BIOGRAPHICAL SKETCH

NAME: Luca Giancardo

eRA COMMONS USER NAME (credential, e.g., agency login): lgiancardo

POSITION TITLE: Associate Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Southampton Solent University, UK	BSc. (Hons)	09/2005	Software Engineering
Heriot-Watt University, UK; Girona University, Spain; University of Burgundy, France	MSc.	08/2008	Computer Vision/Robotics
Oak Ridge National Laboratory, TN; University of Burgundy, France	Ph.D.	09/2011	Computational Image Analysis
Istituto Italiano di Tecnologia, Italy	Postdoctoral	06/2013	Biomedical Pattern Recognition and Image Analysis
Massachusetts Institute of Technology, MA	Postdoctoral	08/2016	Translational Biomedical Engineering

A. Personal Statement

I am a Tenured Associate Professor at the Center for Precision Health, School of Biomedical Informatics (SBMI), UTHealth with co-appointments in Diagnostic and Interventional Imaging, McGovern Medical School, UTHealth and the Institute for Stroke and Cerebrovascular Diseases, UTHealth.

I am a computer scientist with extensive experience in image analysis and machine learning. My work has been applied to several biomedical applications, such as diabetic retinopathy screening or neurodegenerative disease tracking and successfully translated to industry with two successful startups based on my methods. I have authored/co-authored more than 70 peer-reviewed articles (H-index 28), which were featured by news outlets such as MIT Technology Review, Smithsonian magazine, and others. I have received multiple awards, including the prestigious 100k Singapore Challenge (judging panel composed by Nobel Prize and Millennium Technology Prize winners). In 2022, the neuroQWERTY project I started was included in the MIT Museum permanent exhibit “Essential MIT.”

My research lab has been supported by competitive grants from NIH (R01), the Translational Research Institute for Space Health, Learning Healthcare grants, and private companies. Additionally, I administered/hired staff, supervised trainees, wrote multiple research protocols approved by institutional review boards, and managed the software infrastructure to collect patient data. My strong technical background, paired with my experience in practical implementation of projects with human and animal studies has enabled me to successfully translate my research to industry or other practical applications since the very beginning of my research career.

Ongoing and recently completed projects that I would like to highlight include:

NIH R01NS121154 **(Sheth/Giancardo)** 04/01/2021-03/31/2026
NIH/NINDS
Title: Deep Learning Enabled Endovascular Stroke Therapy Screening in Community Hospitals
Project Goal: The goal of this project is to develop and validate machine learning-based software tools to identify patients eligible for endovascular stroke therapy using CT angiography.
Role: PI

NNX16A069A **(Giancardo)** 04/01/2020 – 03/31/2022
BCM/NASA
Title: Actionable Deep Space Stroke Detection with Deep Learning and Retinal Imaging
Goal: This project aims to create and validate software prototypes towards this goal with a ground-based study which involves a data collection and algorithm development effort.
Role: PI

(**Roberts/Giancardo)** 02/01/2022-01/31/2024
McNair Foundation
Title: Artificial Intelligence Approaches to Find New Treatments for Endometriosis
Project Goal: accelerating diagnosis and treatment for endometriosis. This includes natural language process for electronic health records analysis to predict endometriosis diagnosis and outcomes; and automated MRI-imaging interpretation for endometriosis staging and progression.
Role: PI

(Giancardo) 03/01/2022 – 02/28/2023
nQ Medical
Title: nQ Medical Multisensor Research Program
Goal: develop computational biomarker for the detection and quantification of neurodegeneration by combining wearable sensors and interaction with digital devices.
Role: PI

R21EB029575 **(Roberts)** 04/01/2020 – 03/31/2023
NIH
Title: Fine-grained spatial information extraction for radiology reports
Goal: The goal of this project is to extract fine-grained spatial information from radiology reports for use in improving radiology image classification.
Role: Co-I

RP170668 **(Zheng)** 08/31/2017 – 08/30/2022
CPRIT
Title: Data Science and Informatics Core for Cancer Research
Goal: The goal of this project is to establish a data science and informatics infrastructure and translate cutting edge data science and informatics software tools and algorithms developed at UTHealth for cancer research.
Role: Co-I (Imaging lead)

B. Positions, Scientific Appointments, and Honors

Positions and Scientific Appointments

2023- Regular Member, MD Anderson – UTHealth Graduate School of Biomedical Sciences
2022- Associate Professor (with Tenure), Center for Precision Health, School of Biomedical Informatics and Diagnostic and Interventional Imaging, McGovern Medical School. The University of Texas Health Science Center at Houston (UTHealth), TX
2018-22 Assistant Professor, Diagnostic and Interventional Imaging, McGovern Medical School, The University of Texas Health Science Center at Houston (UTHealth), TX
2016-22 Assistant Professor, Center for Precision Health, School of Biomedical Informatics, The University of Texas Health Science Center at Houston (UTHealth), TX
2016- Member, Consortium on Aging at UTHealth
2016- Keck Faculty Affiliate, Gulf Coast Consortia
2013-16 Fellow, Massachusetts Institute of Technology, MA
2011-13 Postdoc, Istituto Italiano di Tecnologia, Italy
2008-11 Researcher, Oak Ridge National Laboratory, TN
2008- Member, Institute of Electrical and Electronics Engineers (IEEE)
2005-06 Computer Vision R&D, Real Time Tracking ltd, UK

Honors

2024 UTHealth SBMI Dean's Excellence Award for Innovation
2022 My neuroQWERTY project included in the MIT Museum permanent exhibit "Essential MIT"
2019 UTHealth SBMI Dean's Excellence Award for Research
2018 First prize at UTHealth consortium of Aging pitch competition
2017 Best Oral Paper at the 4th MICCAI Workshop on Ophthalmic Medical Image Analysis
2015 Winner of 100K Singapore challenge
(judging panel composed by Nobel Prize and Millennium Technology Prize winners)
2014 Selected as MIT representative for the Global Young Scientists Summit in Singapore
2014 Initiative prize at IDEO at design-a-thon at IEEE-HIPOCT in Seattle
2014 Selected as a Translational Fellow at the Research Lab. of Electronics, MIT
2013 Research fellowship for the M+Vision program at MIT
2013 Winner of the first "Hacking Medicine" event in Madrid
2010 R&D Award by R&D Magazine for Telemedical Retinal Image Analysis and Diagnosis
2010 ORNL Award Excellence in Technology Transfer
2010 ORNL Significant Event Team Award
2010 FLC Southeast Regional Award Excellence in Technology Transfer
2009 2nd prize, Memphis BioMedical Imaging Symposium 2009
2006 Research fellowship for the first European VIBOT Master in Computer Vision and Robotics
2005 Winner of the British Computer Society Prize (as best Computer Science student in the University)
2005 David Nicholas Award for Innovation awarded by the Wessex Round Table of Inventors, UK

C. Contribution to Science

1. Machine Learning-based Methods for Neuroimaging (MRI, DTI, CTA) and Multimodal integration

We have developed new machine learning-based approaches to analyze a variety of Brain MRI and Computer Tomography data. Recently, we have developed the proof of principle of a new general-purpose deep learning network architecture sensitive to visual and temporal differences. These approaches allow to be trained using image-level labels to obtain segmentations maps, thereby greatly simplifying the labelling process, also they can be used to detect longitudinal brain changes. These techniques allow for data-driven processing able to discover imaging biomarkers candidates from whole brain or atlas specific diffusion-MRI data. These approaches have been applied to Alzheimer's disease, Parkinson's disease and acute stroke imaging and integration with clinical variables.

a. D Pena, A Barman, J Suescun, X Jiang, MC Schiess, L Giancardo. Quantifying Neurodegenerative Progression With DeepSymNet, an End-to-End Data-Driven Approach. Front Neurosci. 13:1053 (2019).
b. O Peña-Nogales, T Ellmore, R de Luis-García, J Suescun, M Schiess & **L Giancardo***. Longitudinal Connectomes as a Candidate Progression Marker for Prodromal Parkinson's Disease. *Frontiers in Neuroscience* 12**,** (2019).
c. D Pena, J Suescun, M Schiess, T M Ellmore, and **L Giancardo***, "Toward a Multimodal Computer-Aided Diagnostic Tool for Alzheimer's Disease Conversion," *Front Neurosci*, vol. 15, p. 744190, (2022).
d. **L Giancardo***, A Niktabe, L Ocasio, R Abdelkhaleq, S Salazar-Marioni, SA Sheth. Segmentation of acute stroke infarct core using image-level labels on CT-angiography. *NeuroImage: Clinical*, vol. 37, p. 103362 (2023).

2. Other Machine Learning-based Tools for Stroke with Imaging Data

We have developed tools used for analysis specific to stroke imaging. In Estrada et al. (2022), we propose an approach to quantify what is the best acquisition strategy for non-advanced CT-based imaging to estimate infarct core. In Pachade et al. (2022), we used retina images to detect signs of acute stroke. In Czap et al. (2023), we show how our ML models can work on lower quality multi-institutions Mobile Stroke Unit CTAs.

a. U M L-T Estrada, G Meeks, S Salazar-Marioni, F Scalzo, M Farooqui, J Vivanco-Suarez, S O Gutierrez*, S A Sheth, and **L Giancardo***, “Quantification of infarct core signal using CT imaging in acute ischemic stroke,” NeuroImage: Clinical, vol. 34, p. 102998, (2022).
b. S. Pachade, I. Coronado, R. Abdelkhaleq, J. Yan, S. Salazar-Marioni, A. Jagolino, M. Bahrainian, R. Channa, S. A. Sheth, **L. Giancardo***. "Detection of Stroke with Retinal Microvascular Density and Self-Supervised Learning Using OCT-A and Fundus Imaging " *J. Clin. Med.* vol. *11*(24), (2022)
c. A L Czap, M Bahr-Hosseini, N Singh, J-M Yamal, M Nour, S Parker, Y Kim, L Restrepo, R Abdelkhaleq, S Salazar-Marioni, K Phan, R Bowry, S S Rajan, J C Grotta, J L Saver, **L Giancardo**, and S A Sheth*. Machine Learning Automated Detection of Large Vessel Occlusion From Mobile Stroke Unit Computed Tomography Angiography. *Stroke* **53**:1651–6 (2022). **(co-last author)**
d. S A Sheth*, **L Giancardo**, M Colasurdo, V M Srinivasan, A Niktabe, P Kan, "Machine learning and acute stroke imaging". *Journal of NeuroInterventional Surgery*, 15:195–9 (2023). **(co-first author)**

3. Machine Learning-based Tools for Ophthalmic Image Analysis

Since my PhD I have developed novel machine learning approaches for retina image analysis. A significant part of this research was translated to industry. In fact, the software that I developed for automatic diagnosis, lesion segmentation and quality estimation algorithms is currently used in medical clinics and commercialized by a startup, Hubble Telemedical, which was acquired by Welch-Allyn in 2015. Additionally, various industrial and academic prizes were awarded to my research and intellectual property was generated. These works include deep learning-based method for imaging-based biomarker discovery using vasculature (“Best Oral Paper” prize at MICCAI Workshop on Ophthalmology Medical Image) and generalizable deep learning models for anterior segment OCT in Glaucoma

a. **L Giancardo***, F Meriaudeau, T P Karnowski, Y Li, S Gaarg, K W Tobin and E Chaum, “Exudate-based Diabetic Macular Edema Detection in Fundus Images Using Publicly Available Datasets”, Medical Image Analysis 16(1), 216—226, 2012.
b. **L Giancardo***, K Roberts and Z Zhao, “Representation Learning for Retinal Vasculature Embeddings”. Fetal, Infant and Ophthalmic Medical Image Analysis. FIFI 2017, OMIA 2017. Lecture Notes in Computer Science, vol 10554. Springer, Cham, 2017.
c. I Coronado, R Abdelkhaleq, J Yan, S Salazar Marioni, A Jagolino-Cole, R Channa, S Pachade, S A Sheth, **L Giancardo***. “Towards Stroke Biomarkers on Fundus Retinal Imaging: A Comparison Between Vasculature Embeddings and General Purpose Convolutional Neural Network”. Conf Proc IEEE Eng Med Biol Soc. (2021).
d. R Zhou R, AZ Chuang, RM Feldman, **L Giancardo***. “MVGL-Net: A generalizable multi-view convolutional network for anterior segment OCT. Biomedical Signal Processing and Control”, vol. 85 p. 104778 (2023).

4. Computational Biomarkers for Neurodegenerative Diseases with Digital Device Interaction and Machine Learning

The line of research aims to transform the current diagnostic and monitoring of neurological disorders with tools that seamlessly integrate with daily activities. I have been working to address two unmet medical needs: quantitative/high compliance Parkinson's disease symptoms measurements to guide clinical decisions and early detection of Parkinson's to enable testing and deployment of neuroprotective treatments. My team, created from the ground up, comes from medical, engineering and computer science backgrounds. The project was bootstrapped with competitive intramural seed funding on top of my fellowship at MIT. This allowed to develop new computational methods to detect subtle motor impairments based on timing of finger interactions on a standard personal computer or mobile devices without predefined tests. We created and tested software tools to remotely collect months’ worth of data with millisecond resolution and computational algorithms able to repeatably detect the motor effect induced by sleep inertia (an effect similar to sleep deprivation) and distinguish early Parkinson's disease cases from matched controls. This was achieved via machine learning models to create computational biomarkers. These results allowed us to submit a white paper to an open call for the “Aging in place” gran challenge at the Global Young Scientists Summit in Singapore. The research proposal, which I presented, was selected from 60 international submissions and awarded the first prize of $100K.

a. **L Giancardo***, A Sanchez-Ferro, T. Arroyo-Gallego, I. Butterworth, C.S. Mendoza, P. Montero, M. Matarazzo, A. Obeso, M. L. Gray and San José Estepar, “Computer keyboard interaction as an indicator of early Parkinson's disease”, Scientific Reports, vol. 6 p. 34468 (2016).
b. T Arroyo-Gallego, M Ledesma-Carbayo, A Sanchez-Ferro, I Butterworth, C Mendoza, M Matarazzo, P Montero, R Lopez-Blanco, V Puertas-Martin, R Trincado and **L Giancardo***. Detection of Motor Impairment in Parkinson’s Disease via Mobile Touchscreen Typing. IEEE Transaction on Biomedical Engineering, 64, 1994–2002, 2017.
c. A A Holmes, S Tripathi, E Katz, I Mondesire-Crump, R Mahajan, A Ritter, T Arroyo-Gallego*, **L Giancardo***. "A novel framework to estimate cognitive impairment via finger interaction with digital devices". Brain Communication. vol. 4, no. 4 (2022).
d. "Keystroke-Dynamics for Parkinson’s Disease Signs Detection in An At-Home Uncontrolled Population: A New Benchmark and Method". IEEE Transactions on Biomedical Engineering. vol. 70, no. 1, pp. 182–192 (2023).

5. Deep Learning-based Tools for MRI Safety and Machine Learning-based Tools for High-Throughput Animal Behavior Analysis

MRI is an imaging modality essential for the diagnosis, prognosis and tracking of several medical condition. However, people with implantable devices are likely to lack accurate information about the specifics of their device. We demonstrated the feasibility of deep learning-based system to allow for a quick and safe MRI safety clearance from X-ray images. Such system could be tightly integrated with the current radiologist workflow and leverage modern machine learning (ML) algorithms able to identify and quantify image patterns and being continuously updated with newer devices entering the market. We also developed computational techniques that for the first time were able to track the position of multiple mice and classify their behaviors at each instant in time.

a. **L Giancardo***, D Sona, D Scheggia, F Papaleo and V Murino, “Segmentation and Tracking of Multiple Interacting Mice by Temperature and Shape Information”. 21st International Conference on Pattern Recognition, 2012.
b. **L Giancardo***, D Sona, H Huang, S Sannino, F Managò, D Scheggia, F Papaleo and V Murino, “Automatic Visual Tracking and Social Behaviour Analysis with Multiple Mice”, PLOS ONE, 2013.
c. **L Giancardo***, O Arevalo, A Terneiro, R Riascos, E Bonfante, “MRI Compatibility: Automatic Brain Shunt Valve Recognition using Feature Engineering and Deep Convolutional Neural Networks”, Scientific Reports, 8(16052), (2018).
d. S J Sujit, E Bonfante, A Aein, I Coronado, R Riascos-Castaneda, and **L Giancardo***, “Deep Learning Enabled Brain Shunt Valve Identification Using Mobile Phones,” *Computer Methods and Programs in Biomedicine*, p. 106356 (2021).

Complete List of Published Work in my NCBI:
https://www.ncbi.nlm.nih.gov/myncbi/10MtMRnBnJPsOi/bibliography/public/