Humanoid Robots for Education

Rodolphe Gelin

Introducing NAO in Education

Robotics : a huge market for the 21st Century

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!

Why robots in Education?

A progressive dissatisfaction for scientist discipline

Education & Technology are challenging

Engineer Shortage

Growing Demand

EXPLORE AND ACCESS NEW FIELDS OF RESEARCH

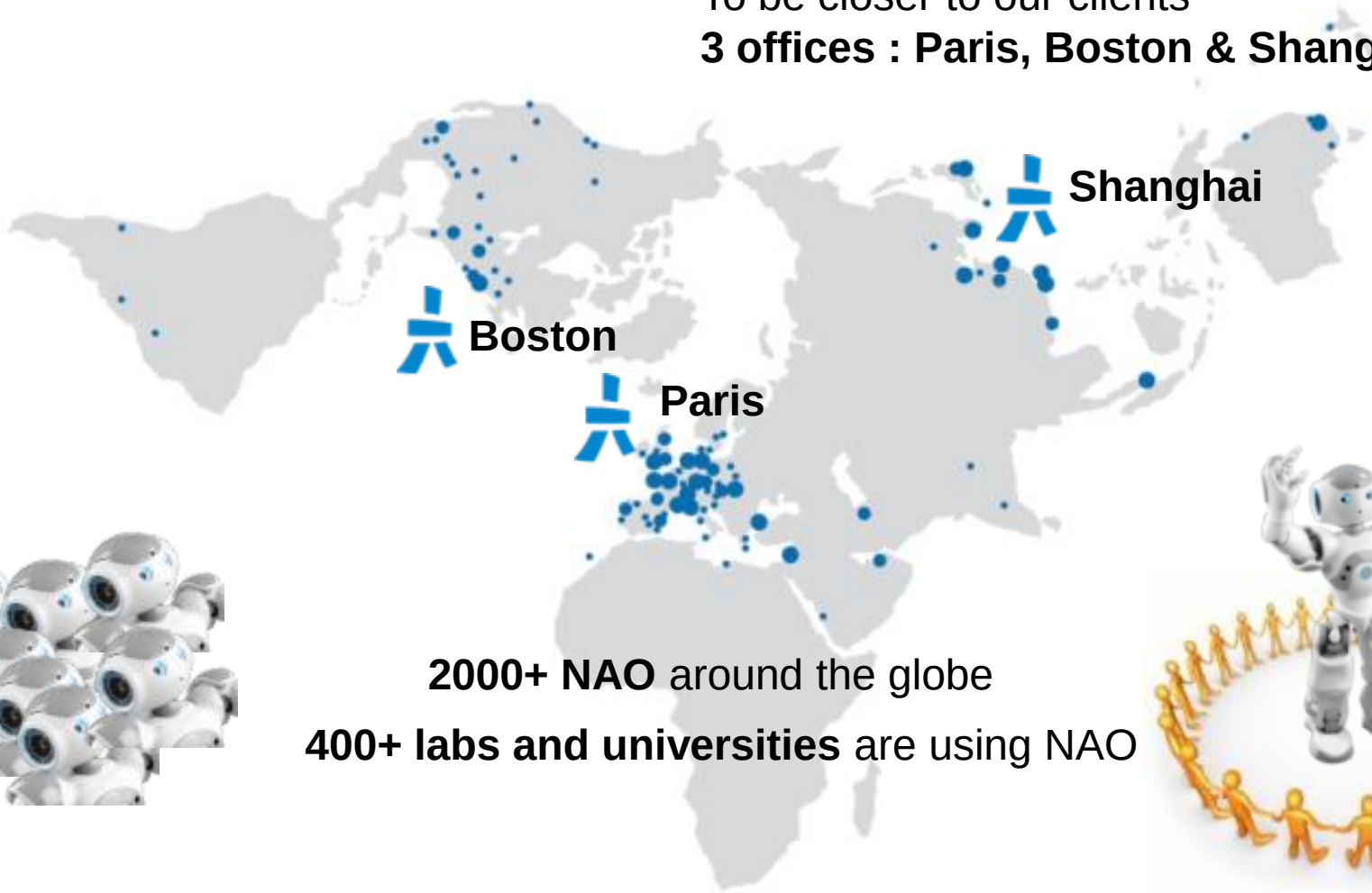
GENERATE AND TRANSMIT KNOWLEDGE

MERGE SUBJECTS

Aldebaran Robotics in a nutshell

A unique team of **130+ employees :**
Engineers, PhDs, Sales & Marketing

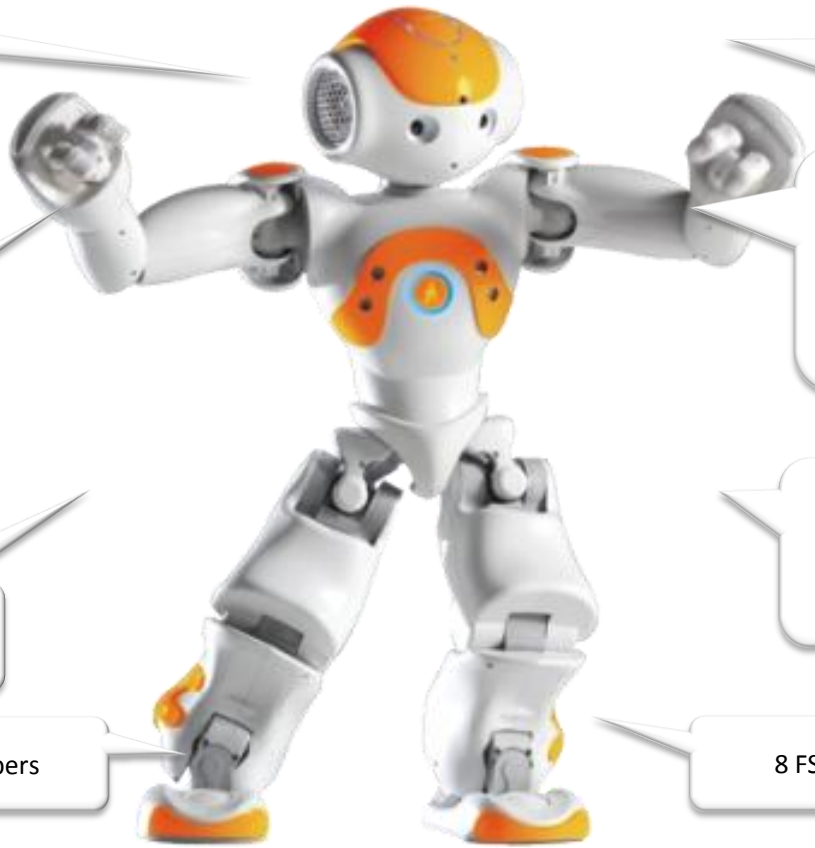
To be closer to our clients
3 offices : Paris, Boston & Shanghai



2000+ NAO around the globe

400+ labs and universities are using NAO

What is Nao ?



2 Loudspeakers
4 Microphones

Head tactile sensors

2 HD CMOS Camera
1280*960
30 FPS

Intel ATOM 1600 Mhz CPU
1GB of DDR2 RAM
2GB of SATA Flash
Minimum of 4 Go micro-SD Flash
WIFI 802.11G

25 DOF
Proprietary actuators using
25V coreless motors
dsPIC microcontrollers
Hall effect sensors: position + motorshaft.
ARM 9
Torque : 6 Nm

Prehensile hands

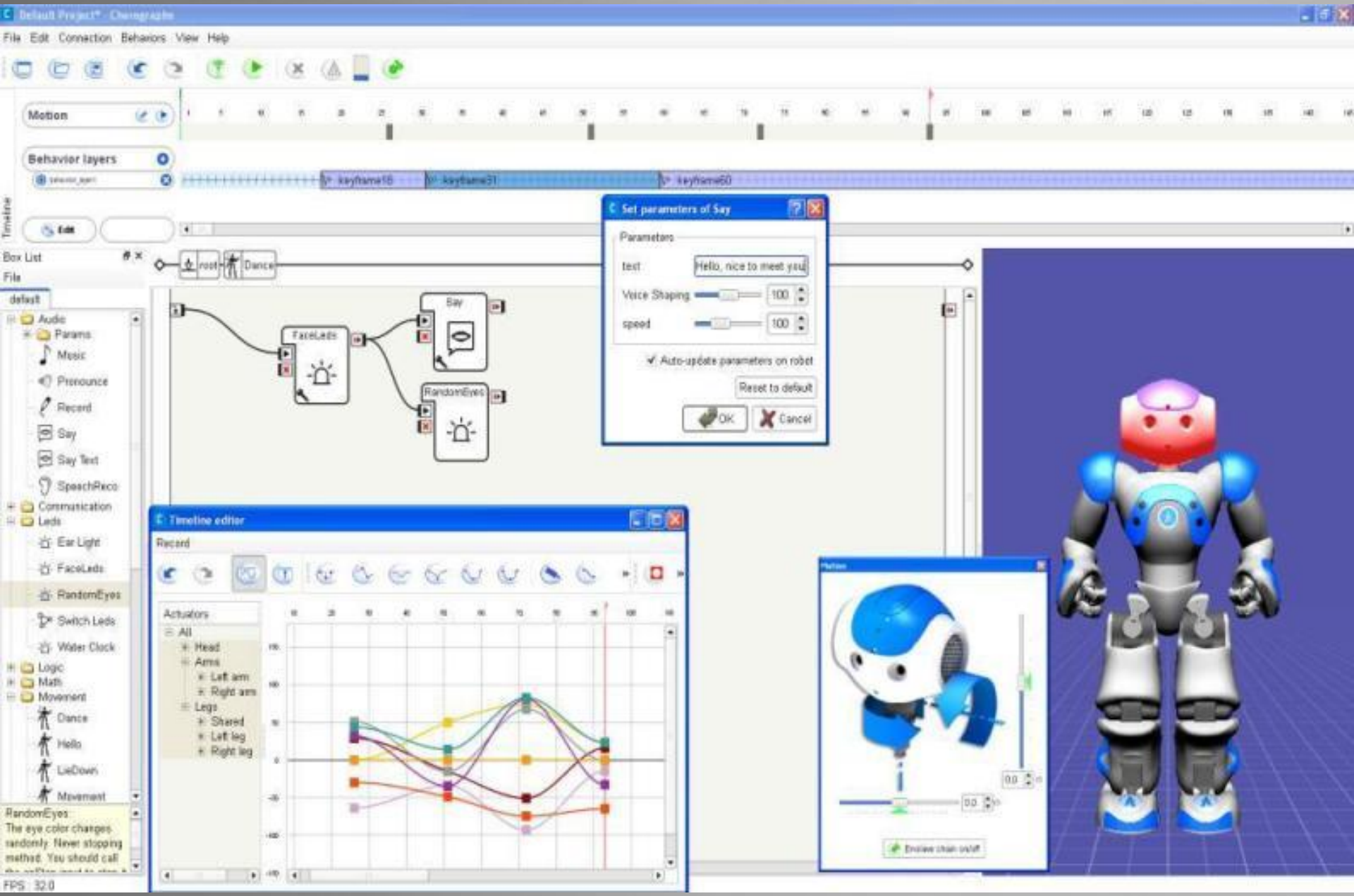
Multi sensored:
Inertial Center (2-axis Gyro, 3-axis Accelero)
Sonars

LiPo 90 min batteries

Bumpers

8 FSRs

Programming : Choregraphe



NAO in Education

PROGRAMMING	TEAM WORK		
		COMMUNICATION SKILLS	
SCIENTIFIC PROCESS	PROJECT MANAGEMENT		INTERDISPLINARY PROJECTS

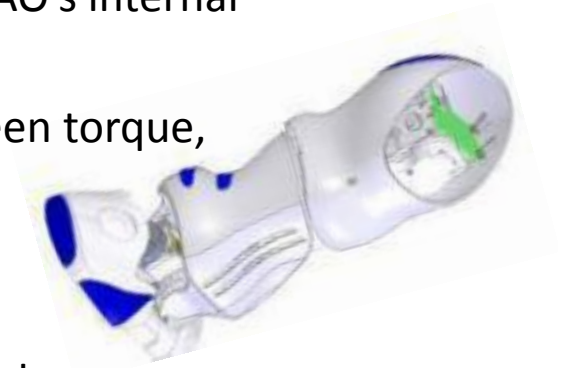
ROBOTICS PHYSICS MATHEMATICS

SCIENCE COMPUTER SCIENCE ENGINEERING

RoboCup: Sport is good for students

Engineering Education with NAO

- 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

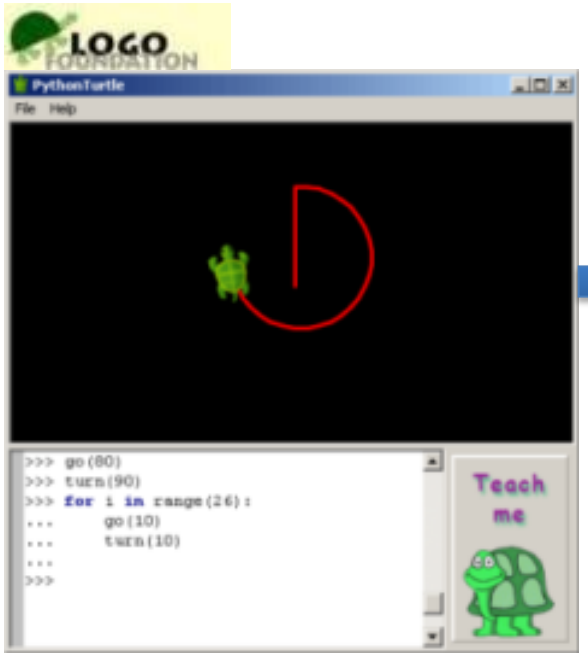


- Electronics
  - Control & Automatism using our motion APIs or Choregraphe
  - Telepathe to see sensors and motors actions (current variations for instance)

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

Computer Sciences with NAO

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

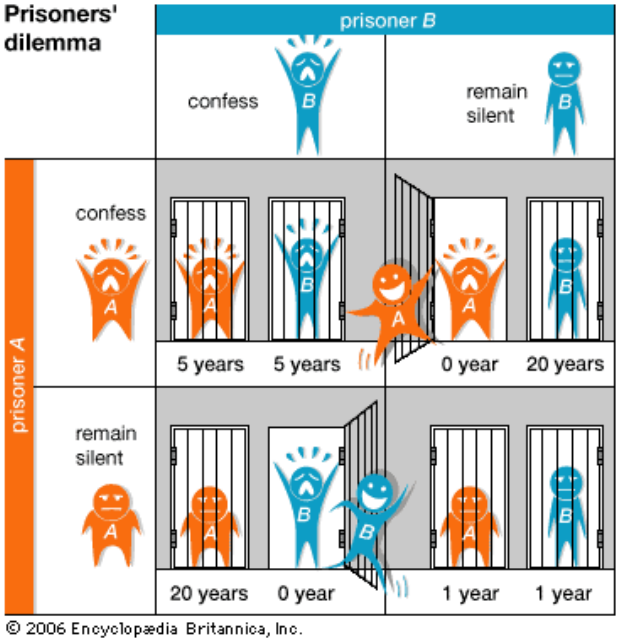


- Vision & audio processing:
  - Calculate the distance of a human according the size of the face
  - Create a line follower module
  - Extract the BPM and make Nao dance in rhythm

Social Sciences with NAO

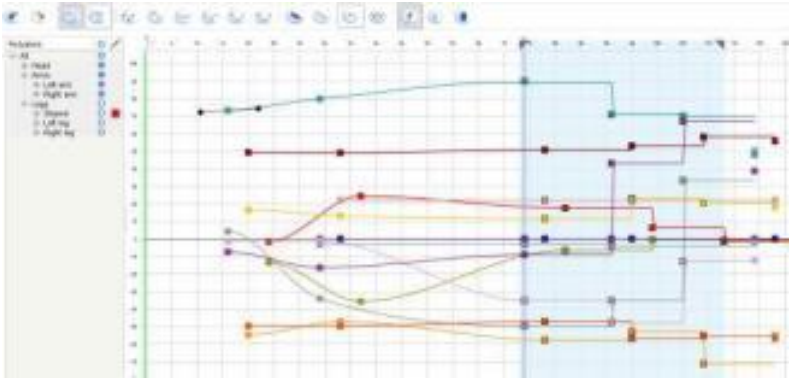
- Game theory in the fields of political science, social psychology, etc.
  - Teach various forms of strategies, equilibrium or games with NAO as the animator

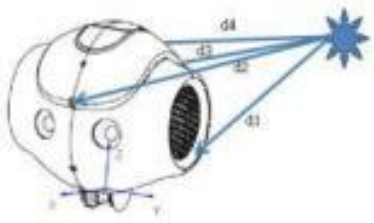
- Human-robot interaction
  - How to express body emotions?
  - How to interact with a human?
  - How to teach ethics to a robot?



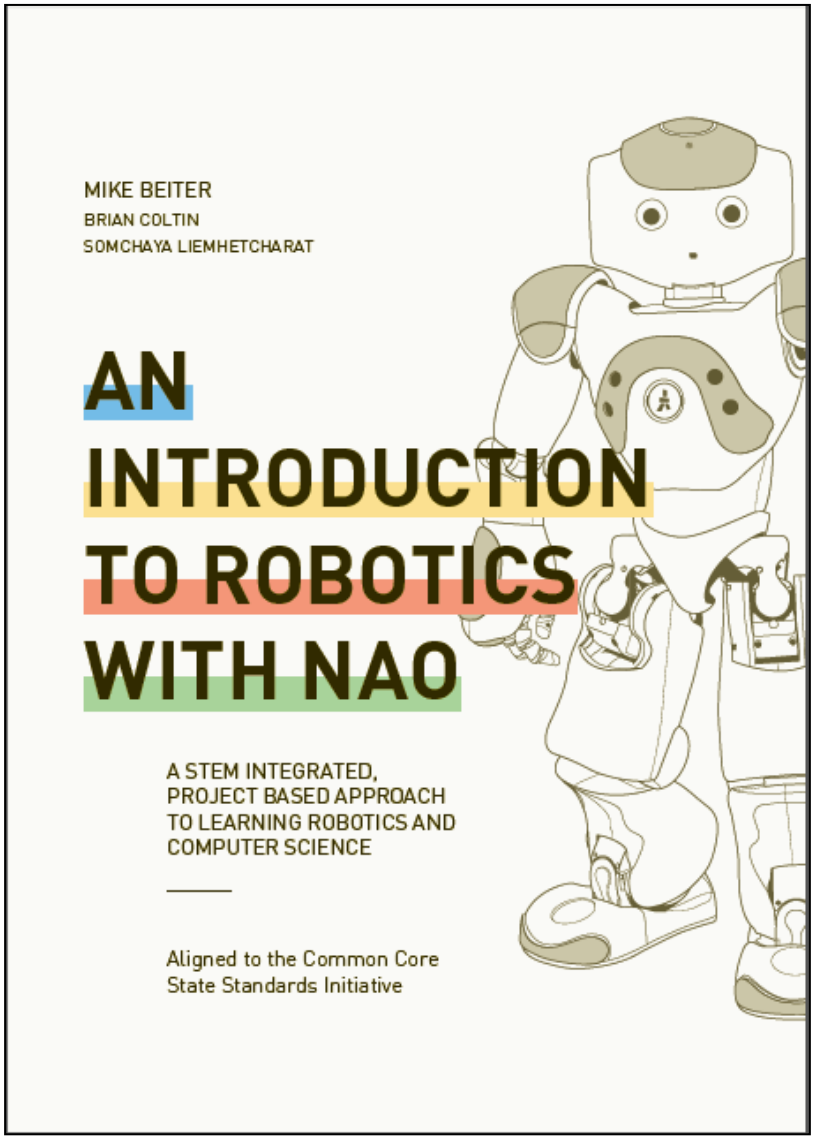
Sciences Education with NAO

- 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
  - 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





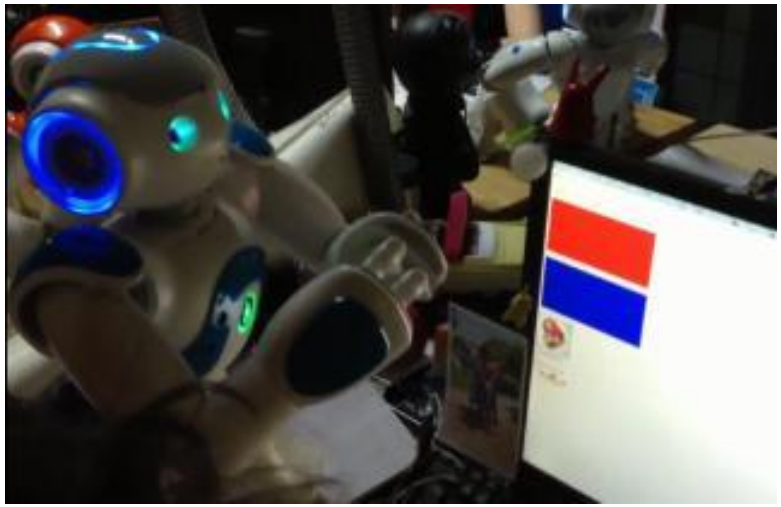
Aldebaran proposes a complete curriculum



Education at Home : the RASPO project

- Collaboration
  - Paraschool : Educative Software on PC
  - Lutin Lab : evaluation of pedagogical impact
  - Funded by DGCIS (French Government)
- Serious Gaming for education of children
  - Robot for Personnal Scholar support
  - Communication via projected pictures
  - Manipulation of pedagogical objects
- Example of exercises
  - Nao gives the change
  - Computation of double and half of numbers
  - Spelling of words
- Principle
  - The robot comes from another planet
  - The child teaches him how things are working on earth

RASPO : First results



- Projection and interaction on Pictures
- First idea : embedded projector on Nao
  - Complex mechatronic integration
  - Low quality of projected picture
  - Problem with focus and shape
  - Vision processing required for interaction
- Second idea : use of a remote display (PC or, even better, tablet)
  - The robot creates a Web page displayed by the tablet
  - No mechatronic integration
  - High quality display
  - Intuitive interaction with the display
  - To be done : Nao watches the display

Humanoid Robots for Education

- Robots are great for teaching
  - Software
  - Signal processing
  - Control
  - Mathematics
  - Physics

© HumaRobotics

- Humanoids are even greater
  - More Fun
  - Man Machine Interaction
  - More intuitive understanding of abstract concepts
  - Education becomes edutainment