

## IEEE-RAS Technical Committee on BioRobotics

### Honest assessment of TC over past 3 years and goals for next 3 years

In the 2007, as an effort from the co-chairs to make a more precise definition of the technical field of the TC, the scope of Biorobotics has been defined as a research field which involves any use of mechatronics systems to understand better complex living organisms. This field can be conceived as a highly interdisciplinary conference that brings together scientists and engineers from different backgrounds to share and learn about research activities in this fast growing field. Due to its interdisciplinary approach, during the past 3 years several efforts have been done to reduce the gap between robotists and biologists (i.e. IEEE/RAS – EMBS).

Even though during the past three years two conferences have been organized related to the field of Biorobotics (BIROB 2006 and BIROB 2008), it is still far to state that the activities promoted by the TC over the last three years attained its original goals. From the point of view of a TC, the Biorobotic research field is too broad (too difficult to define the borders among other TCs). From several discussions among experts of the field, it became necessary to propose a more focused TC which provides a clear definition of the scope and arguments. This approach will certainly promote the activities of the TC on the next coming three-years.

As a result, the co-chairs have been agreed to renew the TC on Biorobotics towards achieving more visible results. The renewal process consists in both rotating the existing co-chairs as well as redefining the objectives of the TC itself. The renewed TC is focused on in applying biological concepts/strategies to improve the current capabilities of robots from a technological point of view. Therefore, it is expected that the renewed TC will have a positive impact on many of the existing RAS TCs for the next coming 3 years.

### List of activities during past three years

- BIROB 2006, Pisa, Italy, February 20-22, 2006
- BIROB 2008, Scottsdale, USA, October 19-22, 2008
- IEEE Transactions on Robotics: Special Issue on Bio-Robotics, Vol. 24(1), 2008
- <sup>(1)</sup> ICRA2008, Workshop on Biorobotics: Research Advances, Standards and Education, Pasadena, USA, May 19, 2008
- <sup>(2)</sup> IROS 2009, Workshop on Biologically-Inspired Robots, St. Louis, USA, October 2009

<sup>(1)</sup> Co-organized by: Surya SINGH, Roger QUINN, Ken WALDRON

<sup>(2)</sup> Co-organized by: Kin Huat LOW, Jorge SOLIS, Xinyan DENG, Ravi VAIDYANATHAN

### List of outreach activities outside the RAS

- Track on "Biorobotics and Biomechatronics" of 4<sup>th</sup> International Conference on Autonomous Robots and Agents, February 10-12, 2009, Wellington, New Zealand (IEEE Instrumentation & Measurement Society)
- Track "Biorobotics" of IEEE/RAS-EMBS 2008 IEEE International Conference on Biomedical Robotics and Biomechatronics, October 19-22, 2008, Scottsdale, USA
- Track "Anthropomorphism" of 17<sup>th</sup> CISM-IFTtoMM Symposium on Robot Design, Dynamics, and Control, July 5-9, 2008, Tokyo, Japan
- Track "Biorobotics for longevity" of 6<sup>th</sup> Int'l Conference of the **International Society for Gerontechnology**, June 4-6, 2008, Pisa, Italy
- CUCS Distinguished Lecture: Blake Hannaford, Surgery over the Internet, Columbia Distinguished **Lecture Series in Computer Science**, September 17, 2007, USA

- Track “Biorobotics” of IEEE/RAS-EMBS 2006 IEEE International Conference on Biomedical Robotics and Biomechatronics, February 20-22, 2006, Pisa, Italy

## List of important publications over past 3 years in TC area.

- B. Hannaford et al., “The RAVEN - Design and Validation of a Telesurgery System,” International Journal of Robotics Research, January 2009.
- Atsuo Takanishi et al., Social Robots that Interact with People. Springer Handbook of Robotics 2008: 1349-1369
- Jean-Arcady Meyer and Agnès Guillot, Biologically-Inspired Robots. Springer Handbook of Robotics 2008: 1349-1369
- B. Hannaford, Atsuo Takanishi et al.: Guest Editorial Special Issue on Biorobotics. IEEE Transactions on Robotics, vol. 24(1): 3-4 (2008)
- B. Hannaford et al., “Doc at a Distance,” IEEE Spectrum, pp. 34-39, October 2006.

## Number of members of each year in the past three years

~ 10

## Summary of top three technical innovations in the area

- **A bipedal jumping and landing robot**  
A bipedal jumping and landing robot with artificial musculoskeletal system inspired on an animal has been presented. Experiments showed the abilities of the robot to realize vertical jumping. Reference: **Y. Kuniyoshi**, et al. “Mowgli: A bipedal jumping and landing robot with an artificial musculoskeletal system”, in Proc. of ICRA 2007, pp. 2546-2551, 2007.
- **A bio-inspired climbing robot**  
A new bio-inspired climbing robot designed to scale smooth vertical surfaces has been presented. The robot, called Stickybot, draws its inspiration from geckos and other climbing lizards and employs similar compliance and force control strategies to climb smooth vertical surfaces. **M. Cutkosky**, et al., “Whole body adhesion: hierarchical, directional and distributed control of adhesive forces for a climbing robot,” in Proc. of ICRA 2007, pp. 1268-1273.
- **Wingbeat Time and the Scaling of Passive Rotational Damping in Flapping Flight**  
A passive mechanism termed flapping counter-torque (FCT) model has been proposed. The FCT model predicts that isometrically scaled animals experience similar damping on a per-wingbeat time scale, resulting in similar turning dynamics in wingbeat time regardless of body size. The model also shows how animals may simultaneously specialize in both maneuverability and stability (at the cost of efficiency) and provides a framework for linking morphology, wing kinematics, maneuverability, and flight dynamics across a wide range of flying animals spanning insects, bats, and birds. Tyson L. Hedrick, Bo Cheng, **Xinyan Deng**, “Wingbeat Time and the Scaling of Passive Rotational Damping in Flapping Flight,” in Science, Vol. 324 (5924), pp. 252 – 255, April 10th 2009:

## Recommendations (and alternates) for new co-chairs

- Atsuo TAKANISHI (ASIA : old)
  - ← (new) Kin Huat LOW<sup>(3)</sup> in 2009 (proposed to the TAB)
  - ← (new) Jorge SOLIS<sup>(4)</sup> in 2009 (proposed to the TAB)
- Blake HANNAFORD (AMERICA: old)
  - ← (new) Xinyan DENG<sup>(5)</sup> in 2009 (proposed to the TAB)

- (EUROPE: *Not assigned*)  
    ← (new) Ravi VAIDYANATHAN<sup>(6)</sup> in 2009 (proposed to the TAB)

<sup>(3)</sup> *K.H. Low*

*Professor, School of Mechanical & Aerospace Engineering  
Nanyang Technological University, Singapore, mkhlow@ntu.edu.sg*

<sup>(4)</sup> *Jorge Solis*

*Lecturer, Research Institute of Science and Engineering  
Waseda University, Japan, solis@kurenai.waseda.jp*

<sup>(5)</sup> *Xinyan Deng*

*Assistant Professor, Department of Mechanical Engineering  
University of Delaware, USA, deng@UDel.Edu*

<sup>(6)</sup> *Ravi Vaidyanathan*

*Lecturer in Biodynamics, Department of Mechanical Engineering  
University of Bristol, United Kingdom, ravi.vaidyanathan@case.edu*