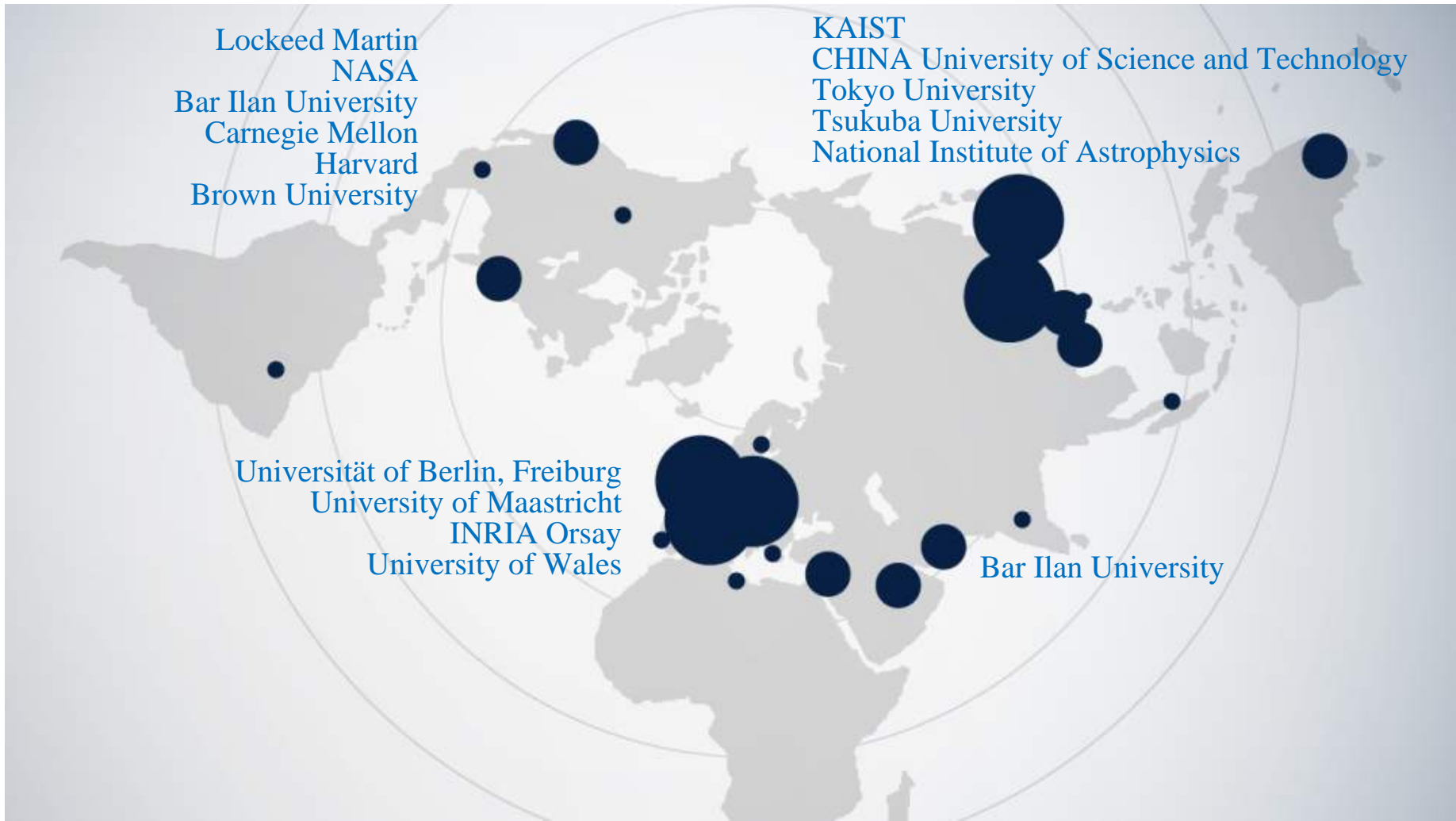
A progressive dissatisfaction for scientist discipline  
Education & Technology are challenging

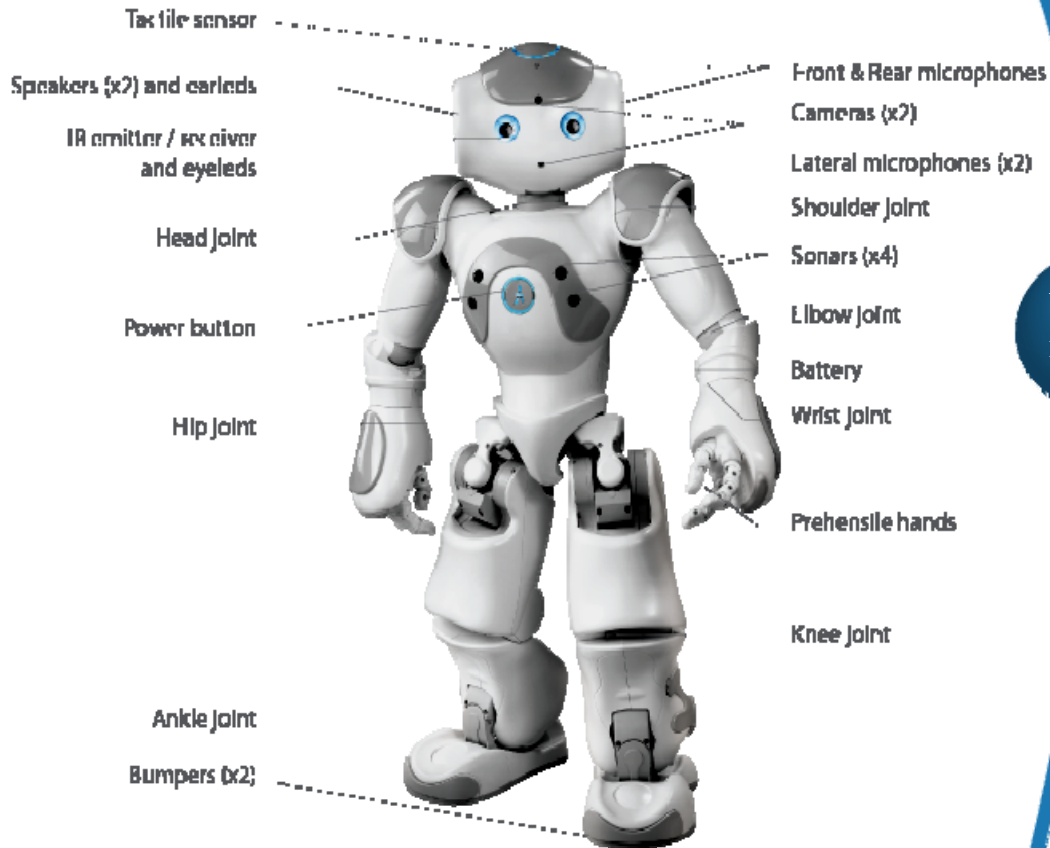


**EXPLORE AND ACCESS NEW FIELDS OF RESEARCH**  
**GENERATE AND TRANSMIT KNOWLEDGE**  
**MERGE SUBJECTS**

- **Founded in 2005, based in Paris,**
- **Sales operations in Boston, Osaka & Shanghai**
- **Goal : humanoid robots for**
  - Research and Education
  - Personal Assistance,
- **1500 NAOs in operations in 35 countries**
- **World Leader in BtoB Humanoid robotics**
- **120+ employees**





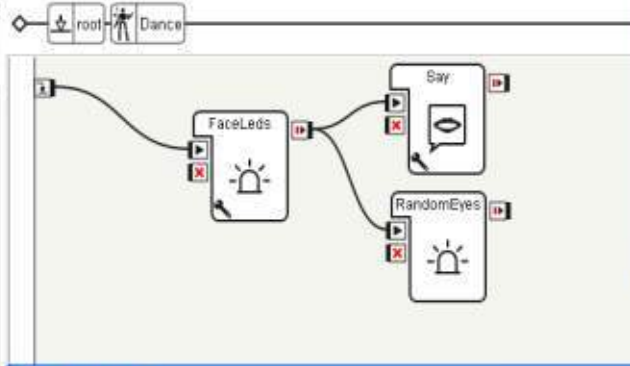




Timeline Edit

Box List File

- default
- Audio
- Params
- Music
- Pronounce
- Record
- Say
- Say Text
- SpeechReco
- Communication
- Leds
- Ear Light
- FaceLeds
- RandomEyes
- Switch Leds
- Water Clock
- Logic
- Math
- Movement
- Dance
- Hello
- LieDown
- Movement



### Set parameters of Say

Parameters

text: Hello, nice to meet you

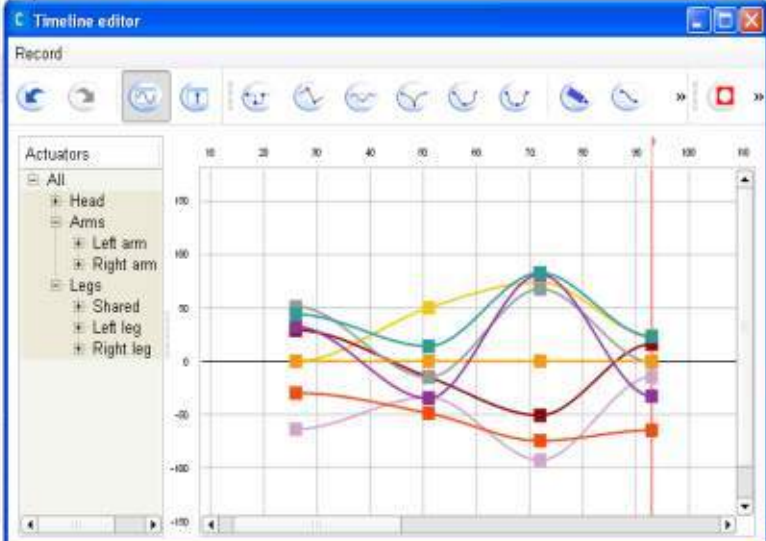
Voice Shaping: 100

speed: 100

Auto-update parameters on robot

Reset to default

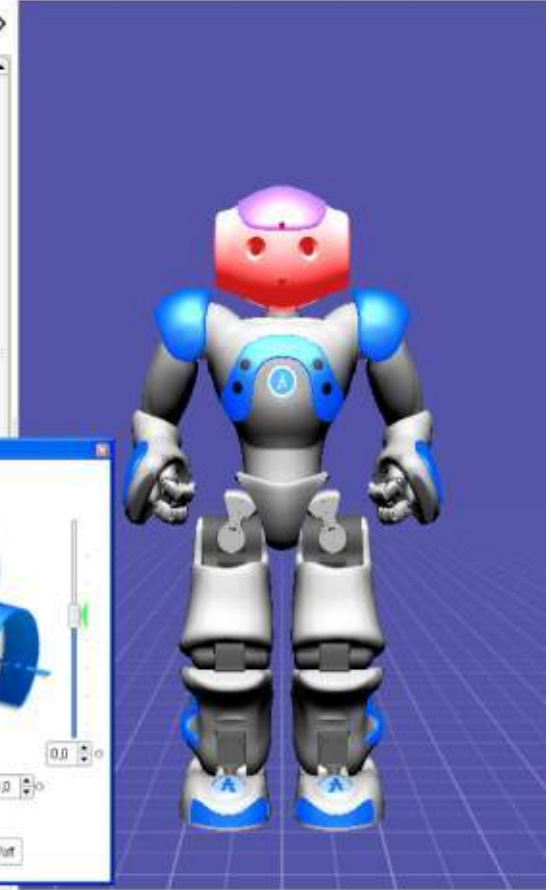
OK Cancel



### Motion

0.0 0.0

Enable chain on/off





- **35 people**
- **Subjects**
  - Mechatronics (actuators, power supply, transmission,...)
  - Control (locomotion, whole body motion)
  - Speech recognition
  - Localization and navigation
  - Grasping
  - Image processing : objects, faces, gestures...
  - Vision based control
  - Learning
  - Reasoning
- **Collaborative projects**
  - ANR (GVLEX, YOJI, RASPO)
  - FUI (Romeo)
  - FEDER (Juliette)
  - Europe (Felix Growing, HumaVips, Echord : GraspY, Babir)



**Hokuyo laser range finder**



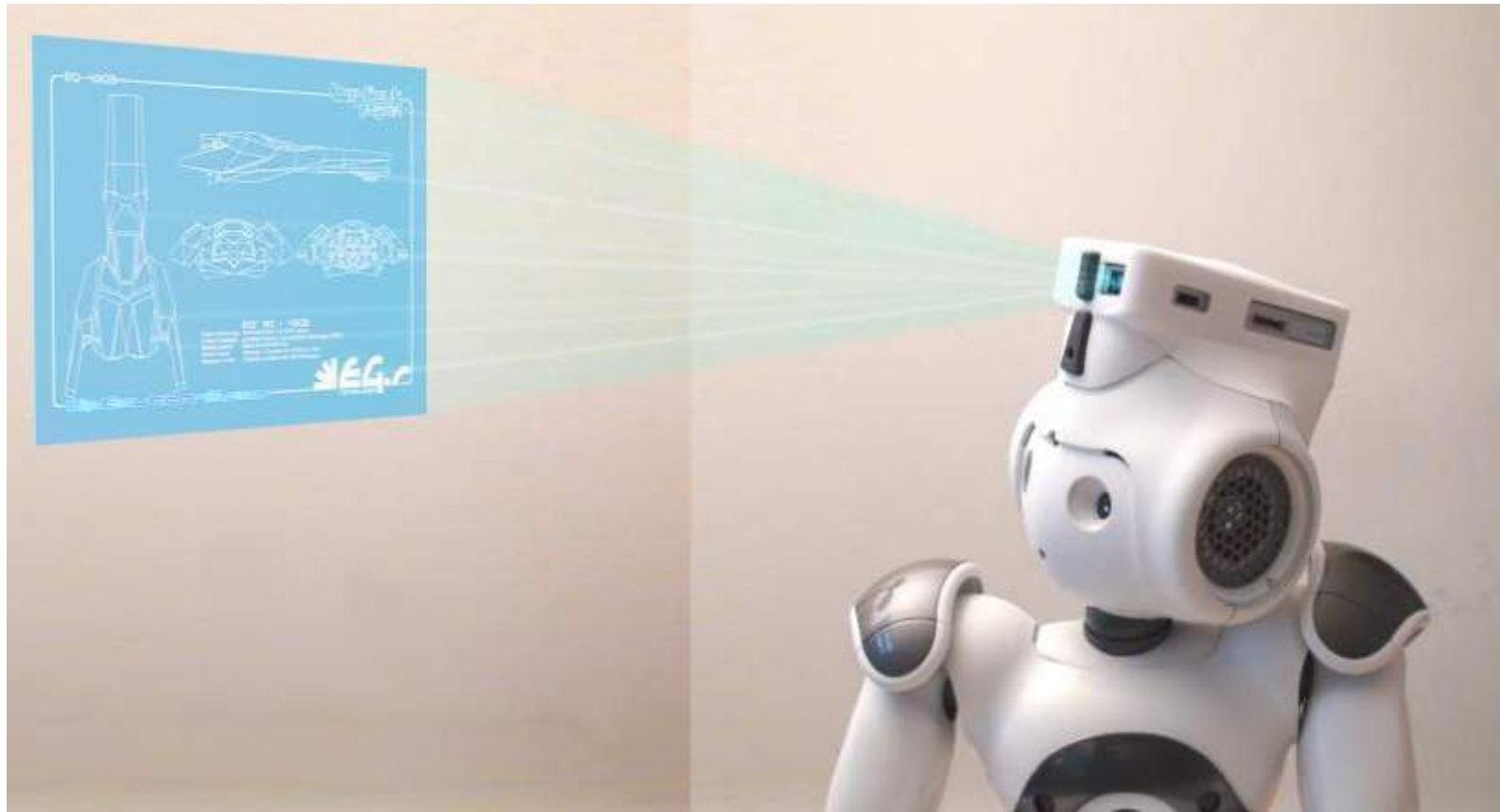
**Microsoft Kinect**



**ACER Pico-projector**



**Asus Primesense**



PROGRAMMING

TEAM WORK



COMMUNICATION  
SKILLS



SCIENTIFIC  
PROCESS

PROJECT  
MANAGEMENT



INTERDISCIPLINARY  
PROJECTS

ROBOTICS

PHYSICS

MATHEMATICS

SCIENCE

COMPUTER SCIENCE

ENGINEERING

## SENSING

**Multimodal fusion**

**Audio**

**Vision**

**Perception**

**Tracking**

## BEING AUTONOMOUS

**Autonomy**

**Embedded Software**

## THINKING

**AI**

**Cognition**

**Learning**

**Cooperation (SWARM...)**

## CONTROLLING

**Control**

**Whole Body**

**Motion**

**Manipulation grasping**

## MOVING

**Mapping**

**Planning**

**Navigation**

**Localization**

## INTERACTING

**Psychology**

**Healthcare**

**Social Robotics**

**Human-Robot Interaction**



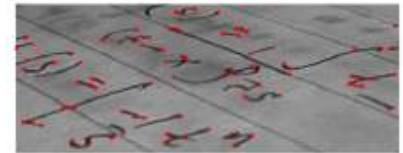
## Engineering

- Mechanical Engineering
- Electronics



## Computer Sciences

- Programming
- Vision & audio processing



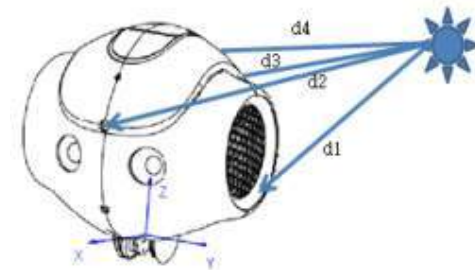
## Social sciences

- Game theory
- Human-robot interaction

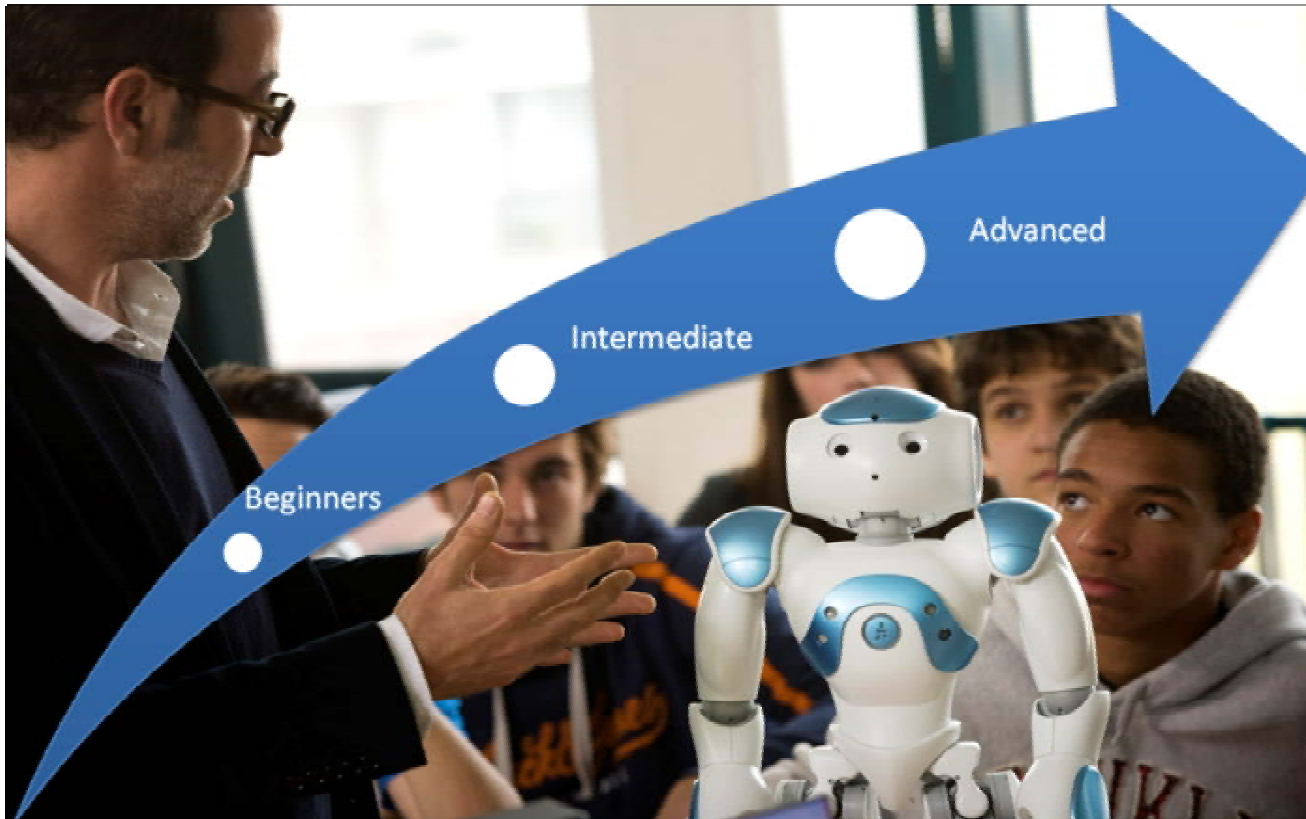


## Sciences: Physics & Mathematics

- Basic principles of physics
- Mathematics



**Robotics is a multi-disciplinary science involving many subjects and levels**



### **MULTI-TEACHING**

Physics, Coding & Project Management at the same time!

### **MULTI-LEVEL**

Whatever your level in coding, you can program NAO

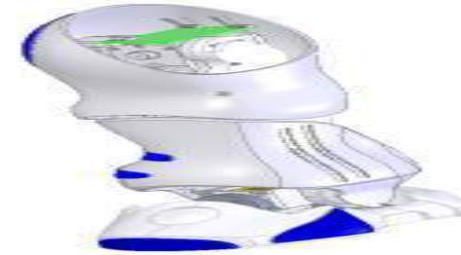
### **MULTI-USES**

Lectures assistant, Lab sessions tool, projects, etc...



- **Mechanical Engineering:**

- Solidworks files of the left arm and right leg to discover NAO's internal conception
- Explain the concept of Torque and the relationship between torque, power and energy



- **Electronics:**

- Control & Automatism using our motion APIs or Choregraphe
- Telepathe to see sensors and motors actions (current variations for instance)

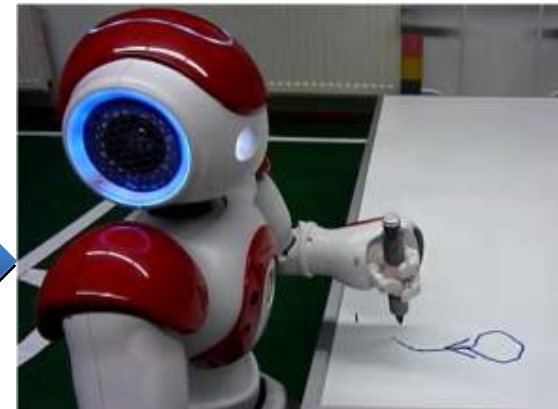
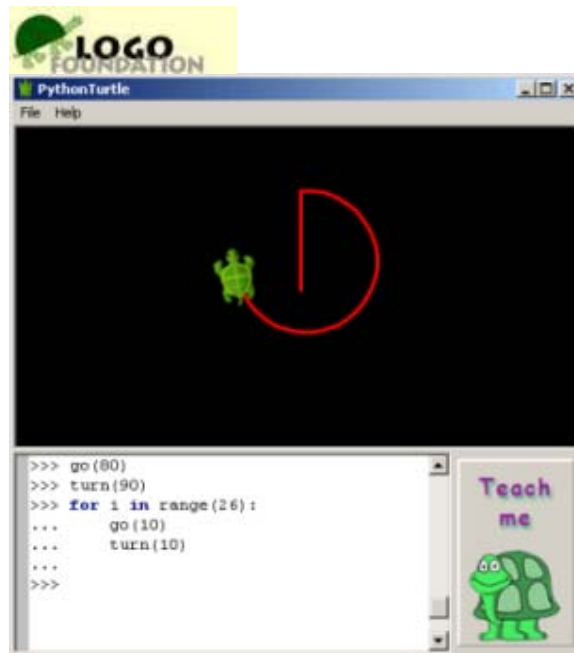
- **NAO's architecture:**

- Teach how a robot is built using NAO's example: mechanical parts, communication buses, firmware and software framework



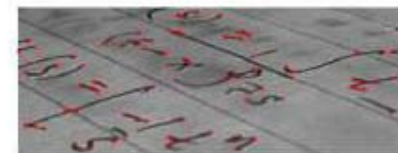
- **Programming**

- Teach basic programming principles (the NAO-turtle programming) or advanced topics (embedded, task planning and scheduling, real-time)



- **Vision & audio processing:**

- Calculate the distance of a human according the size of the face
- Create a line follower module
- Extract the BPM and make Nao dance in rhythm



- **Game theory in the fields of political science, social psychology, etc.**





- Teach various forms of strategies, equilibrium or games with NAO as the animator

- **Human-robot interaction:**

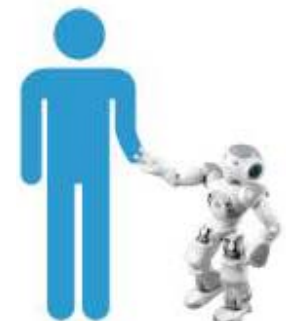
- How to express body emotions?
- How to interact with a human?
- How to teach ethics to a robot?



**Prisoners' dilemma**

		prisoner B	
		confess	remain silent
prisoner A	confess	 5 years 5 years	 0 year 20 years
	remain silent	 20 years 0 year	 1 year 1 year

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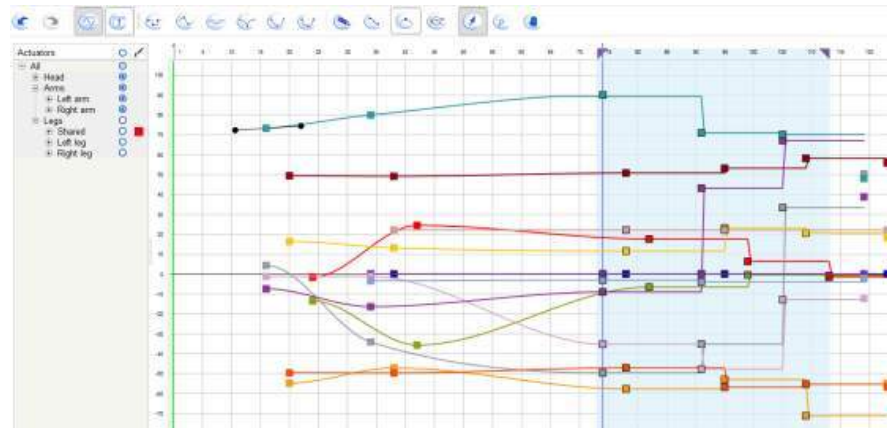


- **Basic principles of physics**

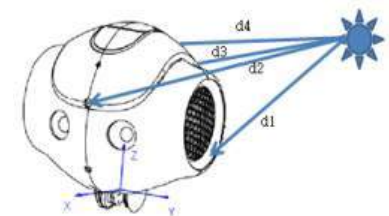
- Light spectrum: use NAO's camera to see "invisible" lights
- Waves: teach the concepts of diffraction and reflection of ultrasounds waves

- **Mathematics:**

- From trigonometry (Sound localization) to vector calculus and Jacobian matrix (joint control)
- Show interpolations in action inside Choregraphe and teach the equations behind.



- Game theory : ask your students to implement algorithms (Nash equilibrium for instance) into 2 (or more) NAOs and see the results of the different game theories





**EDUCATIONAL  
PARTNERSHIP PROGRAM  
ALDEBARAN ROBOTICS**

Aldebaran Robotics supports the Robotics education development with the creation of the Educational Partnership Program.

This program will **finance part of selected projects on a win/win basis.**



## TRAINING

Teacher Kits

2-day *training*

Step by step tutorials

Examples of class-room projects

## FINANCIAL SUPPORT

With a system of grants,  
Aldebaran Robotics helps teachers get  
what they need for their ambitious and  
innovative projects

## VISIBILITY

Become Ambassadors  
of the Robotic Educational  
Community  
Co-Marketing

## SUPPORT

Hot-line  
NAO community




**TECHNICKÁ UNIVERZITA V KOŠICIACH**


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**13. DEŇ OTVORENÝCH DVERÍ**  
 2010  
 OKTÓBER

TECHNICKÁ UNIVERZITA V KOŠICIACH

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