Pietro Cerveri

Born on April 22nd 1969 in Milano - Italy.
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CURRICULUM VITAE ET STUDIORUM

RESUME OF THE ACADEMIC CAREER

Pietro Cerveri was born on April 22nd 1969 in Milano - Italy. MSc Electronic Engineering (1994) - Politecnico di Milano University (Milano, Italy). Since March 1995 to June 1996 he served in the Italian Army as Lieutenant of the Carabinieri Corp (Military Police). Since September 1996 to end of 1998, he worked as Research Fellow at Institute of Neuroscience and Bioimages of the National Research Council (CNR) in Milano. In 1998, he started the PhD program in Bioengineering at Politecnico di Milano under a grant "Visible Human Dataset project" from National Institute of Health (Bethesda, MD – USA). He received the PhD degree in 2001 with the thesis: "Symbolic Representation of Human Anatomical Knowledge. Attempting Integration with Visual Information". Since 2001 to 2007, he was Research Scientist at Fondazione Pro Juventute Don Gnocchi (Milano) and Post-Doc at Bioengineering Department (Politecnico di Milano). Since 2004 to 2009, he was Lecturer of the course "Cognitive System Engineering" - Master Degree in Biomedical Engineering, School of System Engineering at Politecnico di Milano. In 2008 he obtained the permanent position of Assistant Professor and the position of Associate Professor in 2014 at Politecnico di Milano University. Since 2009, he has been Lecturer of the course "NeuroEngineering" - Master Degree in Biomedical Engineering - School of Industrial and Information Engineering at Politecnico di Milano. He spent research periods abroad in Research Centers (1998-National Institute of Health, Bethesda MD, USA, as Research Scientist), Universities (2003, 2010 - Universita Estadual de Campinas, Campinas BR as Visiting Professor) and International Companies (2000-Electronic Arts, Vancouver CA, as Software Engineer). His research activities have concerned Human motion analysis and modeling, Computer Vision, Knowledge Representation, Computer Assisted and Robotics Surgery, Medical Signal/Image Processing and Analysis. He is author/co-author of more than 65 scientific papers published on ISI journals and more than 50 contributes on International Conference Proceedings.

ACADEMIC CAREER AND APPOINTMENTS
- 1994 MSc Electronic Engineering - Politecnico di Milano (Milano, Italy).
- 1996-1997 Research Fellow at National Research Council (Milano, Italy).
- 1998-2001 PhD candidate in Bioengineering at Politecnico di Milano.
- 2001 PhD degree in Bioengineering at Politecnico di Milano.
- 2001-2006 Research Fellow at Bioengineering Department, Politecnico di Milano.
- 2006-2008 Research Consultant at Bioengineering Department, Politecnico di Milano.
- 2008 Assistant professor, Politecnico di Milano.
- 2014 Associate professor, Politecnico di Milano.
- 2012 Board Member of PhD Degree Program in Bioengineering, Politecnico di Milano.
- 2014 National Scientific Qualification (art. 16 Law 240/2010) Competition Sector 09/G2 BIOINGEGNERIA as Associate Professor from Italian Minister of Education, University and Research.

ADVANCED EDUCATION
- 1997 "Projective geometry for Computer Vision", London Royal Society (London - UK)
- 1998 "Specific and quality control of information system: object-oriented and formal methods", Politecnico di Milano (Milano - Italy).
- 1999 "Object-oriented language and JAVA", CILEA Segrate (Milano - Italy).
- 2005 "ITK Advanced Course", Ecole Polithecnic Federal Lausanne, (Lausanne - CH).
- 2008 "Interface, supervision and control programming for KAWASAKI robotic platforms", TIESSEROBOT (Brescia - Italy).

TEACHING

- 1998-2000 Teacher assistant of "Medical Informatics" Master Degree in Biomedical Engineering, School of System Engineering at Politecnico di Milano.
- 1998-2001 Teacher of "Information technologies for clinical data management", Accademia di Bergamo per le Scienze Avanzate Villa Elios (Bergamo - Italy).
- 1999-2000 Teacher of "Information technologies in Medicine", Master program "Information Technology" – CEFRIEL (Milano - Italy).
- 2001-2006 Teacher assistant of "Fundamentals of Electronics Enginering" Bachelor Degree in Biomedical Engineering, School of System Engineering at Politecnico di Milano.
- 2002-2003 Lecturer of "Electronic technologies in Biomedical Engineering", PhD degree in Bioengineering - Politecnico di Milano.
- 2004-2007 Teacher assistant of "Biosensors and Microtechnologies" Master Degree in Biomedical Engineering, School of System Engineering at Politecnico di Milano.
- 2005-2008 Lecturer of "Computer assisted surgery in orthopaedics", Master program "Engineering and Surgery" - Politecnico di Milano (Milano - Italy).
- 2003-2008 Lecturer of "Cognitive System Engineering" , Master degree in Biomedical Engineering – School of System Engineering - Politecnico di Milano (Milano - Italy).
- 2009 – present time Lecturer of "Neuroengineering", Master degree in Biomedical Engineering – School of Industrial and Information Engineering - Politecnico di Milano (Milano - Italy).

SYNTHESIS OF THE SCIENTIFIC CAREER

Following the work done during the master thesis period, Pietro Cerveri's scientific research activity developed initially in the field of video-based 3D human motion capture and kinematic analysis. He specifically addressed automatic calibration of multi-camera systems and motion tracking methodologies in collaboration with the company BTS Engineering (Milano - Italy). The main achievement was the development of a fully automatic methodologies for calibrating a multi-camera system using a single rigid bar exploiting epipolar geometry, absolute conic invariance and evolutionary optimization. The PhD program in Bioengineering, funded by National Institute of Health (Bethesda, MD - USA), was focused on different topics, namely knowledge representation and methodologies for medical image processing and analysis. He designed and implemented an integrated SW framework to join symbolic to visual-based information in volumetric diagnostic images, exploiting semantic networks and content-based access to database. During this period he also cooperated with European Institute of Oncology (Milano, Italy) in the field of bioinformatics. The main achievement was the development of SW platform able to manage and process hundreds of thousand complex genomic data acquired through micro, gene-chips, oligonucleotides array (genomic differential expression data) to evaluate the differential gene expression in a single experiment (i.e. test vs. control condition) and the determination of gene regulation (i.e. significant differential gene expression) across multiple replica experiments.

After the PhD period, he extended the research in the field of human motion analysis proposing pioneering methods, mimicking human perception, integrating kinematic models and predictive filters. The main achievement was the development of a 3D human-motion tracking method, able to work even with a single camera, addressing into an integrated framework kinematic model uncertainty and soft tissue artifacts. He focused on kinematic modeling proposing static- and dynamic-based methods to model human joints of the specific subject and studied motion synthesis approaches based on neural networks. He then extended the research activity to computer assisted surgery (CAS) and medical imaging. He was involved in projects in the field of CAS techniques for Orthopaedic surgery (in collaboration with Lima Spa, Udine – Italy) dealing with image-based and image-less navigation approaches for knee and hip surgery. He developed registration algorithms based on bone-morphing, method to compute intra-operatively the limb mechanics starting from measurements of points or areas on the bone surfaces, automatic methods to track in 3D surgical instruments, procedures to compute the optimal positioning and size of the prosthesis, and finally methods for real-time visualization. In collaboration with San Bortolo Hospital (Vicenza – Italy), he investigated medical imaging techniques and processing, especially for volumetric image registration, applied to the neuro-radiosurgery field. In collaboration with Ist Orthopaedic Department, C.T.O. Hospital, Istituti Clinici di Perfezionamento, (Milano, Italy), he has developed automatic approaches for orthopedic surgery planning proposing operator-free methods for determining the clinical parameters of interest on a patient-specific basis from diagnostic CT and MRI imaging and 3D bone models as well. He then addressed medical robotics from the system integration points in different national and international projects. One of the main achievements in this research field was the assembly of an in-room robotic platform for cone-beam CT image acquisition using a Kawasaki robot in

collaboration with National Center of Oncology Hadron Therapy (CNAO, Pavia - Italy) and TiesseRobot (Visano, Brescia - Italy). The work was extremely complex and challenging: he was responsible of the robot installation design, room virtualization and robotic motion planning, robot programming, safety measures and SW integration. The installation has been fully functional and used clinically since mid of 2013. The cooperation with CNAO is still active in the development of a new HW/SW platform for real-time steering of the particle beam in hadron-therapy to cope with tumor localization uncertainty using thorax surface measurements. This activity leaded to the development of internal-external correlation methods that can be tailored on an individual basis. He has recently extended its research interest in the field of oncology where he is investigating new modeling approaches to predict tumor regression response to radiation and chemo-therapy in collaboration with European Institute of Oncology (Milano, Italy). In the field of human motion analysis and robotics he is presently a participant to a national project funded by Italian Ministry of Education, University and Research. "Biomechatronic hand prostheses endowed with bio-inspired tactile perception, bi-directional neural interfaces and distributed sensori-motor control".

PARTICIPATION IN RESEARCH AND INDUSTRIAL PROJECTS

- **2013-2015** *National Project* funded by Italian Ministry of Education, University and Research. "Biomechatronic hand prostheses endowed with bio-inspired tactile perception, bi-directional neural interfaces and distributed sensori-motor control". P.I. Prof. E. Guglielmelli - Università "Campus Bio-Medico" Roma - Italy. Role: Co-Responsible of the Politecnico di Milano Research Unit (1.2M€).

- **2012-2014** *National Project* funded by AIRC "Short-term high precision radiotherapy for early prostate cancer with concomitant boost on the dominant lesion". P.I. Dr. B. A. Alicja Jereczek – IEO (Milano – Italy). Role: Participant Politecnico di Milano Operative Unit (150k€).

- **2012-2013** *Industrial Project* funded by CNAO (Centro Nationale di Adroterapia Oncologica, Pavia Italy). "Development of a robotic imaging system for hadron-therapy treatment room". P.I. G. Baroni - Politecnico di Milano. Role: WP responsible (560k€).

- **2010-2013** *European Research Project*: "ULICE - Union of Light Ion Centers in Europe" FP7-INFRA-2008-1.1.2). P.I. Prof. R. Orecchia CNAO. Role: participant (8.5M€).

- **2010-2013** *European Research Project*: "ENVISION - *European NoVel Imaging Systems for ION therapy*" N. *241851.* P.I. Dr. M. Donsanj, CERN (Geneva – CH). Role: participant (6.5M€).

- **2010-2014** *International Research Project*: "CRISP - International Dual Degree in Computing, Robotics and Imaging for Surgery Platform" funded by European Commission Programme EU-US Atlantis programme, cooperation in higher education and training. P.I. Prof. G. Baselli - Politecnico di Milano. Role: Scientific and Technical responsible (144k€).

- **2010-2012** *National Project* funded by Ministry of Education and University: Innovative modular micro robotic instruments for transluminal endoscopic surgery". P.I. Prof. R. Molfino, University of Genova (Genova – Italy). Role P.I of Politecnico di Milano Research Unit. (135k€).

- **2010** *International Research Project* funded by University of Campinas Foundation and CAPES (Brasil). "Methods and technologies in Sport Science". (60k€). P.I. Prof. R. Machado Leite De Barros University of campinas (BR). Role: Brasilian PhD student supervisor.

- **2009-2010** *International Project* funded by European Space Agency: TEC-MMG/2009/8 "Self propelled Instrument Carrier for surgery through natural orifices". P.I. P. Cerveri - Politecnico di Milano (25k€).

- **2008-2010** *European Project*: FP7-ICT-2007-215190 "ROBOCAST: ROBOt and sensors integration for Computer Assisted Surgery and Therapy". Theme: Advanced robotics for neurosurgery. P.I. Prof. G. Ferrigno - Politecnico di Milano. Role: WP responsible (3.5M€).

- **2007-2009** *Interuniversity project* funded by Politecnico di Milano and Politecnico di Torino "ORTHOROB, ORTHOpaedic Surgery and ROBotics" P.I. Prof. G. Ferrigno - Politecnico di Milano. Role: WP responsible (75k€).

- **2007** *Regional Collaborative Research Project* funded by FSE INGENIO and Lombardia Region. "New technologies for surgical navigation". P.I. P. Cerveri - Politecnico di Milano. (30K€).

- **2006-2007** *National Industrial Research Project* funded by LIMA Lto (Udine, Italy). "Ultrasound for detection of landmarks and anatomical surfaces in surgical navigation". P.I. Dr. R. Dellaca' - Politecnico di Milano. Role: participant (130k€).

- **2005-2007** *National Research Project* funded by San Bortolo Hospital (Vicenza, Italy). "Innovative methods for 3D image registration in the domain of radiosurgery using the CyberKnife". P.I. Dr. C. Francescon - San Bortolo Hospital (Vicenza – Italy). Role: WP participant (70k€).
- **2005-2006** *National Industrial Research Project* funded by LIMA Lto (Udine, Italy). "Technologies and methods for surgical navigation in knee and hip arthroplasty". P.I. Prof. G. Ferrigno - Politecnico di Milano. Role: WP responsible (350k€).
- **2005-2006** *National Industrial Development Project* funded by DIES srl (Roma, Italy) "VIMS : An innovative system for surgical training in ophthalmic mini-invasive surgery". P.I. Prof. N.A. Borghese - Università degli Studi di Milano (Milano – Italy). Role: WP responsible (70k€).
- **2005-2006** *National Research Project* HINT-Lecco funded by Fondazione CARIPLO. "Biomechanical models of the hand and methods for parameter estimation in the domain of Haptics " P.I. Prof. C. Frigo - Politecnico di Milano. Role: participant.
- **2002-2004** *National Industrial Development Project* funded by BTS Engineering (Milano, Italy): "Model-based human motion tracking" P.I. Prof. G. Ferrigno - Politecnico di Milano. Scientific and technical responsible (60k€).
- **1999-2003** *National Research Project* funded by ASI (Italian Space Agency): "ELITE-S2": P.I. Prof. G. Ferrigno - Politecnico di Milano. Role: WP responsible (440K€).
- **2000-2002** *National Research Project* funded by IEO – European Oncology Institute (Milano, Italy), "Development and implementation of new methodologies for management and analysis of large scale micro-array genomic data. Studies of differential regulation." P.I. Dr. P.G. Pelicci – European Oncology Institute. Role: WP responsible (75k€).
- **1998-2000** *International Research Project*: "Visible Human Dataset". P.I. Dr. M.J. Ackerman, National Library of Medicine, NIH Bethesda, (MD - USA). Responsible of Politecnico di Milano Research Unit: F. Pinciroli. Role: participant (45k€).
- **1998-2000** *National Project* funded by Ministry of Education, University and Research: "Development of Software Agents for Healthcare Information Systems" P.I. Prof. M. Stefanelli – University of Pavia. Role: participant (110k€).
- **1998-1999** *National Research Project* funded by ASI (Italian Space Agency): "ELITE-S2 Phase A Feasibility study 2000 PI": P.I. Prof. G. Ferrigno - Politecnico di Milano. Role: participant (125K€).
- **1997-1999** *European Research Project*: EC Brite-EuRam Project BE96-3433 "ANNIE: Application of Neural Networks to Integrated Ergonomics," Responsible of Politecnico di Milano Research Unit: Prof. G. Ferrigno. Role: participant (2.8M€).
- **1997-1998** *National Industrial Research Project* co-funded by BTS Engineering and Centro di Bioingegneria Fondazione Don Gnocchi (Milano, Italy). "Innovative calibration techniques in human motion capture" P.I. Prof. A. Pedotti - Politecnico di Milano. Role: participant (30k€).

DIRECT RESPONSIBILITY IN RESEARCH AND INDUSTRIAL PROJECTS
- **Workpackage responsible** 2012-2014: *National Project* funded by CNAO. WP 2. Robotic equipment and control, WP 4. Robotic safety.
- **Scientific and technical responsible** 2010-2013: *International Project: "*CRISP - International Dual Degree in Computing, Robotics and Imaging for Surgery Platform*"* funded by European Commission Programme *EU-US ATLANTIS PROGRAMME, COOPERATION IN HIGHER EDUCATION AND TRAINING.*
- **P.I.** 2010-2012: *National Project* funded by Ministry of Education and University: Innovative modular micro robotic instruments for transluminal endoscopic surgery".
- **P.I.** 2009-2010 *International Project funded by European Space Agency*: TEC-MMG/2009/8 "Self propelled Instrument Carrier for surgery through natural orifices".
- **Workpackage responsible** 2008-2010: *European Project*: FP7-ICT-2007-215190 "ROBOCAST: ROBOt and sensors integration for Computer Assisted Surgery and Therapy". WP 6: System integration.
- **P.I.** 2007 *National Collaborative Research Project* funded by FSE INGENIO (Lombardia Region) "New technologies for surgical navigation".

- **Workpackage responsible** 2005-2006: *National Industrial Research Project* funded by LIMA Lto (Italy), "Technologies and methods for surgical navigation in knee and hip arthroplasty". WP 2. Intraoperative software framework.
- **Workpackage responsible** 2005-2006: *National Industrial Development Project* funded by DIES srl (Roma, Italy) "VIMS : An innovative system for surgical training in ophthalmic mini-invasive surgery". WP 2. Camera calibration and surgical tool trajectory tracking.
- **Workpackage responsible** 2001-2004: *National Research Project* funded by ASI (Italian Space Agency): "ELITE-S2 Phase A Feasibility study 2000 PI". WP 3. Camera calibration and 3D reconstruction.
- **Workpackage responsible** 2000-2002: *National Research Project* IEO – Istituto Europeo di Oncologia (Milano, Italy), "Development and implementation of new methodologies for management and analysis of large scale micro-array genomic data. Studies of differential regulation". WP 3. "Data management, clustering methods and analysis.

ADVISOR PROFESSIONAL ACTIVITIES

- 2005-2006 DS Medica srl (Milano, Italy)
  - 3D anatomical models for dermatological inspection.
- 2005 Valtechnic SNC and Rally-art Mitsubishi-Italia (Como, Italy)
  - Dynamic supervision of a rally car using distributed sensors: feasibility analysis, data acquisition and processing methods.
- 2004-2005 Netcont srl (Milano, Italy)
  - Web-based distributed framework for finance data management, processing and visualization.
- 2000 Electronic Arts Canada (Vancouver - British Columbia, Canada)
  - Automated multi-camera calibration algorithms
- 1998 BTS Engineering (Milano, Italy)
  - Analysis of commercial motion capture systems and potentiality for entertainment
- 1998 National Library of Medicine del National Institute of Health (Bethesda MD, USA)
  - Semantic-based multimedia management framework.

EDITORIAL AND SCIENTIFIC REVIEWING ACTIVITIES

Scientific Reviewer

- Annals of Biomedical Engineering (Biomedical Engineering Society); BMC Medical Imaging;Clinical Biomechanics; Computer Methods in Biomechanics and Biomedical Engineering; Computerized Medical Imaging and Graphics; IEEE Transaction on Pattern Analysis and Machine Intelligence (Institute of Electronic and Electrical Engineering); IEEE Transaction Biomedical Engineering (Institute of Electronic and Electrical Engineering); International Journal of Medical Robotics and Computer Assisted Surgery;
- Journal of Neuroscience Methods (Elsevier Science); Journal of Biomechanics; Medical & Biological Engineering & Computing ; Medical Engineering & Physics; Medical Physics; Sports Biomechanics;

Associate editor

- Medical Physics; Brazilian Journal of Sport Science;

Editorial Board

- Brazilian Journal of Sport Science; International Journal of Orthopaedics;

Project Reviewer

- (06/2009 - 07/2009) Evaluator expert EU ICT for Health, under Call 4 of the Information and Communication Technologies Theme of FP7. Call Objective ICT-2009.5.2: Patient Safety (PS).
- (11/2011 - 01/2012) Evaluator expert Natural Sciences and Engineering Research Council of Canada. Collaborative Health Research Projects Selection Panel NSERC/CRSNG.

AWARDS AND INVITED LECTURES

- 2015 Invited seminar "Assessing tactile interaction at the fingertips by means of wearable piezo-resistive force transducers" IIT Genova (Italy).
- 2012 Invited talk in Robotica – The International Humanoid and Service Robots Expo, Milan 7-8 November 2012. "Robotics between research and clinical application: the experience of CART-CAS laboratory of the Politecnico di Milano".

- 2010 Invited lecturer in post graduation course "Fundamentals and quantitative methods for biomechanics" at University of Campinas (Brazil) supported by FUNCAMP foundation. Title: "Methods and technologies in Sport Science", (Campinas - Brazil).
- 2010 Invited speaker in the Symposium of Science and Technologies in Sport - University of Campinas (Campinas - Brazil).
- 2010 Invited lecture "Innovative surgical robotics for natural-orifice transluminal endoscopic surgery: perspectives for space applications" European Space Agency ESA-ESTEC, (Noordwijk - The Netherlands).
- 2010 Invited Member of the Committee of "The Hamlyn Symposium on Medical Robotics" held at The Royal Society of Science (London - UK).
- 2008 Award "Best Innovation" at K-Idea – Scientific technological park *Kilometro Rosso. Robotic technologies for the vision in mini-invasive transluminal endoscopic surgery.* (Bergamo - Italy).
- 2006 Invited lecture " Evolutionary computation". Università degli Studi di Milano (Milano - Italy).
- 2003 Invited lecturer "3D human motion analysis in sport science: present technologies and emerging approaches". University of Campinas (Campinas - Brazil).

PHD AND POST-DOC SUPERVISION AND CO- SUPERVISION
- Joseph Stancanello - PhD degree in Biomedical Engineering (Politecnico di Milano) supported by San Bortolo Hospital (Vicenza - Italy).
- Marialuisa Mandelli - PhD degree in Biomedical Engineering (Politecnico di Milano) supported by Besta Neurological Institute (Milano – Italy)
- Nicola Lopomo - PhD degree in Biomedical Engineering (Politecnico di Milano) supported by Istituti Ortopedici Rizzoli (Bologna - Italy)
- Amanda Piaia Silvatti – PhD degree in Physical Education (Campinas University, Brasil) supported by FAPESP (Brazil). Stage at Politecnico di Milano (2010-2011) supported by CAPES foundation (Brazil).
- Cynthia Zazzarini – Research assistant supported by Italian Ministry of Education, Research and University.
- Matteo Seregni - PhD degree in Biomedical Engineering (Politecnico di Milano) supported by Italian Ministry of Education, Research and University.
- Aurora Fassi - PhD degree in Biomedical Engineering (Politecnico di Milano) supported by Italian Ministry of Education, Research and University.
- Antonella Belfatto - PhD candidate in Biomedical Engineering (Politecnico di Milano) supported by Italian Ministry of Education, Research and University.
- Paolo Patete – Post doc supported by EON Medica (Italy).
- Andrea Pella – Post doc supported by CNAO (Pavia, Italy)

COMPETENCES IN SCIENTIFIC RESEARCH AREAS

Machine vision: in this scientific area, Pietro Cerveri started its activity by coping with the calibration of multi-camera systems and dealt with methods and technologies for object and human motion real-time tracking. He conceived innovative methods for camera calibration based on Evolutionary Computation validated across different motion capture systems. He developed calibration and tracking applications that were acquired by an Italian Company in the field (BTS Engineering, Milano – Italy). The related scientific aspects were object of publication in ISI peer-review international journals of the biomechanical community. In particular, the innovative evolutionary approach was published in the most relevant scientific journal (IEEE Transaction on Evolutionary Computation) in the area of evolutionary computation. Due to his skills in this field of research he collaborated to different research and industrial projects: **a**) in July-August 2000 he was recruited by Electronic Arts Canada in Vancouver (British Columbia, Canada) as a software engineer to collaborate to a project for the development of automatic algorithm for camera calibration of multi-camera system (20 cameras); **b**) since 1999 to 2004 he was involved in the project "ELITE-S2" funded by Italian Space Agency (ASI) where he was responsible of Workpackage 3 "System calibration". The project consisted in the development of a new motion capture platform for acquisition of astronaut movements in microgravity conditions (physiological motion adaptation to microgravity); **c**) since 2005 to 2006, he was involved in a national industrial project funded by

DIES srl (Roma, Italy), named "VIMS: An innovative system for surgical training in ophthalmic mini-invasive surgery", as responsible of the Workpackage 2 "Camera calibration and surgical tip tracking".

Biomechanics: in this scientific area, Pietro Cerveri coped with the problem of the human kinematic estimation from surface markers for clinical and sport applications. Starting from the development of full body kinematic models, he focused its investigation on the analysis of anatomical subparts as the spine, the lower limb and the hand. He developed method to the estimation of kinematic parameters (centers and axes of rotation), he faced the problem of reduction of the effect of soft tissue artifacts and developed innovative algorithm based on state-space filters and neural networks for the simulation of human-like trajectories, and volume capture for the motion analysis without surface markers. The results of such activities were extensively published in ISI peer-review international journals. The corresponding papers now constitute the state-of-the art for motion estimation techniques. Since 2003, he has been collaborating with University of Campinas (Brasil) in the field of motion capture and analysis for sport applications. Since 2005-2006, he participated to a project in cooperation with by Biomotion Laboratory-Mechanical Engineering Department – Stanford University, Stanford, CA (USA) named "Markerless Motion Capture". He was involved in a project co-funded by Nuclear Medicine Department and CERMAC - San Raffaele Scientific Institute aiming at using MRI-based bone surface models to analysis the kinematics of hand and finger joints. He is now a participant in National Project funded by Ministry of Education, University and Research. "Biomechatronic hand prostheses endowed with bio-inspired tactile perception, bi-directional neural interfaces and distributed sensori-motor control" (2013-2015).

Medical informatics: in this scientific area, the research activity of Pietro Cerveri can be split in two main subjects: knowledge representation and bioinformatics. As far as the knowledge representation is concerned, he spent he doctoral period dealing with the problem of symbolic anatomical knowledge representation and the integration of such information with the visual information coming from image (histological, morphological) data. His doctoral program was co-funded by the National Library of Medicine, National Institute of Health in Bethesda (MD - USA) under the "Visible Human Dataset" (the greatest digital archive in the world of histological images of a human cadaver) project. He investigated semantic networks and database technology as infrastructure for representing and coding symbolic information. He focused his research on conceptual classification, ontology and digital medical vocabularies as UMLS and SNOMED to cite few. He developed a software framework for joining visual and symbolic anatomical information by allowing an interactive querying of digital images. The results of the doctoral period were published in ISI peer-review international specialized journals.

In the bioinformatics field, Pietro Cerveri dealt with the management and the analysis of human genetic data (genomic differential expression data) coming from micro, gene-chips, oligonucleotides arrays. He collaborated to a project funded by IEO – European Institute of Oncology (Milano, Italy), called "Development and implementation of new methodologies for management and analysis of large scale micro-array genomic data. Studies of differential regulation" aiming at developing a SW platform for the management and analysis of large scale micro-array data of differential gene expression. In particular, he was responsible of the Workpackage 3 "Data management, clustering methods and analysis". He developed automatic procedures for managing large amount of genomic data (5-25GB every study), algorithms for intra-inter experiment calibration, for data clustering and statistical analysis of differential genomic expression and co-expression. The results of this research activity were published in ISI peer-review international specialized journals.

Medical image processing, computer aided surgery, radiotherapy and medical robotics: in this broad scientific area, Pietro Cerveri dealt with medical image processing, - segmentation, fluoroscopic image rectification, multi-modal volume registration (CT-MR, CT-ANGIO) - for planning of the radio-surgery treatment through the Cyberknife. He extensively collaborated with San Bortolo Hospital in Vicenza (Italy) and Department of Neurosurgery, Neuromed IRCCS, 86077 Isernia (Italy). Particularly, he contributed to the development and validation of methods for registration (rigid and non-rigid) based on the mutual information paradigm. The work focused the automatic identification in the images of organs at morphological and functional risk. He is co-author of a number of publications on the subject in ISI peer-review international journals in the realm of medical physics. In computer aided surgery scientific area, his research activity focused formerly on Orthopaedics. In particular, he dealt with navigation for knee and hip surgery. He developed registration algorithms based on bone-morphing, method to compute intra-operatively the limb mechanics starting from measurements of points or areas on the bone surfaces, automatic methods to computed the optimal positioning and size of the prosthesis, method for real-time visualization. From 2005 to 2006 he was

involved in an Industrial Research project funded by Lima lto (Udine, Italy) named "Technologies and methods for surgical navigation in knee and hip arthroplasty". He was responsible of the Workpackage 5 "Intra-operative software module". His activity in this field evolved as he moved to the design and development of intra-operative monitoring devices that leaded to a number of patents. In 2007, he was leader of the *Collaborative Research Project* funded by FSE INGENIO (Lombardia Region) "New technologies for surgical navigation" where he investigated different technologies for surgical navigation. Since 2007, he has been participating to the *National project* funded by Politecnico di Milano and Politecnico di Torino "ORTHOROB, ORTHOpaedic Surgery and ROBotics" (2007-2009) in quality of responsible of Workpackage 2 "Robot interface". Since January 2008, he has been participating in the *European Project*: FP7-ICT-2007-215190 "ROBOCAST: ROBOt and sensors integration for Computer Assisted Surgery and Therapy" (2008-2010) in quality of responsible of workpackage 6 "System interface". Along this direction, in early 2010 he started a research activity in collaboration with Niguarda hospital in Milano (Italy) with the goal of developing innovative robotic technologies for abdominal surgery. In this domain, Pietro Cerveri was principal investigator of two projects, namely "Self propelled Instrument Carrier for surgery through natural orifices", concerning a feasibility study on robotics for surgery in microgravity funded by the European Space Agency (2009-2010) and "Innovative modular micro robotic instruments for transluminal endoscopic surgery" (2010-2012) funded Italian Ministry of Education, University and Research. In the field of radiotherapy, he is collaborating with National Center of Oncology Hadron Therapy and he has been included in three main projects: "Robotic imaging system for hadron-therapy room" (2012-2013), "ULICE (Union of Light Ion Centers in Europe, FP7-INFRA-2008-1.1.2) (2010-2013) and "ENVISION - European NoVel Imaging Systems for ION therapy" (2010-2013). In the first project, he was responsible of the WP 2. Robotic framework to manage the feasibility analysis, the robot selection, room setup, robot programming and safety measures. Within ULICE, he is currently cooperating in the development of innovative strategies for real-time tumor tracking in hadron-therapy using artificial neural networks. Within ENVISION, he is currently cooperating in the development of a HW/SW framework for real-time steering of the particle beam in hadron-therapy to cope with tumor localization uncertainty.

SCIENTIFIC PUBLICATIONS

International journals

1. Belfatto A, Riboldi M, Ciardo D, Cattani F, Cecconi A, Lazzari R, Jereczek-Fossa B, Orecchia R, Baroni G, **Cerveri P.**, Kinetic models for predicting cervical cancer response to radiation therapy on individual basis using tumor regression measured in vivo with volumetric imaging. In press Technol Cancer Res Treat. 2015.
2. Belfatto A, Riboldi M, Baroni G, Ciardo D, Cattani F, Cecconi A, Lazzari R, Jereczek-Fossa B, Orecchia R, **Cerveri P.**, Modeling the interplay between tumor volume regression and oxygenation in uterine cervical cancer during radiotherapy treatment. In press IEEE J Biomed Health Inform. 2015 Jan 30.
3. Fassi A., Seregni, M. Riboldi M., **Cerveri P.**, Sarrut D,. Ivaldi G.. Liotta M., Baroni G., Surrogate-driven deformable motion model for organ motion tracking in particleradiation therapy, in press Phys Med Biol. 60(4):1565-1582, 2015. ISSN 0031-9155.
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PATENTS AND PATENT PENDING:

Title: Dispositivo per la rilevazione di superfici anatomiche all'interno di articolazioni
Pub. No.: MI2007A001469
Assignee : IST ORTOPEDICO GALEAZZI SPA Via Riccardo Galeazzi 4, I-20161 Milan (IT).
Inventor(s): G. Ferrigno, P. Cerveri, E. De Momi, W. Pascale
Date: 20-07-07.

Title: Device for the detection of articular forces
Pub. No.: WO/2008/129414 International Application No: PCT/IB2008/001011
Assignee: IST ORTOPEDICO GALEAZZI SPA Via Riccardo Galeazzi 4, I-20161 Milan (IT)
Inventor(s): FERRIGNO G; CERVERI P; DE MOMI E, PASCALE W.
Date: 30-10-2008.

Title: Architettura di robot articolato per uso medico
Pub. No.: n. BI.11.013.A
Assignee: POLITECNICO DI MILANO, Piazza Leonardo da Vinci 32, 20133 Milan Italy.
Inventor(s): P. Cerveri, R. Zaltieri
Date: 24-10-2011.

Title: Miniaturized device for endoscopic vision
Pub. No.: WO2013179207, International Application No.: PCT/IB2013/054370
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Date: 31-05-2012.

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