Activities and Publications Report

PhD Student: Danilo Calderone

Student DR number: DR996114

PhD Cycle: XXXVII
PhD Cycle Chairman: Prof. Stefano Russo

PhD program student's start date: 01/01/2022

PhD program student's end date: 31/12/2024

Supervisor: Prof. Mario Cesarelli
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Co-supervisor: Prof. Fabrizio Clemente
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PhD scholarship funding entity:
PON "Ricerca e Innovazione" 2014-2020, Azione IV.5 –"Dottorati di ricerca su tematiche Green"

General information

Danilo Calderone received in year 2021 the Master Science degree in Biomedical Engineering from the University of Napoli Federico II. He attended a curriculum in 3D printing for healthcare and Telemedicine within the PhD program in Information Technology and Electrical Engineering. He received a grant from "PON Ricerca e Innovazione 2014-2020" and "REACT EU" for financing its PhD studies, which consented him to obtain a job opportunity as R&D in "Emicenter S.R.L." during its course.

Study activities

Attended Courses

PhD Year	Course Title	Type	Credits	Lecturer	Organization
1st	Ultra High Field Magnetic Resonance Imaging	Ad hoc course	3	Prof. Giuseppe Ruello	ITEE
1st	Statistical data analysis for science and engineering research	Ad hoc course	4	Prof. Roberto Pietrantuono	ITEE
1st	Big Data Architecture and Analytics	Ad hoc course	5	Prof. Giancarlo Sperlì	ITEE
1st	Biosignals measurement and analysis	Ad hoc course	4	Dr. Emilio Andreozzi	ITEE
1st	Data Science for Patient Records Analysis	Ad hoc course	3	Prof. Marcello Cinque	ITEE
1st	Interaction Control in Surgical and Rehabilitation Robotics	Ad hoc course	2,4	Associate Prof. Ficuciello Fanny	ITEE
2nd	Biosignal and Postural Control: BioVRSea	Ad hoc course	3	Prof. Paolo Gargiulo	Reykjavik University
2nd	Academic Entrepreneurship	Ad hoc course	4	Prof. Pierluigi Rippa	ITEE
2nd	Using Deep Learning Properly	Ad hoc course	4		ITEE
3rd	Strategic Orientation For Stem Research & Writing	Ad hoc course	5	Prof. Chie Shin Fraser	ITEE
3rd	From Virtual histology to neural science	Ad hoc course	3	Prof. Paolo Gargiulo	ITEE

Attended PhD Schools

PhD Year	School title	Location	Credits	Dates	Organization
3rd	Neurotechnologies to understand and restore the nervous system	Bressanone, Italy	6	20/09/24 – 24/09/24	XLIII GNB Annual School 2024

Attended Seminars

PhD Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organization
1st	Systems biology as a compass to understand tumor-immune	0,3	MD Bedognetti Davide	DIETI	ITEE
1st	The learning landscape in deep neural networks and its exploitation by learning algorithms	0,3	Prof. Zecchina Riccardo	DIETI	ITEE
1st	Computational analysis of cancer genomes	0,3	Prof. Nùria Lòpez-Bigas	DIETI	ITEE
1st	Bench to Bytes to Bedside: Converting genomic data into healthcare Tools	0,3	Prof. Serena Nik-Zainal	DIETI	ITEE
1st	Towards a political philosophy of AI	0,4	Prof. Mark Coeckelbergh	DIETI	ITEE
1st	An Introduction to Deep Learning for Natural Language Processing	0,2	Dr. Marco Valentino	DIETI	ITEE
1st	Explainable Natural Language Inference	0,3	Dr. Marco Valentino	DIETI	ITEE
1st	Using delays for control	0,2	Prof. Emilia Fridman	DIETI	ITEE
1st	On using simple optimization techniques for tuning of UAVs	0,4	Associate Prof. Dariusz Horla	DIETI	ITEE
1st	Assessing postural control and motion sickness using electrophysiological signals	0,4	Prof. Paolo Gargiulo	DIETI	ITEE
1st	Probing and infusing biomedical knowledge for pre-trained language models	0,4	Dr. Zaiqiao Meng	DIETI	CQB
1st	Accelerating target identification and drug discovery through the power of high scale human genetics	0,2	PhD Giusy Della Gatta	DIETI	CQB
1st	Symbiotic Control of Wearable Soft Suits for human motion assistance and augmentation	0,4	Prof. Lorenzo Masia	DIETI	CQB

1st	Assessing postural control and motion sickness BioVRsea paradigm	0,4	Prof. Paolo Gargiulo	DIETI	ITEE
1st	New paradigms for 3D modelling and surgical planning	0,4	Prof. Paolo Gargiulo	DIETI	ITEE
1st	Durability of fuel-cell systems	0,4	Prof. Elodie Pahon	DIETI	ITEE
2nd	Learning gene association networks using single-cell RNA-seq data: a graphical model,	0,2		DIETI	CQB
2nd	Evolution of the 3D chromatin architecture in acute leukemia	0,2		DIETI	CQB
2nd	The state of the art of AI and Physics-Based Simulations in drug discovery	0,2		DIETI	CQB
2nd	Measuring cancer evolution from (epi)genomic data	0,2		DIETI	CQB
2nd	AI, Robots and Society: Challenges and Opportunities for Social Innovation	0,2		DIETI	ITEE
2nd	EEG Source Connectivity (Part 1)	0,4	Prof. Paolo Gargiulo	Reykjavik University	Reykjavik University
2nd	EEG Source Connectivity (Part 2)	0,4	Prof. Paolo Gargiulo	Reykjavik University	Reykjavik University
2nd	3D Printing Workshop: Anatomy segmentation in Mimics	0,4	Prof. Paolo Gargiulo	Reykjavik University	Reykjavik University
2nd	3D Printing Workshop: Introduction to advanced 3D printing	0,4	Prof. Paolo Gargiulo	Reykjavik University	Reykjavik University
2nd	3D Printing Workshop: Introduction to VR segmentation	0,4	Prof. Paolo Gargiulo	Reykjavik University	Reykjavik University
2nd	3D Printing Workshop: ELUCIS for VR segmentation	0,4	Prof. Paolo Gargiulo	Reykjavik University	Reykjavik University
2nd	Picariello lectures - Data Excellence Part 1	0,4			
2nd	Picariello lectures – Artificial Intelligence for ocean dynamics	0,4			
3rd	Rewire the brain: the	0.4	Prof. Paola	DIETI	ITEE

	potential of neuroplasticity		Marangolo		
3rd	Verso una gestione smart della risorsa idrica con il supporto della digital innovation	1	Prof. Elvira Raviele	DIETI	ITEE
3rd	Perché Digital, In Un Mondo Che Sembra Già Estensivamente Digitale E Perché Trasformare – Tim	0.8	Prof. Antonia Maria Tulino	DIETI	ITEE

Research activities

Research activity aimed at studying and creating innovative models and tools for ICT based healthcare, in particular 3D printing technology and telemedicine. In collaboration with "Santobono Innovation srl" company and University of Reykjavik, the research activity carried out the PhD studies was mostly based on two main fields: "3D Printing for healthcare" and "Telemedicine".

For the telemedicine field, in collaboration with National Research Council, activities were focused on the telemonitoring service "Guardian Angel" activated in the "Santobono Pausilipon" hospital of Naples. In particular, these activities were carried out:

- Gathering of clinical and mechanical data of patients enrolled for a telemedicine service for domiciliation of patients treated with mechanical ventilation

- Characterization of the previously stated telemedicine service with PDCA Protocol

- Review of current literature of applications combining telemedicine with 5G technology

For the 3D printing field, the use of 3D printed patient specific anatomical models in healthcare was explored, highlighting advantages and disadvantages. In particular, these activities were carried out:

- Use of 3D Printing for supporting neurosurgeons and orthopedics in preoperative planning and surgery simulation using patient's 3D Printed anatomical models

- Use of 3D Printing for the mimicking of mechanical behavior of biological tissue

- Use of 3D Printing for radiotherapy for patient specific orthoses

Tutoring and supplementary teaching activities

No supplementary activities

Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
1st	21,4	5,3	38	0
2nd	11	3,8	44	0
3rd	14	2,2	52	0

Research periods in institutions abroad and/or in companies

PhD Year	Institution / Company	Hosting tutor	Period	Activities
2nd – 3rd	University of Reykjavik	Prof. Paolo Gargiulo, Abroad Tutor	6 months	Advanced 3D printing of mixtures of 3D printable materials: mechanical characterization and comparison with human anatomical tissues
1st – 2nd – 3rd	Santobono Innovation srl	Prof. Fabrizio Clemente, co-tutor	10 months	3D printing in healthcare: 3D printing of anatomical models for pediatric neurosurgery and pediatric orthopedics; Telemedicine

PhD Thesis

In the PhD Thesis, titled "Innvation in Pediatric Healthcare: 3D Printing and Telemedicine", the PhD student Danilo Calderone investigates the integration of 3D printing and telemedicine in pediatric healthcare, focusing on their transformative roles in clinical practice and their potential to address key challenges in treating young patients. The research explores how these technologies contribute to improving surgical precision, patient outcomes, and healthcare accessibility, while also considering current limitations and areas for future development.

The first part of this thesis explores the applications of 3D printing in pediatric healthcare, focusing on its significant contributions to pediatric orthopedics and neurosurgery. 3D printing has revolutionized surgical planning and intervention by enabling the creation of patient-specific anatomical models, prosthetics, and surgical guides. In pediatric orthopedics, these models facilitate complex surgeries, such as corrective osteotomies, by providing surgeons with precise, customized tools that reduce operative time and improve accuracy. Pediatric neurosurgery similarly benefits from 3D-printed models, which aid in preoperative planning for conditions requiring delicate interventions. The thesis discusses clinical case studies from the "Santobono-Pausilipon" Pediatric Hospital of Naples, where 3D printing enhanced surgical outcomes by adapting the procedures to the unique anatomical structures of young patients. Limitations, such as printing time and mechanical properties of materials, are addressed alongside optimization strategies to improve workflow efficiency and mimic biological tissues.

The second part of the thesis presents the use of telemedicine in pediatric healthcare, with a focus on telemonitoring applications. Telemedicine addresses key challenges in pediatric care, such as

frequent hospital visits and geographical disparities in access to specialists. By enabling remote consultations and continuous monitoring, telemedicine reduces the burden on families while ensuring timely medical interventions. The thesis highlights the development and implementation of the "Guardian Angel" telemedicine service at the "Santobono-Pausilipon" Hospital, designed to support children requiring home mechanical ventilation. The quality and efficacy of the service are evaluated, demonstrating its potential to enhance care delivery, improve patient outcomes, and optimize resource utilization.

In conclusion, this thesis underscores the critical role of 3D printing and telemedicine in advancing pediatric healthcare. While 3D printing offers unparalleled customization for surgical planning and treatment, telemedicine ensures equitable and efficient access to specialized care. Together, these technologies represent a paradigm shift, addressing the unique needs of pediatric patients and paving the way for more personalized, effective, and sustainable healthcare solutions.

Research products

Research results appear in M papers published in international journals, N papers published in national journals, P contributions to international conferences, Q contributions to national conferences, R patents.

List of scientific publications

International journal papers

Dolcini, A., Iuppariello, L., Calderone, D., Cesarelli, M., & Clemente, F.
"Guardian Angel 2.0: A telemedicine service for children with home mechanical ventilation",
Revue Roumaine Des Sciences Techniques Série Électrotechnique Et Énergétique,
vol. 67.3: pp. 355-358. 2022

Iuppariello, L., Calderone, D., Casaburi, A., Romano, G., Guida, P., & Clemente, F.
"Use of three-dimensional printing technology for supporting the hip reconstruction surgery in paediatric patients",
Discover Applied Sciences,
vol. 6(2), p. 44

Calderone, D., Cesarelli, G., Ricciardi, C., Amato, F., & Clemente, F.
"3D printing application for orthopedic pediatric surgery–a systematic review"
Rapid Prototyping Journal
Vol. 30(11), pp. 275-287.

International conference papers

Calderone, D., Cesarelli, G., Cesarelli, M., Iuppariello, L., Guida, P., Casaburi, A., ... & Clemente, F.
"Optimization of 3D Fused Deposition Modeling Printing Process For the Manufacturing of Devices For Medical Use"
Presented at 2023 IEEE International Conference on Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE), Milan, Italy

Calderone, D., Cesarelli, G., Iuppariello, L., Mirone, G., Cinalli, G., Amato, F., & Clemente, F.
"Applications of 3D Printing and Neuronavigation in Neurosurgery: a Literature Review and a Clinical Case Report"
Presented at E-Health and Bioengineering (EHB) 2023, 9/11-10/11, Iasi, Romania (Online participation).

Angelone, F., Ponsiglione, A. M., Andreozzi, E., Calderone, D., Cesarelli, G., Amato, F., & Romano, M.
"3D Dental Reconstruction with Photogrammetry Technology"
Presented at 2023 IEEE International Conference on Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE), Milan, Italy

Patents and/or spin offs
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Awards and Prizes
Participation to **StartCup Campania 2024** for the presentation of the start-up idea "Oris Vision" born in collaboration with University "Federico II" of Naples and "Maipec Srl" based on 3D scanners for oral cavities combined with artificial intelligence for the detection of pathologies of oral cavities: **3rd Place**

Date 14/12/2024

PhD student signature _____

Supervisor signature _____