

## The Birmingham Hand

**Date(s)** Wednesday 11th July 2012 (09:00-16:30)

**Contact** Workshop Leader: **Dr Rustam Stolkin** (<http://www.cs.bham.ac.uk/about/people/Rustam%20Stolkin>)

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### Academic rationale for hand research at Birmingham



1) The hand is scientifically and culturally iconic. The human hand is intimately intertwined with human evolution and cognition. A robotic hand and associated algorithms to control grasping and manipulation, that can achieve the dexterity of a human, is an important, but still far from attained, goal of automation engineering. Such a hand would have numerous applications, represent a pinnacle in mechatronic technology and AI, and form a major milestone in the development of real-world intelligent machines.

2) There are currently no satisfactory humanoid or non-humanoid dexterous multi-finger robot hands available, for research or industrial applications. Existing hands are:

- i) Prohibitively expensive, typically £50,000 - £100,000 per hand.
- ii) Delicate and fragile – coming nowhere near the robustness of industrial grippers.
- iii) Weak – payloads of a few hundred grams, in contrast to human hands which can lift order 100kg.
- iv) Sorely lacking in sensory capabilities, especially tactile sensing which plays a critical role in human grasping.
- v) Lacking satisfactory control algorithms for autonomous grasping and manipulation under uncertainty.
- vi) Lacking suitable input and sensory feedback devices (and knowledge of best practice and human-factors issues in using them) for human controlled tele-operative grasping.
- vii) Insufficiently informed by an understanding of human and animal cognitive processes for grasping and manipulation.

3) Research in these areas is highly interdisciplinary, and would bring together a wide range of expertise from many schools across the University of Birmingham campus, as well as building on major university investments in cross-school centres and initiatives:

- i) Mech. Eng. School – outstanding manufacturing facilities, and expertise in MEMS sensors (inc. tactile).
- ii) CS school - autonomous grasping and manipulation algorithms (three major FP7 grants).
- iii) EECE - expertise in bilateral control for human-robot interaction in tele-operated grasping (recent defence funding).
- iv) Psychology – leading centre of expertise in human grasping and manipulation.
- v) Chem. Eng. – expertise in the tribology of fingertips and their interaction with objects and materials.
- vii) New centres including CNCR (centre for Computational Neuroscience and Cognitive Robotics) and new HCI (centre for Human-Computer Interaction).

### Delegate List

#### Overseas academics:

- Aaron Dollar, Yale, USA – novel hand mechanisms.
- Marco Gabiccini, Antonio Bicchi, U of Pisa, Italy – haptics and dexterous robotic manipulation.
- Vincent Hayward, Université Pierre et Marie Curie, France – haptics and tactile sensing devices.
- Peter Kyberd, Inst. Biomedical Engineering, U of New Brunswick, Canada – prosthetic grasping.

#### Guests from industry and non –university labs:

- Christoph Borst, DLR German Aerospace Research Centre – robotic hands and robotic manipulation.
- John Heindel, Schunk Intec – robotic hands.
- Richard Greenhill /Armando De La Rosa, Shadow Robot Company – robotic hands.

#### University of Birmingham delegates:

- *School of Computer Science – Intelligent Robotics Lab:* Aaron Sloman, Ales Leonardis, Marek Kopicki, Richard Dearden, Jeremy Wyatt, Sebastian Zurek, Chris Burbridge, Claudio Zito, Rustam Stolkin.
- *School of Psychology:* Alan Wing, Dietmar Heinke, Satoshi Endo, Hoi Fei Kwok, Max DiLuca
- *School of Mechanical Engineering:* Duc Pham, Mozafar Saadat, Mike Ward, David Cheneler
- *School of Electrical Electronic and Computer Engineering:* Bob Stone
- *School of Chemical Engineering:* Mike Adams
- *School of Biosciences:* Jackie Chappell
- *Institute of Advanced Studies:* Malcolm Press, Sue Gilligan

