Motion Planning for Humanoid Robots: Feedback from HRP2-14 Platform

Jean-Paul Laumond

LAAS-CNRS

INSTITUT CARNOT LAAS CNRS

Motion planning for industrial robots

1- Motion planning for humanoid robots

2- What place for humanoid robots in industry?

1- Motion planning for humanoid robots

- A testimony from LAAS

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A question asked by K. Yokoi and E. Yoshida (AIST) at IEEE IROS 2004 in Sendai:
« Are motion planning algorithms developed at LAAS for digital mannikins applicable to humanoid robots? »

- A testimony from LAAS

The challenge of the gravity

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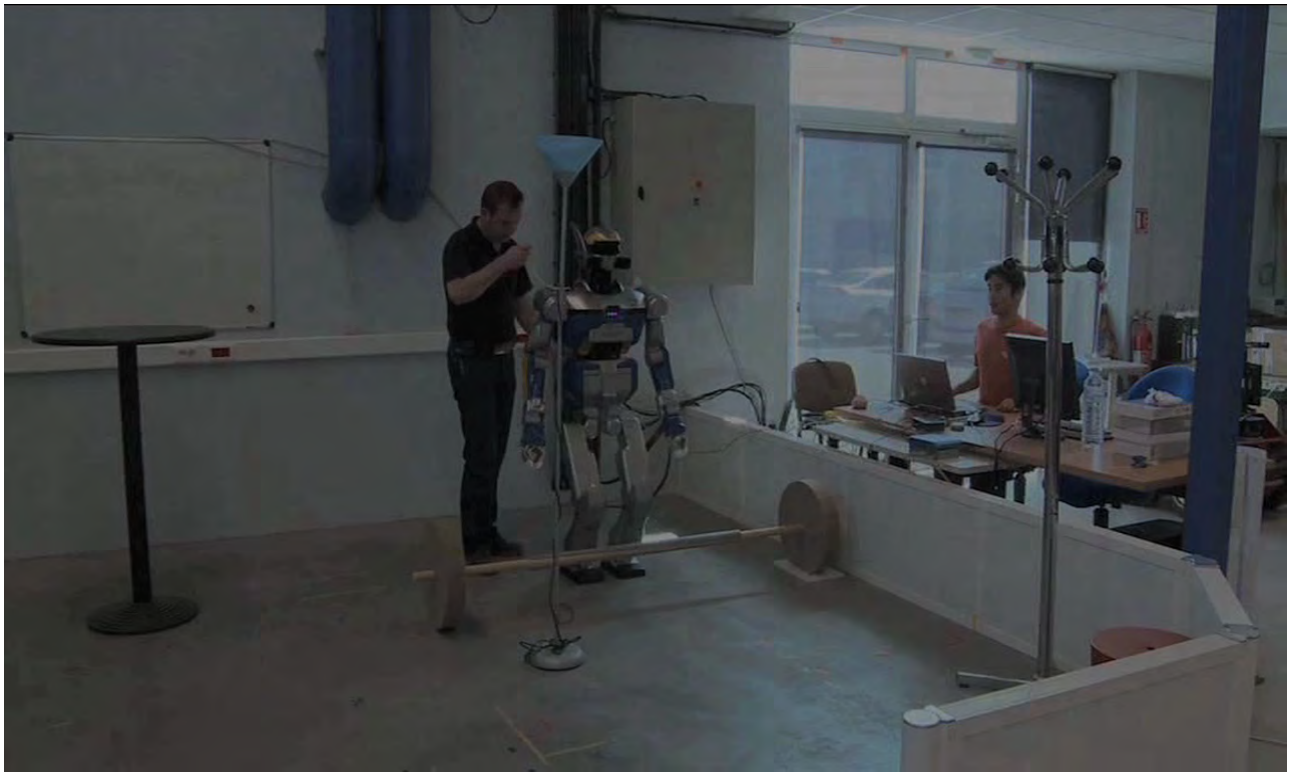
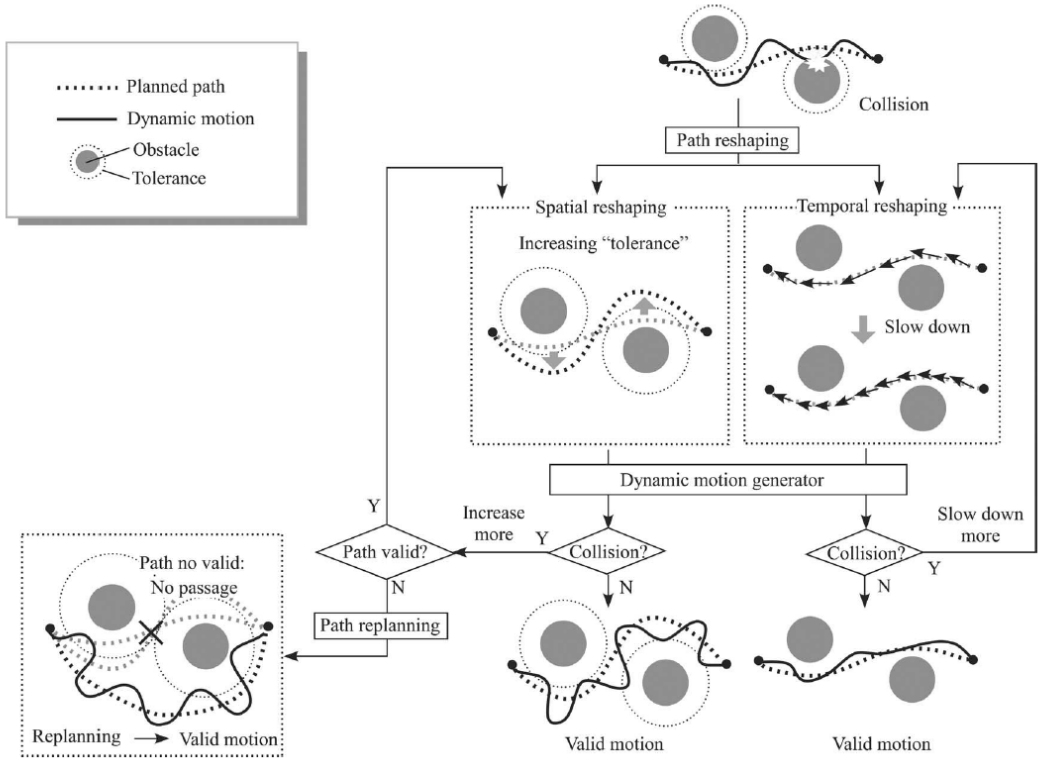


2007: First results

E. Yoshida, C. Esteves, I. Belousov, J. P. Laumond, T. Sakaguchi, K. Yokoi, IEEE Transactions on Robotics, Vol. 24, N°5, 2008.

A testimony from LAAS



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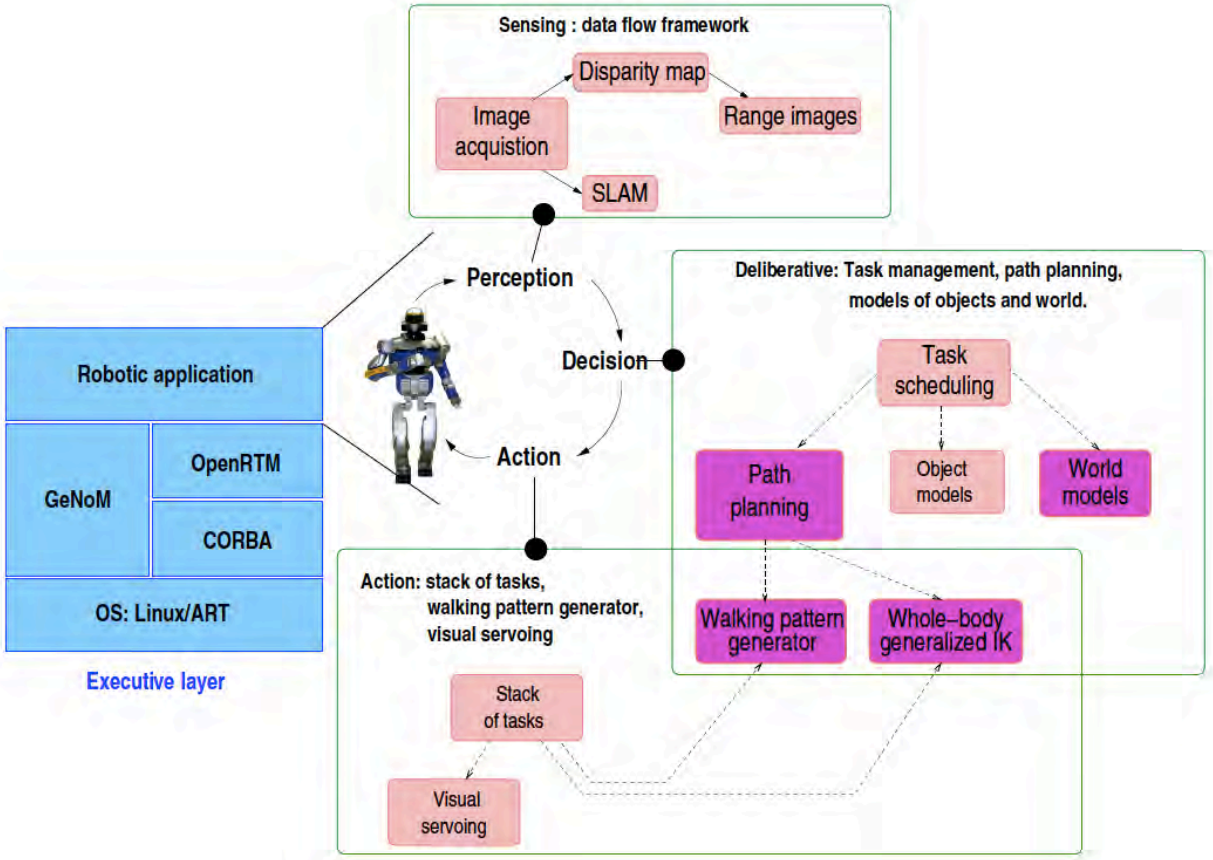
HPP: Humanoid Path Planner



F. Lamiraux , O. Stasse, A. Mallet, E. Yoshida, F. Kanehiro and J.-P. Laumond
Unpublished Rejected Paper, 2008.

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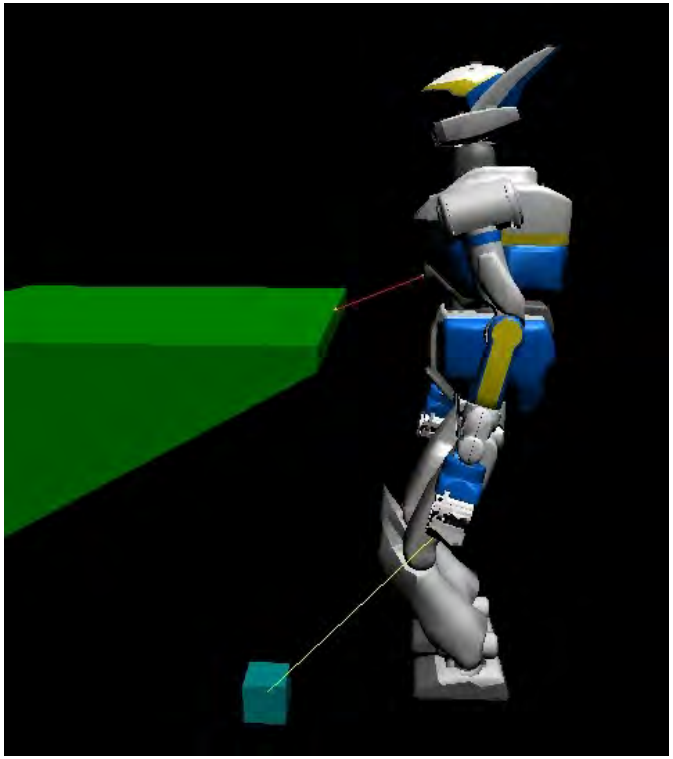
- The challenge of embodied action



Generalized Inverse Kinematics

F. Kanehiro, F. Lamiraux, O. Kanoun, E. Yoshida, J.P. Laumond, Robotics : Science and Systems, 2008.

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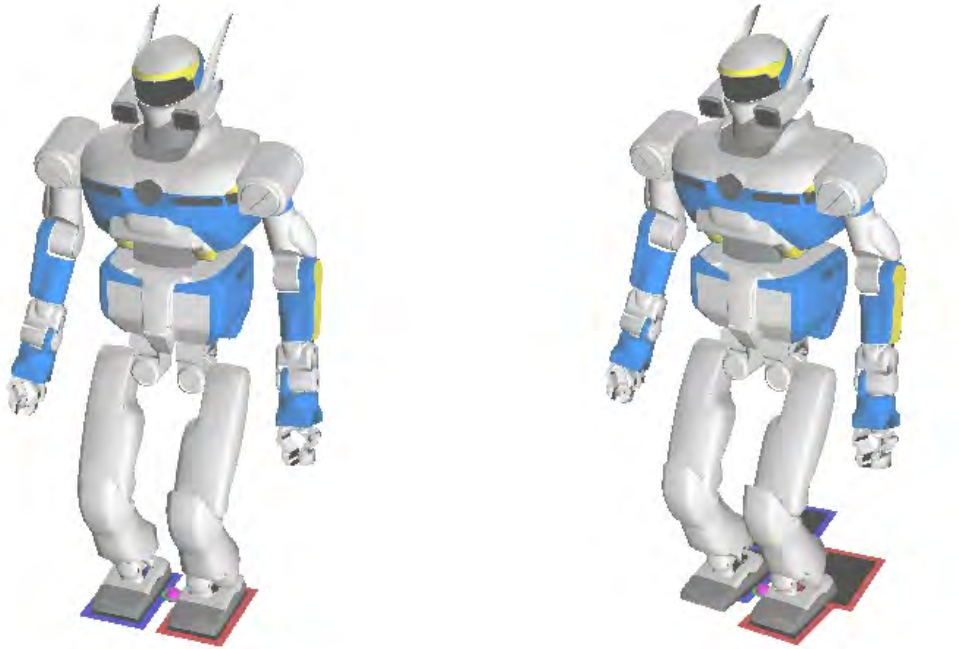

2009: HRP-2 grasps an object on the floor without stepping dedicated program

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International Journal of Robotics Research, Vol. 30, N°4, 2011.

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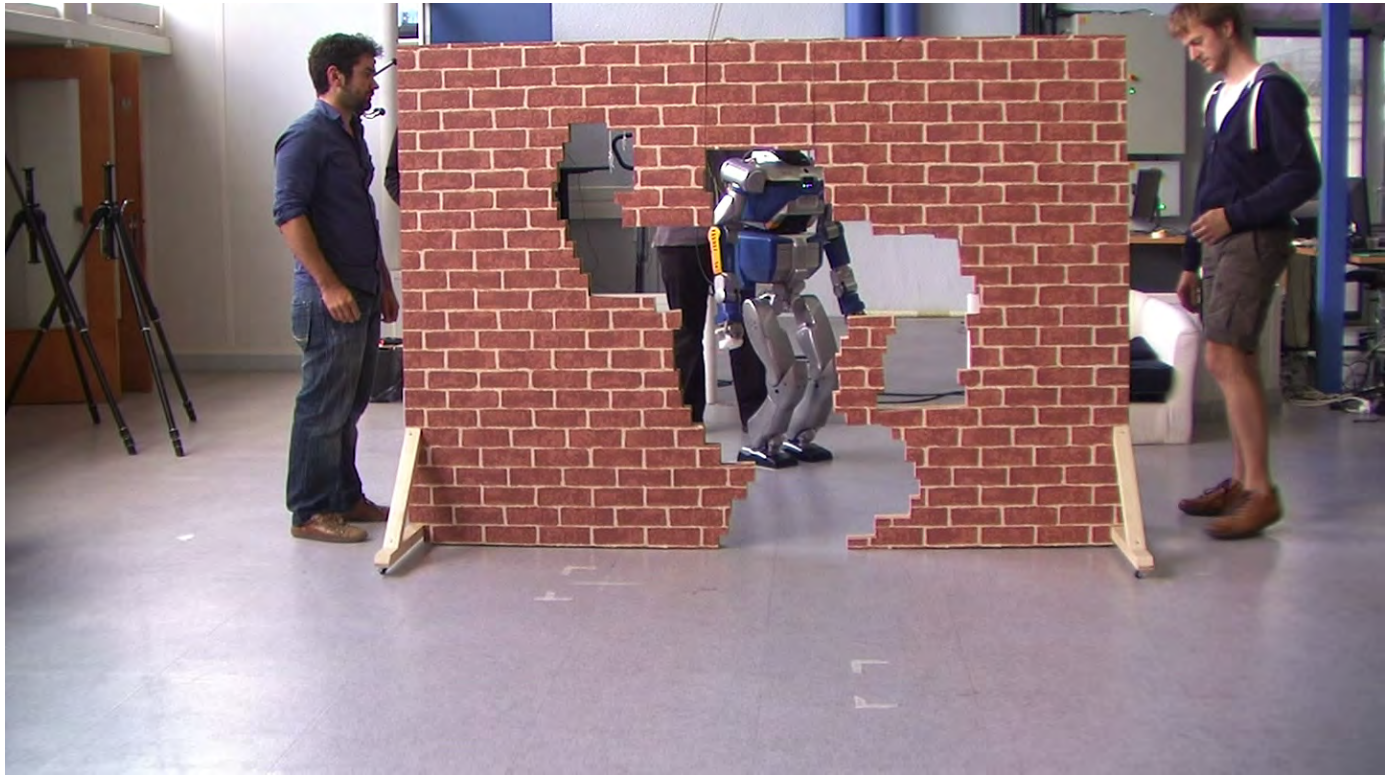
- Humanoids are small-space controllable



2012: HRP-2 goes through the wall!

S. Dalibard, A. El Khoury, F. Lamiraux, A. Nakhaei, M. Taix, J.P. Laumond, International Journal of Robotics Research, Vol. 32, N°9-10, 2013.

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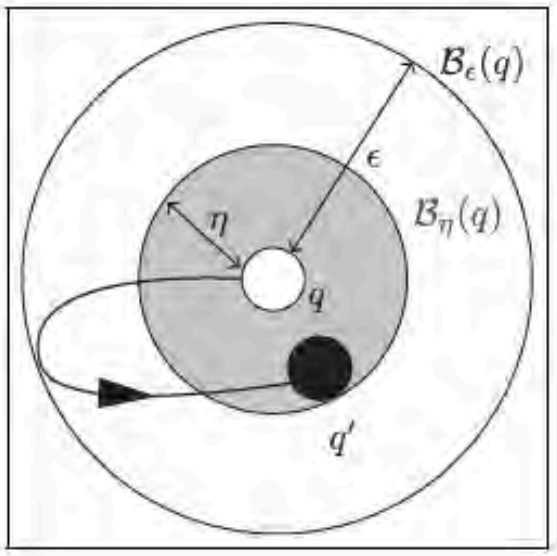

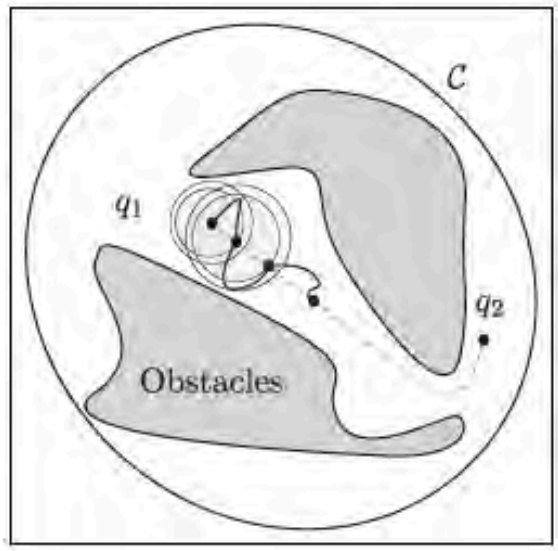

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2- What place for humanoid robots in industry?

- Robotics: a success story in manufacturing

Ford Factory, 1913

Ford, 2006 Factory

KUKA

ABB

FANUC

- Manufacturing remains a market for robotics

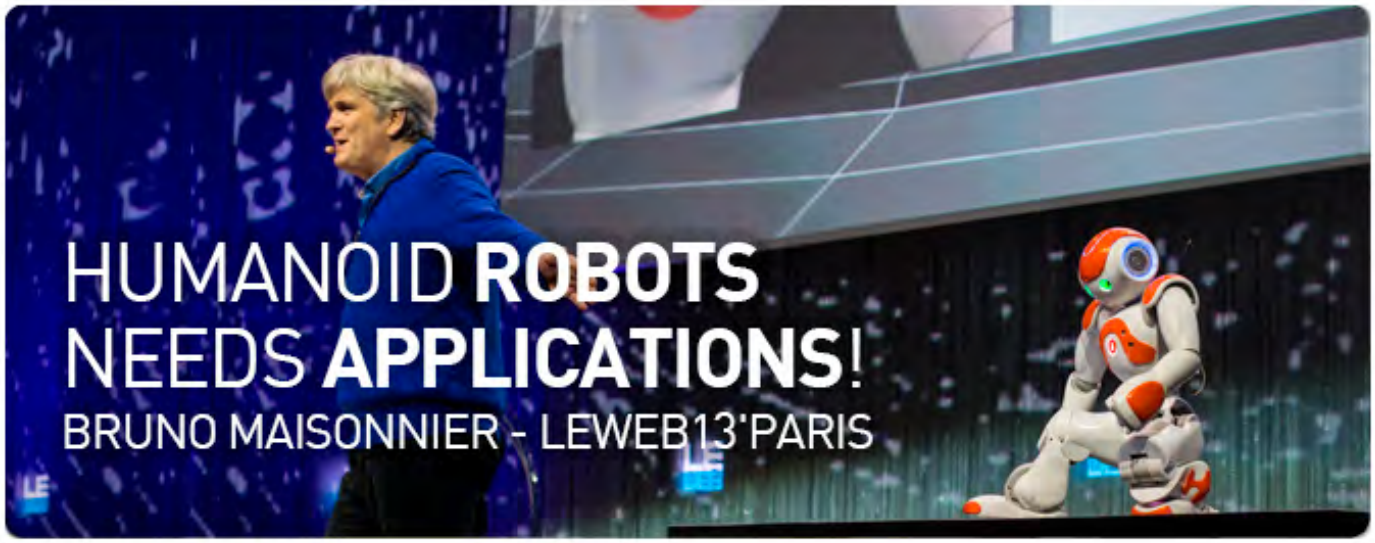
© Andreas Gurski

Servicing, Manufacturing, Extreme worlds

- Mobility and Servicing

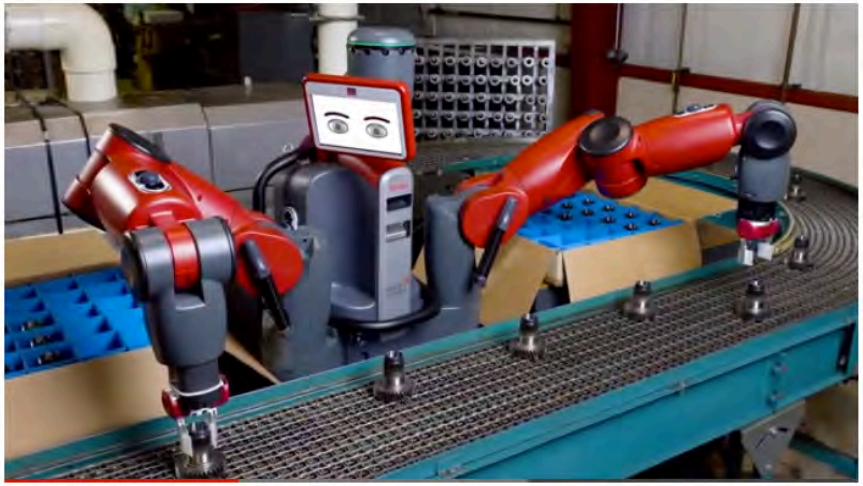
Toyota vision

- Entertainment, Servicing, Education



Aldebaran vision: Nao, Romeo

- Manufacturing



Rethink vision: Baxter

- Manufacturing

Kawada vision: Nextage

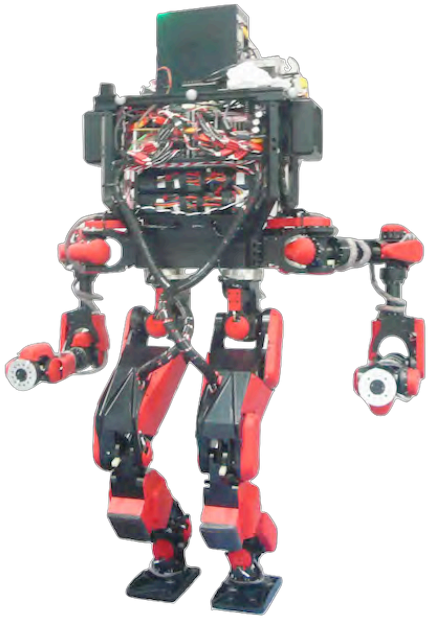
- Manufacturing

K. Harada, T. Tsuji, J.P. Laumond,
IEEE ICRA 2014.

- Extreme worlds

DARPA Grand Challenge

- Extreme robots for extreme worlds



Schaft (Google)

Atlas (Google)

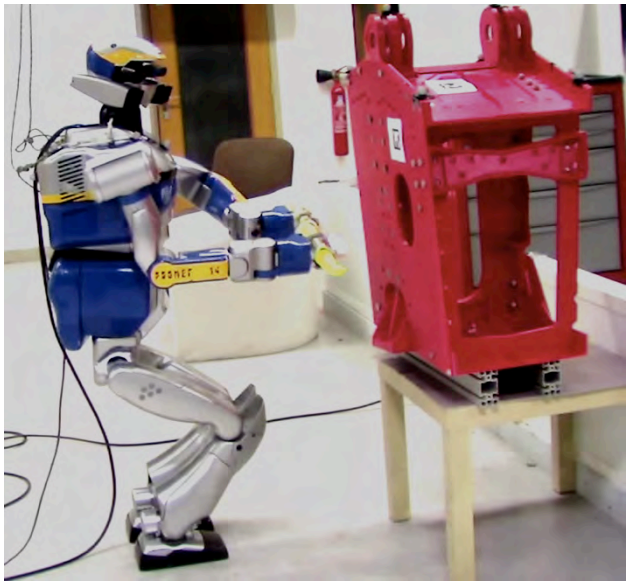
Chimp (CMU)

- Large scale manufacturing?

Airbus A380, © Bloomberg

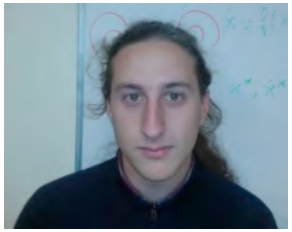
Large-Scale Manufacturing

- ✓ Adaptability
- ✓ Reactiveness
- ✓ Accuracy
- ✓ Whole-body action



2014 – Proof of concept: early stage

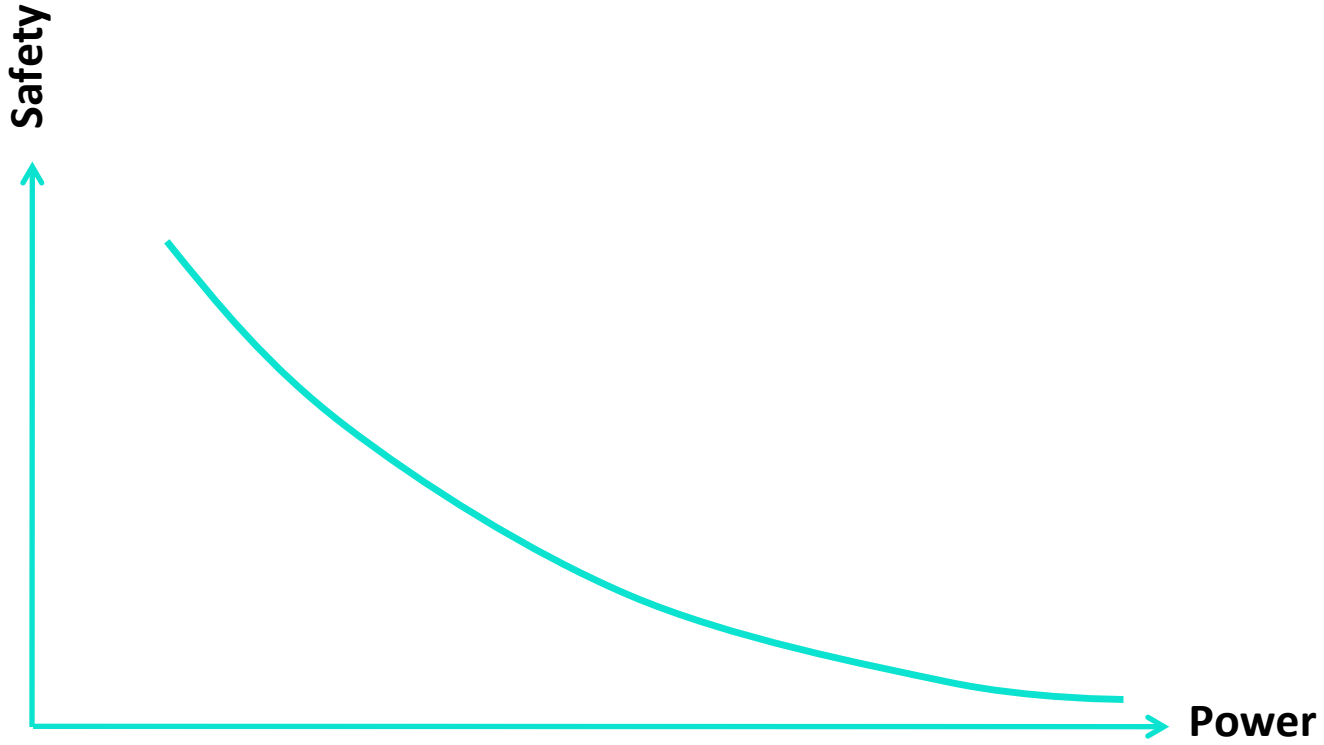
LAAS-CNRS AIRBUS



Towards new platforms

- ✓ Adaptability
- ✓ Reactiveness
- ✓ Accuracy
- ✓ Whole-body action

- ➢ Safety
- ➢ Power



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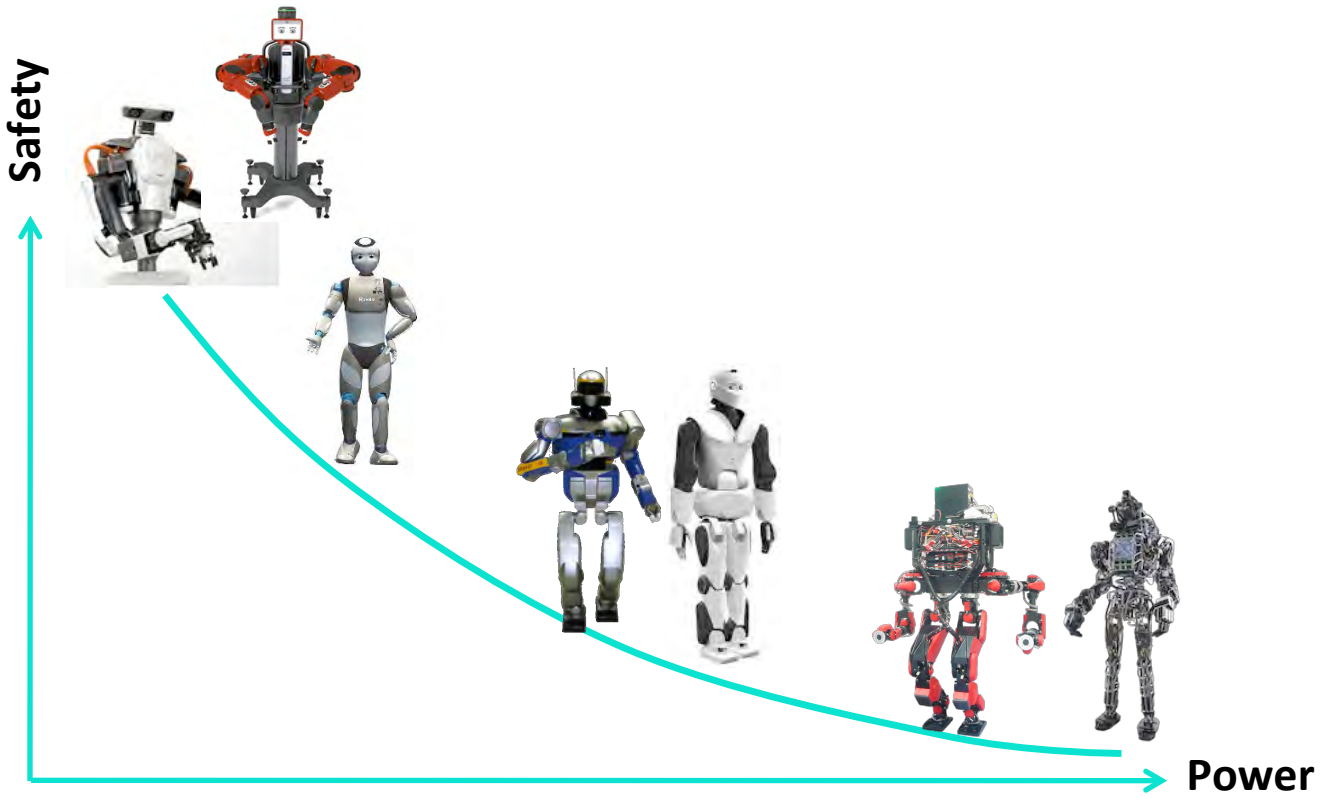

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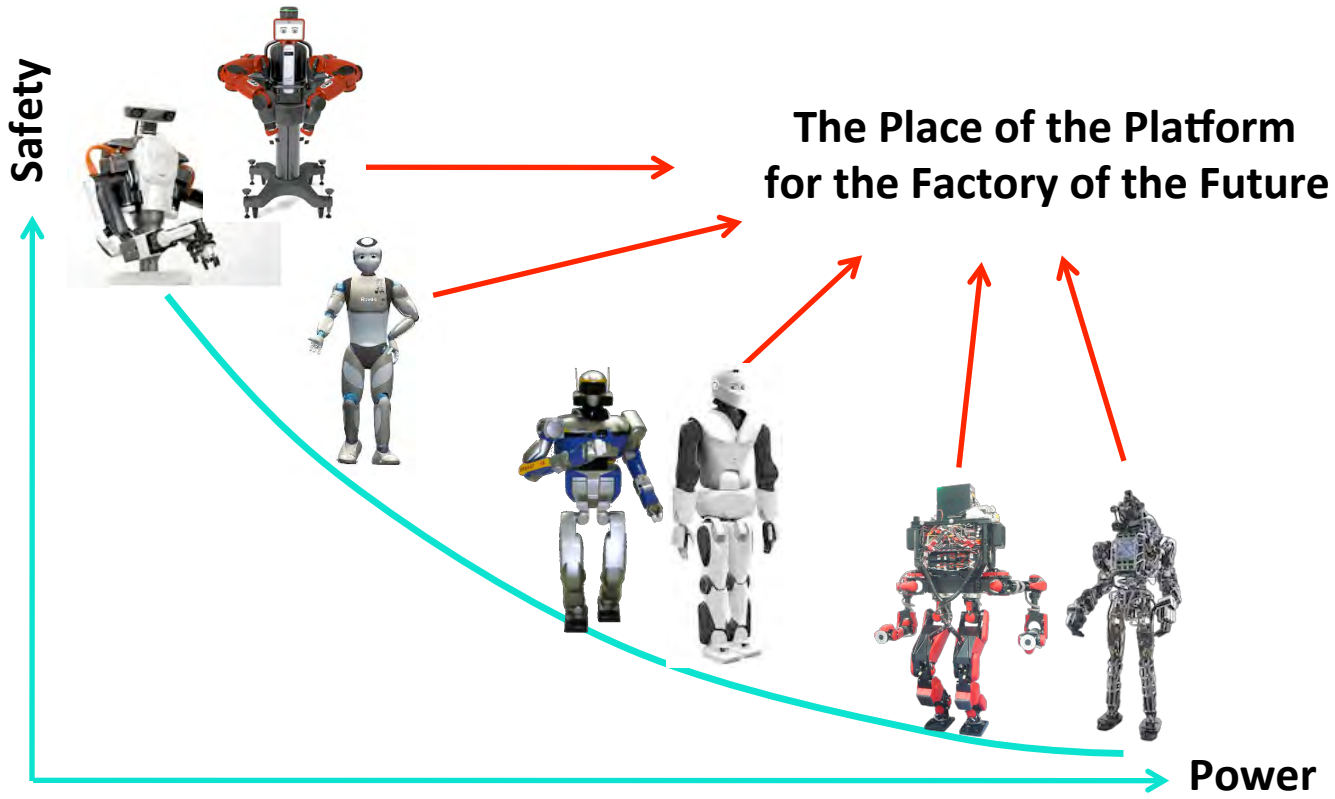

Develop a Humanoid Robot Industry

- ✓ Adaptability
- ✓ Reactiveness
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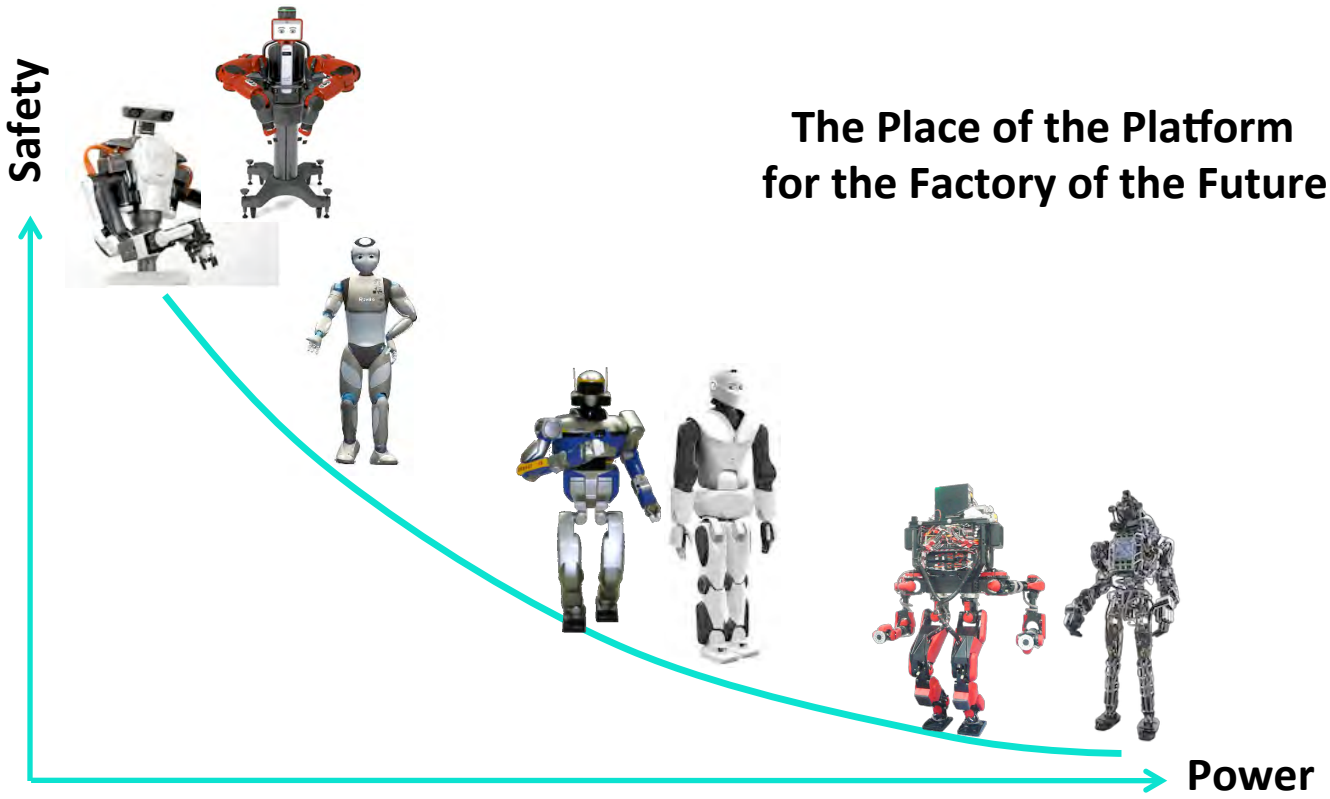
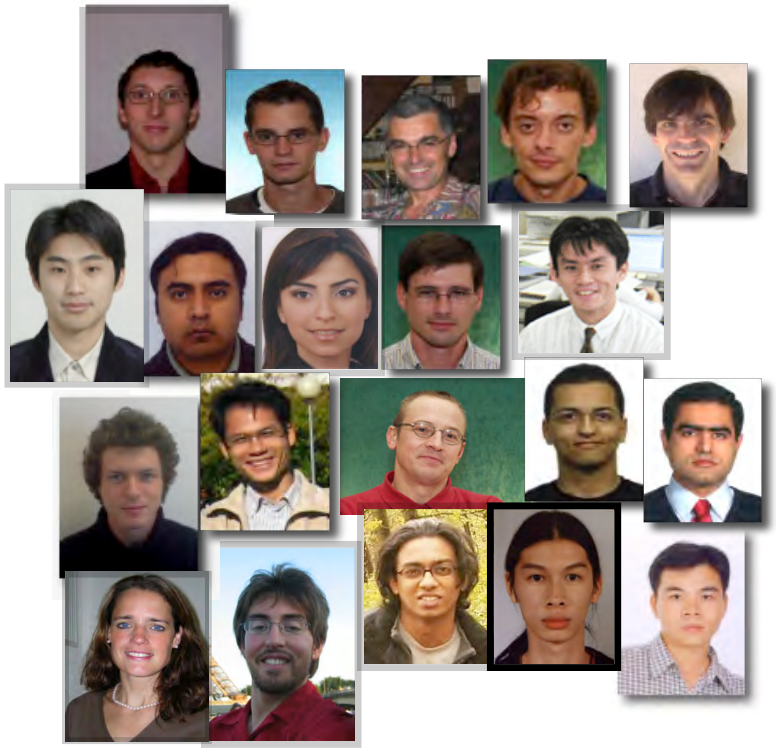
- ➢ Power



Thank you



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Equipe Gepetto (2010)

AIST cnrs

Joint Robotics Lab

- Thank you for your attention