Researches awarded by RSJ (1)

- RSJ Paper Award 2006

Power assist method based on Phase Sequence and muscle force condition for HAL
Hiroaki Kawamoto and Yoshiyuki Sankai (University of Tsukuba)
(Advanced Robotics Vol.19, No.7, pp.717-734)
Study on 3D Active Cord Mechanism with Helical Rotational Motion
Toshio Takayama and Shigeo Hirose (Tokyo Institute of Technology)
(Journal of RSJ Vol.22, No.5, pp.625-635, 2004)
Load-Sensitive Continuously Variable Transmission for Robot Hands
Takeshi Takaki and Toru Omata (Tokyo Institute of Technology)
(Journal of RSJ Vol.23, No.2, pp.238-244, 2005)
Dynamic Roll-and-Rise Motion by an Adult-Size Humanoid Robot
Yasuo Kuniyoshi *1, Yoshiyuki Ohmura *1, Koji Terada *1 and Akihiko Nagakubo *2 (*1 The University of Tokyo, *2 AIST)
(Journal of RSJ Vol.23, No.6, pp.66-77,2005)

Researches awarded by RSJ (2)

- RSJ Paper Award 2007

Natural resolution of ill-posedness of inverse kinematics for redundant robots: a challenge to Bernstein's degrees-of-freedom problem
Suguru Arimoto, Masahiro Sekimoto, Hiroe Hashiguchi and Ryuta Ozawa (Ritsumeikan University et al.)
(Advanced Robotics, Vol.19, No.4, pp.401-434)

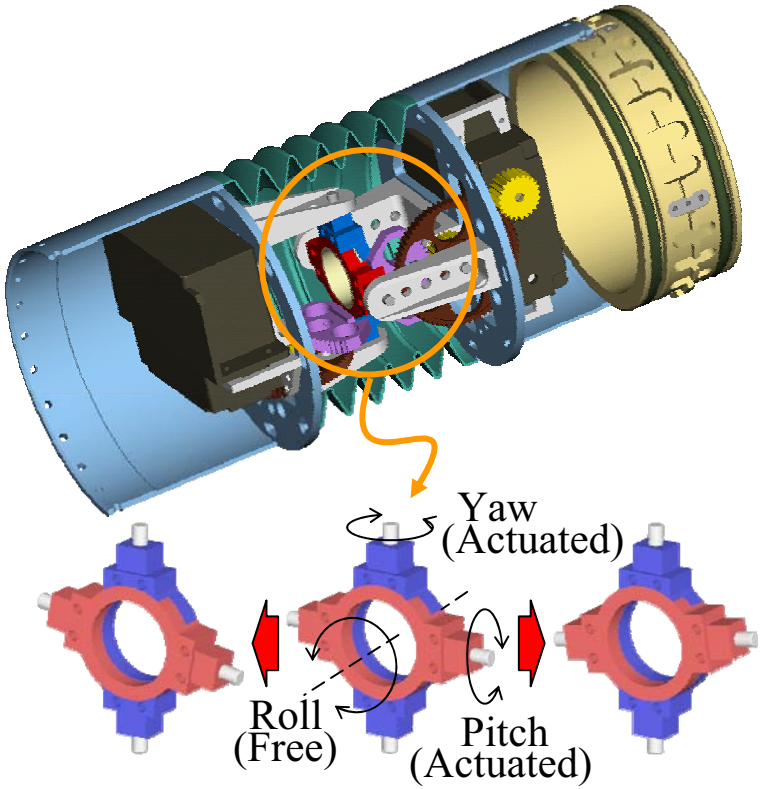
Slip-compensated path following for planetary exploration rovers
Daniel M. Helmick, Stergios I. Roumeliotis, Yang Cheng, Daniel S. Clouse, Max Bajracharya and Larry H. Matthies (Jet Propulsion Laboratory et al.)
（Advanced Robotics, Vol.20, No.11, pp.1257-1280）

Whole-body Cooperative Reaction Force Manipulation on Legged Robots with COG Jacobian involving Implicit Representation of Unactuated Coordinates
Tomomichi Sugihara and Yoshihiko Nakamura (The University of Tokyo et al.)
（Journal RSJ Vol.24,No2, pp.222-231）

Non-contact Stiffness Imager
Tomohiro Kawahara, Satoshi Matsunaga, Shinji Tanaka and Makoto Kaneko (Hiroshima University et al.)
(Journal of RSJ Vol.23, No.6, pp.66-77,2005)

Study on 3D Active Cord Mechanism with Helical Rotational Motion

Toshio Takayama and Shigeo Hirose, Tokyo Institute of Technology



This study proposes a new kind of propulsion principle for the under water 3D Active Cord Mechanism named “Helical Distortion Propulsion”, in which each articulated body segment creates distortion motion, while keeping the whole body in a helical shape, and progress along the center axis of the helices. Furthermore, to realize the constant velocity distortion motion through the whole body, a special small and hermetic 2 DOF joint is developed.

Load Sensitive Continuously Variable Transmission for Robot Hands

Takeshi kaki and Toru Omata (Tokyo Institute of Technology)

- To improve the performances of robot hands, this paper focuses on power transmission rather than actuators.
- The five-linkage CVT in Fig. 1 can remarkably improve the performance of a robot finger as shown in Fig. 2.
- The recent finger in Fig. 3 which weighs only 100g can lift a 10kg object.

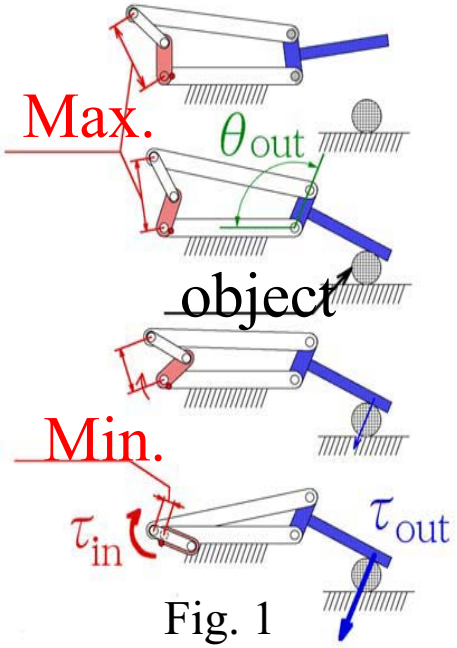


Fig. 1

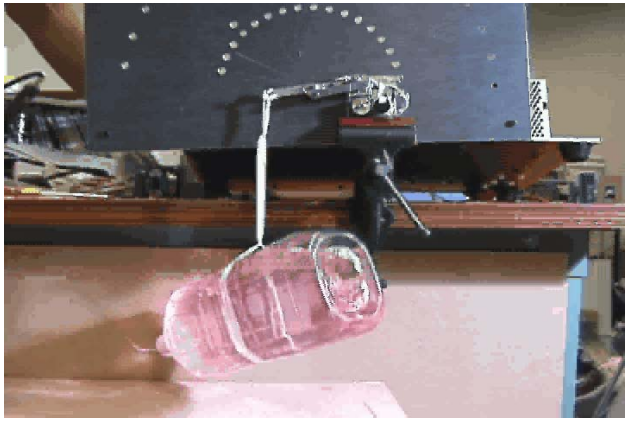


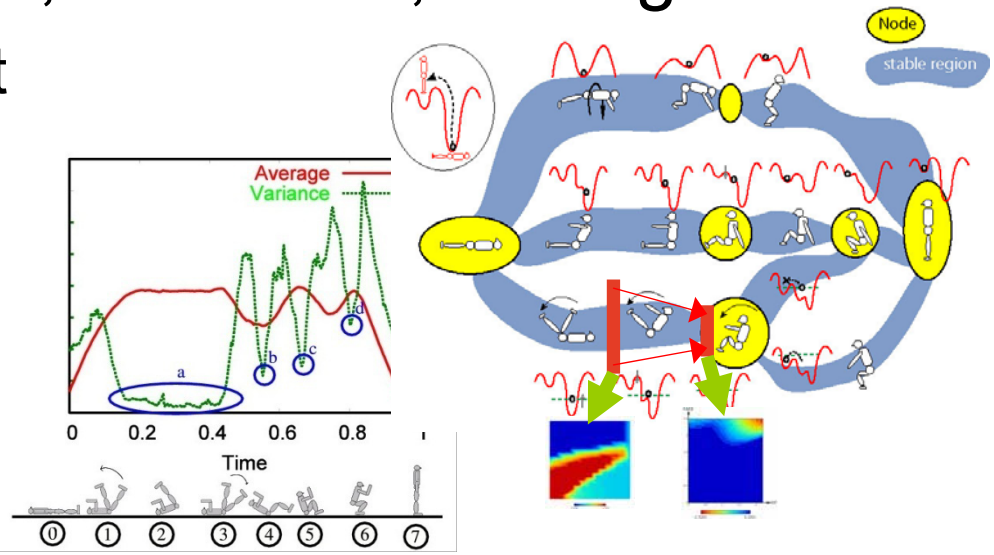
Fig. 2

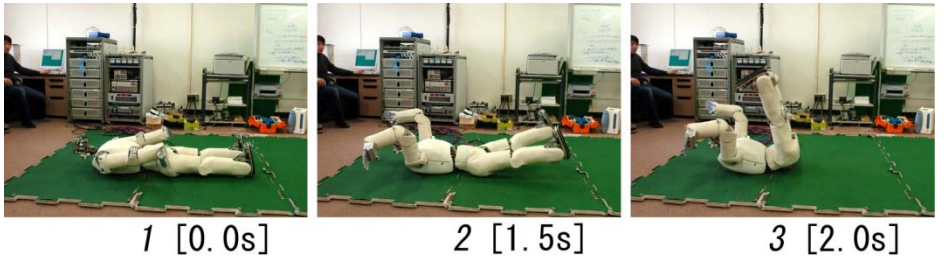
Fig. 3

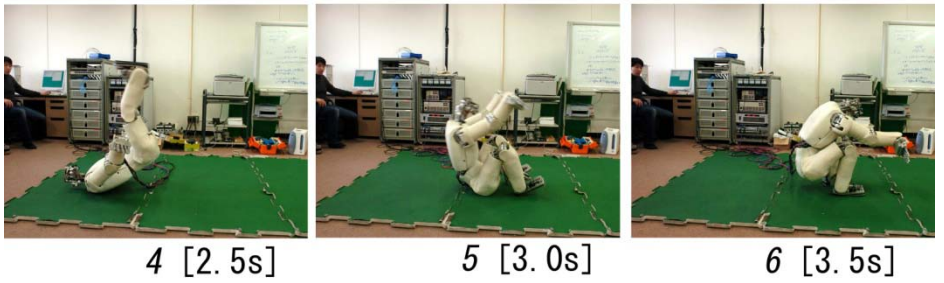
Dynamic Roll-And-Rise Motion By An Adult-Size Humanoid Robot

Y. Kuniyoshi, Y. Ohmura, K. Terada, A. Nagakubo

- Novel control strategy for fast and dexterous whole body motion.
- Exploit & “surf” on body-environment interaction to reach the goal state.
  - Exploit gravity/inertia, impulse force, switching dynamics.
- Human strategy analyzed, modeled, and realized on an adult-size humanoid robot.
  - “Knacks”:Important states. Confirmed by analysis and robot experiments.







Natural resolution of ill-posedness of inverse kinematics for redundant robots: a challenge to Bernstein's degrees-of-freedom problem

Suguru Arimoto, Masahiro Sekimoto, Hiroe Hashiguchi, and Ryuta Ozawa
Ritsumeikan University, Japan

- **Ill-posedness of inverse kinematics in redundant multi-joint movements**

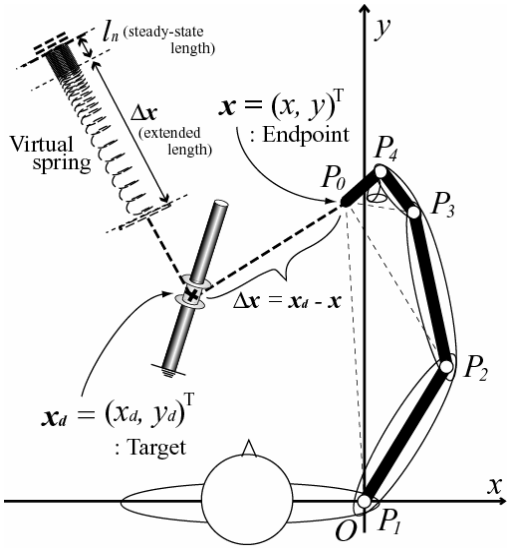
  When the total number of DOFs of a robot is larger than the number of variables for task description, its pose achieving the task cannot be determined uniquely.

- **Bernstein's "degrees of freedom problem" in physiology**

  In physiology, this ill-posedness problem was claimed by N. A. Bernstein half a century ago, but has remained unsolved.

- **Natural resolution of the problem in a dynamic sense**

  A simple control signal, evoking a spring-like force with a stiffness parameter in task space and a group of joint dampings, naturally resolves the problem without considerations of inverse kinematics.



Control Signal

$$u = -C\dot{q} - J^T k \Delta x$$

Joint dampings

A spring-like force

Whole-body Cooperative Reaction Force Manipulation on Legged Robots with COG Jacobian involving Implicit Representation of Unactuated Coordinates

T. Sugihara (Kyushu Univ.) Y. Nakamura (Univ. of Tokyo)

What we proposed

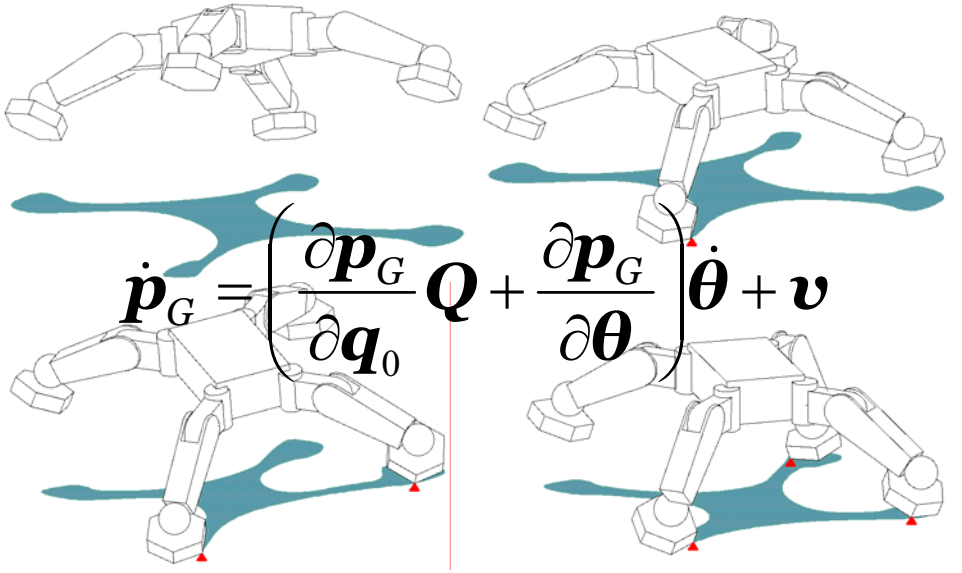
1. COG Jacobian matrix of legged robots embedding unactuated baselink coordinates.
2. Resolved COG rate control with all motors cooperated.

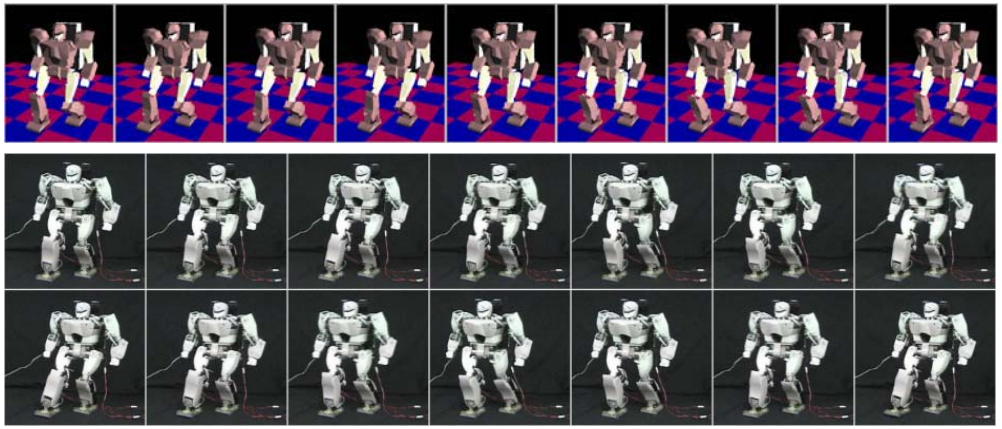
What was the challenge?

Dynamical constraints which rules the movement of unactuated baselink varies with supporting conditions.

What is the benefit?

Reaction force manipulation for advanced legged control becomes available with less computational cost.





Non-Contact Stiffness Imager

Tomohiro Kawahara[1], Satoshi Matsunaga[2], Shinji Tanaka[3], and Makoto Kaneko[4]

1 Hiroshima Univ., 2 NTT Comware Co. Ltd., 3 Hiroshima Univ. Hospital, 4 Osaka Univ.

- Non-contact stiffness sensing by using fluid flow.
- Tumor is detected through the pattern of stiffness distribution.
- Clinical application to human stomach.