

Workshop on “Clinical Perspectives of Hybrid Bionic Systems” at ICORR 2007

Hybrid Bionic Systems, intended as robotic artefacts connected to human bodies and brains, are one of the current frontiers of robotics research and of the development of robotics technologies. Developing hybrid bionic systems is a challenge that needs a strategic alliance between robotics and neuroscience and that can bring benefits to both disciplines: roboticists have the opportunity of developing new-generation robotic systems, incorporating knowledge and models from neuroscience; neuroscientists have the opportunity of studying the brain with new experimental tools, i.e. biomorphic robotic artefacts controlled by the brain as parts of the body.

The NEUROBOTICS Integrated Project (IP) (www.neurobotics.org), funded by the European Commission in the IST/FET Programme, aims at exploring the field of hybrid bionic systems, by taking the challenge of designing and developing new robotic artefacts and new human-robot interfaces, incorporating models of the human nervous system as formulated in neuroscience. The NEUROBOTICS IP is investigating the problems of developing hybrid bionic systems by taking into account three different scenarios:

- the “Beyond Tele-operation” scenario consists of biomimetic robotic artefacts, not physically connected to the human body, but controlled by the person (see Fig.1(a)). This scenario is aimed at investigating the problems related to interfacing humans with scalable artefacts not physically coupled with the human body;
- the “Beyond Prostheses” scenario consists of an implanted arm-hand system, for investigating the problems related to interfacing humans with robotic artefacts which are tightly physically connected to the body (see Fig.1(b));
- the “Beyond Orthoses” scenario consists of wearable robotic artefacts and helps investigate the problems related to interfacing humans with wearable artificial systems, mechanically coupled with the body (see Fig.1(c)).

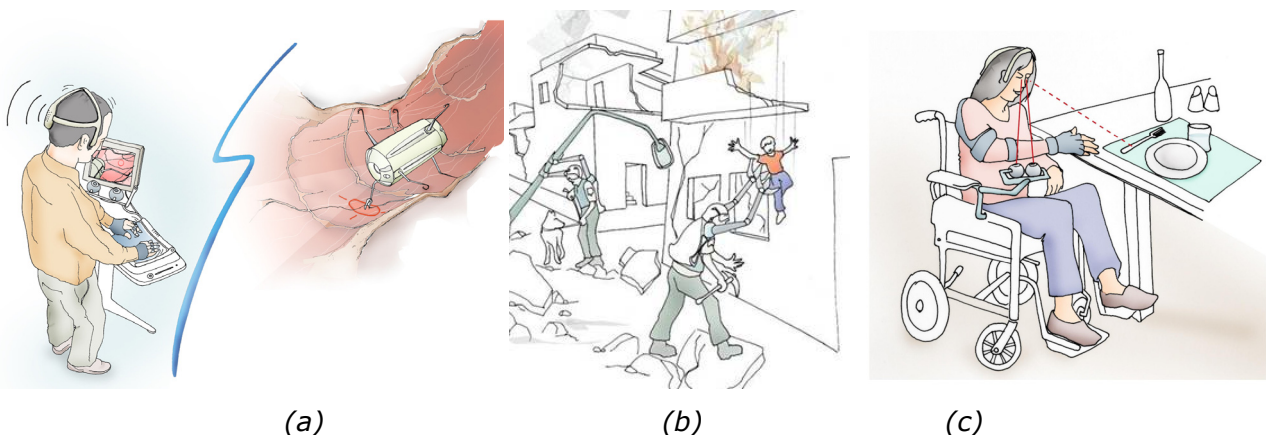


Fig. 1. Illustration of the NEUROBOTICS HBS scenarios: (a) “Beyond Tele-operation”: robotic aliases for explorations in environments that are remote and/or difficult to access; (b) “Beyond Prostheses”: a smart exoskeleton for improving accuracy, endurance and strength of human arm and hand movements; (c) “Beyond Orthoses”: a novel highly anthropomorphic arm/hand system, for limb substitution or for adoption of additional limbs

An example of platform under development in the "Beyond Prostheses" scenario is a cybernetic hand, with neural connection with the peripheral nervous system (see Fig.2(a)). The robotic technology in this case is a novel robotic hand, based on underactuated fingers, equipped with a tactile system and proprioceptive sensors (see Fig.2(b)). This platform incorporates plasticity models of the nervous system, models for coding afferent sensing, and clinical models. A specific investigation is done on the peripheral neural interface, involving the optimization of LIFE and regenerative electrodes, the set-up of implantable peripheral interfaces, and the processing of the neural information.

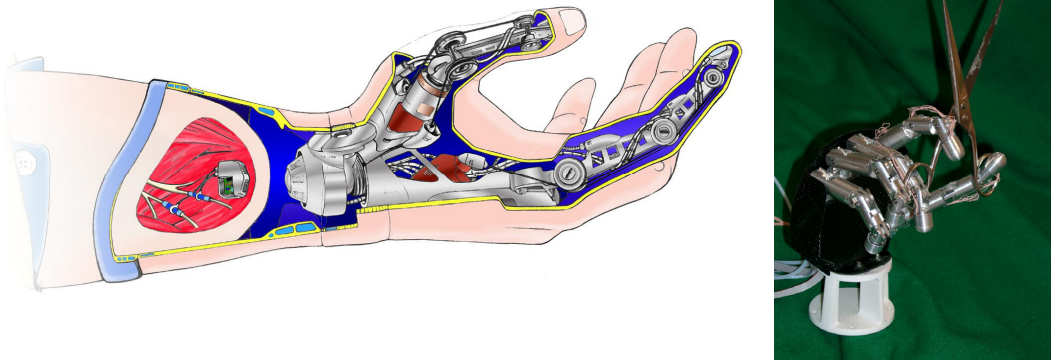


Fig. 2. The cybernetic prosthesis, as an example of platform in the "Beyond Ortheses" scenario. (a) Scheme of the prosthesis and its connection to the human nervous system; (b) the robotic five-fingered, underactuated, sensorized hand developed as cybernetic prosthesis

The NEUROBOTICS IP is investigating the problem of developing adequate human-robot interfaces for hybrid bionic systems with a very wide and open approach and with rigorous scientific method, by taking into account all the diverse approaches, i.e. direct(neural) / indirect, cortical/non-cortical, invasive/non-invasive.

Even though the NEUROBOTICS IP is a basic research project, with no push from the application point of view, envisaged scenarios for application of the results that NEUROBOTICS will bring are not in the *augmentation* of a human person's capabilities, but in their *recovery* from impairment. For this reason, though in a very long term, NEUROBOTICS has perspectives for clinical applications.

The aim of the Workshop on "Clinical Perspectives of Hybrid Bionic Systems" at ICORR 2007 is to discuss the potential of the NEUROBOTICS IP with respect to clinical applications of some of the bionic systems developed in the project, with potential end users. The final goal for the organizers is to receive a consistent feedback for steering the project activities and for planning the further developments of the project results.

The workshop will present the NEUROBOTICS objectives and achievements so far for what relates more directly to a potential clinical application. Additional presentations will be given by invited speakers on more general issues related to bionics and human-robot interfaces. A focussed session will be devoted to an open discussion of the key issues raised in the workshop with the potential and users and all the attendees.