

**PH.D. PROGRAM IN BIROBOTICS SCIENCE AND ENGINEERING
YEAR 2005 - XX CYCLE**

The PhD Program in Biorobotics Science and Engineering aims at training highly competent researchers with the potential to lead Biorobotics research worldwide.

Biorobotics is a new scientific and technological area with a unique interdisciplinary character. It derives its methodology mainly from the sectors of Robotics and Biomedical Engineering, but boasts its cultural and application scope towards many sectors of engineering, towards basic and applied science (medicine, neuroscience, economics, law, bio/nanotechnologies in particular), and even towards humanities (philosophy, sociology, psychology, ethics).

Biorobotics aims at increasing knowledge on how biological systems work by analyzing them from a "biomechatronic" viewpoint, and exploiting this knowledge in order to develop innovative methodologies and technologies, both for the design and construction of high performance bio-inspired machines and systems (at the macro, micro and nano scales), such as animaloid and humanoid robots, and for developing devices for biomedical applications, e.g., for minimally-invasive surgery and neuro-rehabilitation.

The program will impart on its graduates a professional profile that combines substantial technical and scientific expertise in advanced areas, and a system-oriented approach to design problems, with a vision that retains man at the centre of the development and the evaluation of technology, and with the capability of conceiving and designing new and innovative (including industrial) research projects, with an autonomous entrepreneurship capability.

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Academic Year 2004/2005

I TERM: March – May 2005

Course Title: Introduction to Biorobotics

Abstract: This course aims at outlining the context of biorobotics science and engineering, by illustrating scope and application. A series of lectures will be given in this course, not only by (robotics) engineers but also by researchers in the biological and medical fields and by experts in humanities. Lab tours and sessions of reciprocal presentations/introductions will be organized.

Lecturer: Paolo Dario, Scuola Superiore Sant'Anna, Pisa :

From the Renaissance Engineer to the Engineer of the 21st Century

Lecturer: Alessandro Battaglia, Unità Operativa di medicina riabilitativa della Asl 12 Versilia:

Problems in Rehabilitation

Lecturer: William Provancher, University of Utah:

Haptic Perception

Lecturer: Blake Hannaford, University of Washington, Seattle :

Perspectives in Biorobotics

Lecturer: Romano Nanni, Direttore della Biblioteca Leonardiana di Vinci:

Leonardo Da Vinci and the Renaissance Engineers

Lecturer: Roland Johansson, Umea University, Sweden :

Sensory-Motor Coordination in Manipulation

Course Title: Fundamentals of Biorobotics

Abstract: This course introduces fundamental principles of biorobotics. This includes in depth presentation of basic principles of biologically inspired design, as well as methods and technology for the development of robots for biomedical applications.

Lecturer: Paolo Dario, Scuola Superiore Sant'Anna, Pisa

Course Title: Robotics in Surgery and Endoscopy

Abstract: This course gives an insight of the main problems and the fundamental technological solutions currently adopted in surgery and endoscopy, from the surgeon's point of view.

Lecturer: Alfred Cuschieri, Scuola Superiore Sant'Anna, Pisa

Course title: Humanoid Robotics

Abstract: This course presents problems, theory, techniques and case-studies on the design and development of humanoid robots.

Lecturer: Atsuo Takanishi, Waseda University, Tokyo

II TERM – May – July 2005

Course title: Control theory

Abstract: This course provides basic knowledge in control theory. The aim is to introduce students to the types of problems encountered in optimal control, to provide techniques to analyse and solve these problems, and to provide examples of where these techniques are used in robotics practice.

Lecturer: Hisham Abou-Kandil, Ecole Normale Supérieure de Cachan, Cachan

Course title: Robot Locomotion and Creative Engineering

Abstract: Bioinspired Legged Robotics, see on page: <http://bdml.stanford.edu/twiki/bin/view/Courses/LeggedLocomotionIMT>

Creative Engineering Design: see on page: <http://bdml.stanford.edu/twiki/bin/view/Courses/CreativeEngineeringDesignIMT>

Lecturer: Mark Cutkosky, Stanford University, Stanford

Course title: Optics engineering; part I: diffraction

Abstract: Propagazione; Fourier and linear Systems; diffraction; diffraction figures; Diffraction through lenses; Funzioni di trasferimento coerente ed incoerente; Reticoli; Applications; Modulazione acustico-ottica e integrazioni

Lecturer: Mario Martinelli, Politecnico di Milano

INVITED LECTURERS AND SEMINARS

- *Joint Robotics-Neuroscience Lecture: Humanoid Robotics, Emotion and Expressions in Robots – from Emotion to Feeling, how the Brain enlightens our Lives*

Prof. Atsuo Takanishi, Waseda University, Tokyo

Prof. Pietro Pietrini, University of Pisa

- *Joint Lecture, Cultural Differences in the Perception of Robots in Italy and Japan – The Mith of Cyborgs*

Prof. Atsuo Takanishi, Waseda University, Tokyo

Prof.ssa Barbara Henry, Sant'Anna School of Advanced Studies

- *Brain, Space and Movement*

Prof. Alain Berthoz, College de France, Paris

- *Dynamic Control of Robots and Humanoids*

Prof. Oussama Khatib, Stanford University