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

Jean-Paul Laumond
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
Motion Planning for Humanoid Robots

A testimony from LAAS
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 manikins applicable to humanoid robots? »
Motion Planning for Humanoid Robots

A testimony from LAAS

The challenge of the gravity

A question asked by K. Yokoi and E. Yoshida (AIST) at IEEE IROS 2004 in Sendai:
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A testimony from LAAS

2007: First results

E. Yoshida, C. Esteves, I. Belousov, J. P. Laumond, T. Sakaguchi, K. Yokoi,
A testimony from LAAS

2007: First results

E. Yoshida, C. Esteves, I. Belousov, J. P. Laumond, T. Sakaguchi, K. Yokoi,
HPP: Humanoid Path Planner

Motion Planning for Humanoid Robots

HPP: Humanoid Path Planner

Give him the Purple Ball
Joint French-Japanese Robotics Laboratory
JRL

E. Yoshida, A. Mallet, F. Lamiraux, O. Kanoun,
O. Stasse, M. Poirier, P-F. Dominey, J-P. Laumond, K. Yokoi

The challenge of embodied action

Generalized Inverse Kinematics

F. Kanehiro, F. Lamiraux, O. Kanoun, E. Yoshida, J.P. Laumond,
The challenge of embodied action

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

O. Kanoun, J.P. Laumond, E. Yoshida,
The challenge of embodied action

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

O. Kanoun, J.P. Laumond, E. Yoshida,
Humanoids are small-space controllable

2012: HRP-2 goes through the wall!

S. Dalibard, A. El Khoury, F. Lamiraux, A. Nakhai, M. Taix, J.P. Laumond,
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,
2- What place for humanoid robots in industry?
Robotics: a success story in manufacturing
• Manufacturing remains a market for robotics
Humanoid Robotics: which place?

Servicing, Manufacturing, Extreme worlds
Humanoid Robotics: which place?

- Mobility and Servicing

Toyota vision
Humanoid Robotics: which place?

- Entertainment, Servicing, Education

Aldebaran vision: Nao, Romeo
Humanoid Robotics: which place?

- Manufacturing

Rethink vision: Baxter
Humanoid Robotics: which place?

- Manufacturing

Kawada vision: Nextage
Humanoid Robotics: which place?

- Manufacturing

Humanoid Robotics: which place?

- Extreme worlds

DARPA Grand Challenge
Humanoid Robotics: which place?

- Extreme robots for extreme worlds

Schaft (Google)  
Atlas (Google)  
Chimp (CMU)
Humanoid Robotics: which place?

- Large scale manufacturing?

Airbus A380, © Bloomberg
Humanoid Robotics: New Opportunities

- Large-Scale Manufacturing

- Adaptability
- Reactiveness
- Accuracy
- Whole-body action

2014 – Proof of concept: early stage
Humanoids for Large-Scale Manufacturing

Towards new platforms

- Adaptability
- Reactiveness
- Accuracy
- Whole-body action
- Safety
- Power
Towards new platforms

✓ Adaptability
✓ Reactiveness
✓ Accuracy
✓ Whole-body action

Safety

Power
Humanoids for Large-Scale Manufacturing

Towards new platforms

- Adaptability
- Reactiveness
- Accuracy
- Whole-body action
- Safety
- Power

The Place of the Platform for the Factory of the Future

J. P. Laumond

IEEE ICRA

Hong Kong, June 2014
Humanoids for Large-Scale Manufacturing

Develop a Humanoid Robot Industry

- Adaptability
- Reactiveness
- Accuracy
- Whole-body action

The Place of the Platform for the Factory of the Future

Kawada, Honda, Pal Robotics, Aldebaran, Rethink, Google ...

J.P. Laumond, IEEE ICRA, Hong Kong, June 2014
Thank you

Equipe Gepetto (2010)
Thank you for your attention