

Santa Di Cataldo – Curriculum Vitae

Personal Information

First Name: Santa
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Address (work): Dep. of Control and Computer Engineering (DAUIN) , Politecnico di Torino,
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Citizenship: Italian
Date (dd, mm, yy) and place of birth: 10, 05, 1982 - Torino, Italy

Work Experiences

Feb 2016 – present Politecnico di Torino Torino, Italy
Assistant Professor at EDA Group, Dept. of Control and Computer Engineering
Biological and Medical Image Processing.

Jan 2011 – Dec 2015 Politecnico di Torino Torino, Italy
Post-doctoral Researcher at EDA Group, Dept. of Control and Computer Engineering (*)
Biological and Medical Image Processing.

Feb 2007 – Dec 2007 Politecnico di Torino Torino, Italy
Research Assistant at EDA Group, Dept. of Control and Computer Engineering (**)
Development of algorithms for computer-aided pathology.

Education

2008-2010 Politecnico di Torino Torino, Italy
PhD in Systems and Computer Engineering (Ingegneria Informatica e dei Sistemi)
Official length of the program (yy): 3
Date of award (dd,mm,yy): 11, 04, 2011
PhD Thesis: Image Processing Techniques for Histopathology (Tecniche di Image Processing per Applicazioni Istopatologiche)

2004–2006 Politecnico di Torino Torino, Italy
MSc in Biomedical Engineering (Laurea Specialistica in Ingegneria Biomedica)
Official length of the program (yy): 2
Date of award (dd,mm,yy): 21, 12, 2006
Score: 110/110 summa cum laude

2001–2004 Politecnico di Torino Torino, Italy
BSc in Biomedical Engineering (Laurea in Ingegneria Biomedica)
Official length of the program (yy): 3
Date of award: (dd,mm,yy): 21, 09, 2004
Score: 110/110 summa cum laude

1996-2001 Liceo Scientifico C. Darwin Rivoli, Italy
High School Diploma (Diploma di Maturità Scientifica - PNI)
Official length of the program (yy): 5
Date of award (dd,mm,yy): 06, 07, 2001
Score: 100/100

Visiting experiences

Sep 2010 – Feb 2011 Philips Healthcare Best, Netherlands

Intern at Advanced Development MRI Division

Research activity on image processing techniques for Nuclear Magnetic Resonance imaging of the brain, including:

- design and development of an automated technique for the correction of motion artefacts in Arterial Spin Labelling images
- design and prototyping of a technique for the automated selection of volumes of interest and the automated tracking of nervous fibers in Diffusion Tensor images.

Languages

- English: proficient user (level C1)
- Italian: mother tongue

Technical Skills

Computer and Programming:

- Programming in C / Java / C# / Matlab
- Good command of ImageJ tool and libraries
- Good command of LaTeX and MS Office tools

Operating Systems:

- Windows / Linux / Mac OS X

Biomedical Engineering:

- Biomedical data and image processing and analysis
- Computer vision and pattern recognition
- Biological and physiological signal processing and analysis
- Bioimage enhancement, registration and tracking
- Medical Instrumentations
- Information technologies in medicine

Teaching/tutoring activity

Teaching assistant in courses of Politecnico di Torino:

- Informatica, Cod. 06BHDFJ, language: Italian, a.a. 2008-2009
- Computer Sciences, Cod. 02JCJFJ, language: English, a.a. 2009-2010
- Computer Sciences, Cod. 04JCJLI, language: English, a.a. 2010-2011
- Informatica, Cod. 12BHDLZ, language: Italian, a.a. 2011-2012
- Informatica, Cod. 12BHDLZ, language: Italian, a.a. 2012-2013
- Informatica, Cod. 12BHDLZ, language: Italian, a.a. 2013-2014
- Informatica, Cod. 12BHDLZ, language: Italian, a.a. 2014-2015
- Informatica, Cod. 12BHDLZ, language: Italian, a.a. 2015-2016

Guest lecturer of PhD courses in Politecnico di Torino:

- Methods and tools for bioinformatics, language: English, a.a. 2010-2011
- Methods and tools for bioinformatics, language: English, a.a. 2011-2012

Production of teaching materials (slides, exercises, lab notes and exams) for the courses of “Informatica”, “Computer Sciences” and “Methods and tools for bioinformatics”

Tutoring of 2 junior research assistants

Contributions to European and National funded projects

National projects:

- *CIPE Regione Piemonte, Clinical-molecular correlation in the lung cancer with alteration of the epidermal growth factor*
2005-2008 Collaboration to research activities

- *Ricerca Corrente 2012* (Ministero della Salute), with Istituto Zooprofilattico del Piemonte, Liguria e Valle d'Aosta
2013-2015 Collaboration to proposal, management and research activities

European projects:

- *CSI (Central Nervous System Imaging)* <http://www.eniac-csi.org/CSI/>
2010-2013 Collaboration to proposal, management and research activities

- *DENECOR (Devices for NeuroControl and NeuroRehabilitation)* www.denecor.info
2013-2016 Collaboration to proposal, management and research activities
Local scientific coordinator and task leader (sep 2013 – apr 2014)

Reviewer activity

Reviewer for international journals:

- Transactions on Information Technologies in Biomedicine (IEEE)
- Journal of Biomedical and Health Informatics (IEEE)
- Transactions on Computers (IEEE)
- Transactions on Computer-Aided Design of Integrated Circuits and Systems (IEEE)
- Computer Methods and Programs in Biomedicine (Elsevier)
- Opto-electronics Review (Springer-Verlag Heidelberg)
- Biomedical Signal Processing and Control (Elsevier)
- Pattern Recognition Letters (Elsevier)
- Artificial Intelligence in Medicine (Elsevier)
- Micron (Elsevier)
- Journal of Medical Imaging and Health Informatics (American Scientific)
- International Journal of Medicine and Medical Sciences
- Expert Systems and Applications (Elsevier)

Reviewer for international conferences:

- BIOINFORMATICS (International Conference on Bioinformatics Models, Methods and Algorithms)
- iCBEB (International Conference on Biomedical Engineering and Biotechnology)
- IEEE CBMS (International Symposium on Computer-Based Medical Systems)

Contribution to organization of conferences

TPC (Technical Program Committee) member of international conferences:

- IEEE CBMS 2014 (27th International Symposium on Computer-Based Medical Systems)
- iCBEB 2014 (International Conference on Biomedical Engineering and Biotechnology)
- iCBEB 2015 (International Conference on Biomedical Engineering and Biotechnology)
- iCBEB 2016 (International Conference on Biomedical Engineering and Biotechnology)

Lectures

Conference speeches:

- *Selection of tumor areas and segmentation of nuclear membranes in tissue confocal images: A fully-automated approach*, full paper presentation at BIBM 2007, IEEE International Conference on Bioinformatics and Biomedicine, Fremont, US, 2-4 nov 2007
- *Fully-automated segmentation of tumor areas in tissue confocal images: Comparison between a custom unsupervised and a supervised SVM approach*, full paper presentation at BIOSTEC/BIOSIGNALS 2008, International Conference on Bio-inspired Systems and Signal Processing, Funchal, Madeira, 28-31 jan 2008
- *Segmentation of nuclei in cancer tissue images: Contrasting active contours with morphology-based approach*, full paper presentation at BIBE 2008, 8th IEEE International Conference on Bioinformatics and BioEngineering, Athens, Greece, 8-10 oct 2008
- *Applying textural features to the classification of HEP-2 cell patterns in IIF images*, full paper presentation at ICPR 2012, 21st International Conference on Pattern Recognition, Tsukuba, Japan, 11-15 nov 2012
- *SVM Classification of HEP-2 Cell Patterns based on Textural Features*, abstract presentation at the Contest on HEP-2 cells classification, 11 nov 2012, Tsukuba, Japan
- *Unsupervised HEP-2 mitosis recognition in Indirect Immunofluorescence Imaging*, full paper presentation at the 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC 2015), 29 aug 2015, Milan, Italy

Invited seminars and lectures:

- *Going for Smart: Automated Roi Drawing in DTI Fiber Tracking*, Philips Healthcare, Best, NL, February 2011
- *Le tecnologie al servizio della sanità animale e della sicurezza alimentare*, Castello del Valentino, Turin (Italy), April 2014

Awards

- *Premio Donna Innovazione Piemonte, 2010* for the project "Biossol", presented at Start Cup Torino Piemonte 2010 (October 2010)
- *Best paper nomination* at the international conference BIOSTEC / BIOINFORMATICS 2013

Research activity and Contributions

Since february 2007, Santa Di Cataldo is with the EDA group of the Dept of Control and Computer Engineering in Politecnico di Torino, under the direction of Prof. Enrico Macii. Since end of 2011, she is in charge of the research activities of EDA Group on *Bioimaging*, focusing on the design and development of methods, algorithms and tools for the automatic analysis of medical and biological images.

More specifically, contributions are in the design of novel techniques or automated pipelines for

(i) image segmentation and automated discrimination of anatomical parts, tissues or cellular regions; (ii) recognition and classification of specific patterns within the images; (iii) definition and selection of features for image characterization in a specific clinical context; (iv) registration and superposition of scans acquired at different times or from different patients or using different imaging technologies.

Based on medical/biological application, the research activity of Santa Di Cataldo can be categorized into five main areas. These areas are summarized in the following, with reference to main research topics and motivations, collaborations and obtained scientific results and publications.

1- Immunohistochemistry for cancer diagnosis

Immunohistochemistry (IHC) is today one of the most popular techniques of microscopy to analyze the presence and activity of specific proteins in tissues, with important applications in the diagnosis of many types of cancer. The diagnostic potentials of this technique, however, are severely limited by the subjectivity of the visual inspection of the images.

The international medical community has long raised the issue of IHC standardization, recognizing a possible solution in the automatization of image analysis. However, such automatization has many difficulties. Indeed, IHC images of tissues are subject to numerous sources of noise and heterogeneity. This is partly due to problems in the preparation of the samples, and partly to non-predictable variations induced by the pathological process. Hence, despite IHC image analysis is a very lively and active field, there are still many open problems to be addressed by the research community.

Santa Di Cataldo began her research activity on the automated analysis of analysis of IHC images in early 2007, in collaboration with the Dept. of Anatomical Pathology of San Luigi Hospital in Orbassano (Torino), within a project funded by CIPE Piedmont Region (2005-2008). This activity was extended during her PhD (2008-2011) and finalized in a doctoral thesis entitled "Image processing techniques for histopathology."

During these years of research, Santa Di Cataldo addressed several problems in the field of automatic image IHC, including the design of automated techniques for the automatic discrimination of the pathological tissue, for the segmentation of all the cellular areas of interest (nuclei, cell membranes and cytoplasm), and for the extraction of objective measures of protein activity by IHC imaging. This research led to four articles in international journals with review process, 3 articles in international conferences with review process and a book chapter.

2- Neuro-imaging (MRI, PET, US)

The inevitable aging of the European population requires the design of new technologies to support the diagnosis and treatment of diseases of the central nervous system. Neuro-imaging technologies such as minimally invasive MRI (Magnetic Resonance Imaging), PET (Positron Emission Tomography) and US (Ultrasound) allow a proper monitoring of these diseases and a better definition of the strategy and effectiveness of prescribed therapies. In recent years, the European Union has devoted increasing attention to these research topics. The ENIAC European projects CSI and DENECOR are an example.

Santa Di Cataldo has been actively involved in such projects, with activities aimed at developing novel software techniques for the analysis of brain images acquired with the latest generation neuro-imaging technologies. These activities required continuous collaboration with Italian and multinational research institutions, organizations and companies operating in the field of microelectronics applied to biomedicine as well as design and manufacture of biomedical systems. Among the others, STMicroelectronics and Philips Healthcare. The collaboration with Philips Healthcare also led to an internship of Santa Di Cataldo at the Division of Advanced Development of MRI Philips Healthcare in Best (Netherlands) in the period September 2010 - February 2011.

The research activities performed in this area include:

- Design and development of software for automatic correction of the motion artifact from magnetic resonance images acquired with ASL (Arterial Spin Labeling) technology. This research, in collaboration with Philips Healthcare NL, led to the publication of an international conference article and to a MS thesis from the Polytechnic of Turin under the supervision of Santa Di Cataldo.
- Study, design and prototyping of a novel technique for the selection of volumes of interest and the automatic tracking of neural fibers in magnetic resonance images acquired with DTI (Diffusion Tensor Imaging) technology. The implemented software has been integrated into a prototype MRI system at the laboratories of Philips Healthcare in Best (Netherlands). This activity, finalized during the internship at the Department of Advanced Development MRI-CTO was presented at the invited seminar "*Going for Smart: Automated Drawing Roi in DTI Fiber Tracking*", 16-02-2011.
- Design and development of software for the generation of 3D linear attenuation coefficient maps of the brain from the segmentation of MRI images. Such activity, in collaboration with Philips Healthcare, is aimed at improving PET image reconstruction within integrated MR-PET systems of latest generation.

- Design and implementation of a library for the automatic measurement of image quality in small animal PET systems. This activity, in collaboration with the University of Debrecen (Hungary), is aimed at validating a prototype of latest generation PET system.
- Design of a software techniques for real-time superposition and registration of brain images obtained with MRI and US of the latest generation. Such software will be employed in a neuro-navigation system for neurosurgical applications, implemented in collaboration with STMicroelectronics.

3- Indirect immunofluorescence for the diagnosis of autoimmune diseases

Indirect immunofluorescence (IIF) is very effective and powerful diagnostic test based on fluorescence microscopy, which is able to detect in a timely manner various types of immune pathologies, whose incidence is growing in recent years. However, the visual analysis of IIF images presents several drawbacks, including the large inter-operator variability, which limits the reproducibility of the test, and the need of significant resources to train the personnel. The automation of the IIF image analysis may offer a solution to this problem.

Since the end of 2012, Santa Di Cataldo focused her research activity on the design and development of a Computer-Aided Diagnosis (CAD) system to support IIF analysis. This is a relatively new and under-investigated field, which is attracting more and more interest by the international scientific community. In November 2012, Santa Di Cataldo participated with a team of colleagues to a competition hosted by ICPR Conference 2012 in Tsukuba (Japan), *Contest on HEP-2 cells classification*. The theme of the contest was the automatic recognition of HEp-2 pattern staining in IIF samples IIF, which is an application of primary importance for the differential diagnosis of autoimmune diseases. Since then, the research activities of Santa Di Cataldo in the field of IIF image analysis led to three articles in international conferences, a book chapter and three international journal articles.

4- Histology applied to food security

In collaboration with the Istituto Zooprofilattico Sperimentale del Piemonte, Valle d'Aosta and Liguria (IZSTO), Santa Di Cataldo's research activity is focused on the automatic analysis of histological images of cattle tissues, for the detection of fraudulent treatments with corticosteroids. The aim of the project, funded by the Ministry of Health in 2012, is to replace the existing chemical methods subsidized by the Ministry, which have significant disadvantages in terms of reliability as well as economical sustainability. A prototype of the software is already in use for experimental validation at IZSTO.

5- 3D morpho-functional image analysis for the assessment of neuropathies

Diabetic polyneuropathy is a major complication of diabetes mellitus, which causes severe alterations of the neural circuits between the spinal nerves and the spinal cord. The quantitative analysis of 3D confocal images of dorsal root ganglia in diabetic mice, where different types of fluorescent markers are used to identify different types of nociceptors, can help understanding the mostly unknown mechanisms of this pathology. Nevertheless, due to the inherent challenges of 3D confocal imaging, a thorough and comprehensive investigation of such mechanisms is very difficult. Hence, there is a strong demand for automated image analysis techniques supporting this study. Santa Di Cataldo has recently established a collaboration with the Dept. of Veterinary Sciences of Università di Torino, aimed at designing and developing an automated tool for (i) recognizing the positively labelled cells within the 3D volume; (ii) performing a 3D reconstruction and rendering of the neurons (iii) performing quantitative measures of signal intensity and density of positive neurons in each channel (iv) studying statistical differences between morphological characteristics of the neurons in healthy and diabetic samples.

Publications

See the updated list at:

http://porto.polito.it/view/creators/Di_Cataldo=3ASanta=3A019491=3A.html

Torino, 01/03/2016

SANTA DI CATALDO *

* To the senses of Italian legislative decree n.196/2003, I give my consent to the treatment of my personal data for human resources research