
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

**DOTTORATO DI RICERCA / PhD PROGRAM IN
INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING**

Activities and Publications Report

PhD Student: **Verde Maria Teresa**

Student DR number: DR996117

PhD Cycle: XXXVII

PhD Cycle Chairman: Prof. Stefano Russo

PhD program student's start date: 1/1/2022

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

Supervisor: Leopoldo Angrisani

e-mail: angrisan@unina.it

Co-supervisor: Francesco Bonavolontà

e-mail: francesco.bonavolonta@unina.it

PhD scholarship funding entity: *PON Dottorati di ricerca su tematiche dell'innovazione e green - Azione IV.5 (Green)*

General information

Maria Teresa Verde received in 2019 the Master Science degree in Veterinary Medicine from the University of Napoli Federico II. She completed her postgraduate specialization in Infectious Diseases, Prophylaxis, and Veterinary Control in 2024. She took a curriculum in Electrical and electronic measurements (IMIS-01/B) within the PhD program in Information Technology and Electrical Engineering. She received a grant from PON “Dottorati di ricerca su tematiche dell'innovazione e green” - Azione IV.5 (Green).

Study activities

Attended Courses

Year	Course Title	Type	Credits	Lecturer	Organization
1 st	Piattaforme di misura e monitoraggio basate su Internet of Things.	External PhD course	6	Rosario Schiano Lo Moriello, DII, University of Naples Federico II	PhD in Industrial Engineering, University of Naples Federico II
1 st	Big Data Architecture and Analytics	Ad hoc course	5	Proff. Giancarlo Sperli, Giovanni Improta, Jari Haukka, Peter van Ooijen	ITEE
1 st	Sensori e Trasduttori di Misura	MsD Electronic engineering	9	Prof. Domenico Antonio Grillo	DIETI, University of Naples Federico II
1 st	Sensori e Smart Metering	MsD Electronic engineering	9	Prof. Francesco Bonavolontà	DIETI, University of Naples Federico II
1 st	Intelligenza Artificiale	MsC Type A2 course	6	Prof. Flora Amato	ITEE, DIETI, University of Naples Federico II
2 nd	Misure su Sistemi Wireless	MsC Type A2 course	9	Prof. Leopoldo Angrisani	ITEE, DIETI, University of Naples Federico II
2 nd	Data Uncertainty	MsC Type A2 course	6	Prof. Leopoldo Angrisani	ITEE, DIETI, University of Naples Federico II

Attended Specialization Schools

Year	School title	Location	Credits	Dates	Organization
3 rd	Infectious Diseases, Prophylaxis, and Veterinary	Napoli, Italy	180	23/7/2024	University of Naples Federico II

Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organization
1 st	“La termografia come strumento di precisione nell'allevamento degli animali da reddito.”	0.2	Dr. Fabio Abeni	Research centre: Centro di Ricerca Zootecnica e Acquacoltura, Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria (CREA), Italy	ASPA, Commissione Precision Livestock
1 st	“Transdairy Living Lab’s Open Day ICT & Bio Nanotechnology”	1.5	Prof. Luigi Zeni	University of Campania “Luigi Vanvitelli”	University of Campania “Luigi Vanvitelli”
1 st	Picariello Lectures on Data Science – II Cycle Ethics and Politics of A.I	0.4	Prof Mark Coekelbergh	Seminary at the University of Naples. Prof Mark Coekelbergh is Professor of Philosophy of Media and Technology at the Department of Philosophy at the University of Vienna	University of Napoli Federico II, Picariello Lectures on Data Science – II Cycle.
1 st	Picariello Lectures on Data Science – II Cycle Can a Text-to-Speech Engine Generate Human Sentiments?	0.2	Prof. Vijay K. Gurbani	Seminary at the University of Naples. Vijay K. Gurbani is a Research Associate Professor at Illinois Institute of Technology	University of Napoli Federico II, Picariello Lectures on Data Science – II Cycle.
1 st	Protozoi Intestinali come ospiti sgraditi: Giardiasi e Trichomoniasi nella pratica clinic	0.1	Dr. Tommaso Furnarello	Innovet Veterinary Innovation (Swedencare AB (publ), Svezia	Innovet Veterinary Innovation (Swedencare AB (publ), Svezia

Activities and Publications – Final Report

UNINA PhD in Information Technology and Electrical Engineering – XXXVII Cycle

PhD candidate: Maria Teresa Verde

1 st	Elementi di Automazione e Introduzione al concetto di domotica. Smart Building e vantaggi del sistema nelle strutture ricettive. I sistemi di comunicazione e la connessione tra i dispositivi. Il concetto di attuatore e di cavo bus.	1	Prof. Francesco Bonavolontà	DIETI, University of Naples Federico II	University of Naples Federico II, Mostra d'Oltremare
1 st	Running towards Car Electrification, ST MICROELETRONICS	0.5	Prof. Francesco Bonavolontà Ing. Salvatore Cannavacciuolo	DIETI, University of Naples Federico II, STMicroelettronics	University of Naples Federico II, STMicroelettronics
1 st	Artificial Intelligence @ The Deep Edge	1.2	Prof. Francesco Bonavolontà Davide Ruggiero (Senior Advanced Research Engineer)	DIETI, University of Naples Federico II, STMicroelettronics	University of Naples Federico II, STMicroelettronics
1 st	Augmented reality for remote use of measurement Instrumentation	0.3	Prof. Annalisa Liccardo Prof. Francesco Bonavolontà	DIETI, University of Naples Federico II	5G Academy, University of Naples Federico II
1 st	Power Electronics: control and architecture. A mini-Campus.	3	Ing. Francesco Pirozzi, Ing. Alan Smith, Ing. Mauro D'Angelo	DIETI, University of Naples Federico II, STMicroelettronics	DIETI, University of Naples Federico II, STMicroelettronics
1 st	Il futuro della medicina alla luce dell'applicazione dell'intelligenza artificiale e della robotica	0.5	Prof. Bruno Siciliano	DIETI, University of Naples Federico II	Il Sabato delle Idee
1 st	Focus on di Ginecologia	0.6	Dr. Cristiano Barisani	SIVAR - Società Italiana Veterinari per Animali da Reddito	SIVAR - Società Italiana Veterinari per Animali da Reddito
2 nd	Smart clothes and wearable technology	0.4	Prof. Antonio Gloria	DII, Dipartimento di Ingegneria Industriale, University of Naples Federico II	ACCADEMIA DELLE BELLE ARTI DI NAPOLI
2 nd	Power and Analog electronics: Design, Control and Architecture	3	Ing. Francesco Pirozzi, Ing. Alan Smith,	DIETI, University of Naples Federico II, STMicroelettronics	DIETI, University of Naples Federico II, STMicroelettronics

			Ing. Mauro D'Angelo		
2 nd	“Corso formazione specialistico Classyfarm per veterinari aziendali: Modulo specialistico bufala da latte.” Piattaforma per la rilevazione, la raccolta e la elaborazione dei dati relativi alle seguenti aree di valutazione: biosicurezza; benessere animale; parametri sanitari e produttivi; alimentazione animale; consumo di farmaci antimicrobici;.	3	Domenico Vecchio	Istituto Zooprofilattico Sperimentale del Mezzogiorno (IZS)	Istituto Zooprofilattico Sperimentale del Mezzogiorno (IZS)
2 nd	Kick-off meeting della Task 5.3.8 (Living Labs) - Spoke 5 AGRITECH,	0.4	Prof. Enrico Sturaro	University of Padua	University of Padua
2 nd	“Nuove opportunità per progetti di ricerca industriale: l'intervento “Scoperta imprenditoriale” del MIMIT”,	1.5	Prof. Antonio Garofalo	Rector of the University of Naples Parthenope	University of Naples Parthenope
3 rd	Farmaci Veterinari, il nuovo decreto	0.4	Dr.Marco Melosi, Dr. Arianna Bolla, Dr.Roberto Rebasti, Dr.Mario Facchi, Dr. Giorgio Neri	SIVAR - Società Italiana Veterinari per Animali da Reddito	SIVAR - Società Italiana Veterinari per Animali da Reddito
3 rd	L'ora del farmaco – le novità della normativa sul farmaco.	0.2	Dr. Giorgio Neri	SIVAR - Società Italiana Veterinari per Animali da Reddito	SIVAR - Società Italiana Veterinari per Animali da Reddito
3 rd	Seminars at First International Conference on Buffalo Mozzarella & Milk production 24-25/9/2024.	2	Prof. Giuseppe Campanile, Prof. Matteo Lorito, Prof. Roberta Cimmino	Università degli Studi di Napoli Federico II.	Università degli Studi di Napoli Federico II.
3 rd	La Dislocazione dell'Abomaso: tecniche chirurgiche tradizionali.	0.4	Dr. Cristiano Barisani	SIVAR - Società Italiana Veterinari per Animali da Reddito	SIVAR - Società Italiana Veterinari per Animali da Reddito

3 rd	La Dislocazione dell'Abomaso: trattamento per via endoscopica.	0.4	Dr. Cristiano Barisani	SIVAR - Società Italiana Veterinari per Animali da Reddito	SIVAR - Società Italiana Veterinari per Animali da Reddito
3 rd	L'Intelligenza Artificiale nell'Ecosistema dell'Innovazione in Campania	0.4	Prof. Antonio Pescapè, Prof. Bruno Siciliano, Prof. Giovanni Acampora, Giorgio Ventre	Università degli Studi di Napoli Federico II.	Università degli Studi di Napoli Federico II.

Research activities

Maria Teresa Verde participated in research focused on the development and application of Precision Livestock Farming (PLF) technologies, specifically for Mediterranean buffalo farming. Here's a summary of her work over the three years:

Year 1: She began by identifying critical parameters for assessing buffalo welfare and sustainability. This involved an extensive literature review on PLF applications and the conceptualization of innovative measurement systems, including sensors and data collection devices. These systems were designed to monitor factors such as health, environmental conditions, and production efficiency.

Year 2: The second year emphasized the creation of proof-of-concept prototypes for sensor networks and measurement systems. Practical field tests included using infrared thermography to detect subclinical mastitis. Data were collected and analyzed, leading to preliminary validation of the developed systems. Maria Teresa Verde also contributed to academic publications and presented her findings at conferences.

Year 3: In the final year, the focus was on developing and validating an IoT platform for the collection and integration of data related to buffalo welfare. The monitoring systems were developed and tested individually, with particular emphasis on infrared thermography for detecting subclinical mastitis, the measurement of enteric emissions, and other key animal health parameters. The data collected from the various systems were integrated into the platform to create scalable solutions and support sustainable livestock management.

Maria Teresa Verde concluded her work by preparing her dissertation, contributing to scientific publications, and presenting the results at international conferences. Her research represented a significant step forward in sustainable livestock management, with a strong emphasis on technological innovation and environmental responsibility.

Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
----------	---------	----------	----------	---

1 st	35	8.7	24	-
2 nd	15	8.3	45	-
3 rd	0	3.8	60	
TOTAL	50	20.8	129	

Research periods in institutions abroad and/or in companies

PhD Year	Institution / Company	Hosting tutor	Period	Activities
2 nd	Castelluccia s.n.c.	Fausta Conte, Rap. Legale	3	On-field experiments using infrared thermography as a potential non-invasive tool to monitor udder health status
3 rd	Castelluccia s.n.c..	Fausta Conte, Rap. Legale	3	On-field experiments on a suitable gas sensor to monitor enteric methane emissions from ruminants.

PhD Thesis

The increase in global population and growing economic availability have led to a rise in the demand for meat and its derivatives, resulting in a proliferation of intensive farming systems. While these systems optimize production at reduced costs, they also generate significant issues, including worsening animal health and welfare, a reduction in product quality, and an increase in greenhouse gas emissions (methane, ammonia).

In her PhD Thesis, Maria Teresa Verde addresses these criticalities through the application of Precision Livestock Farming (PLF) techniques, with a focus on Italian Mediterranean buffalo farming in the Campania Region—a strategic sector for the local and national economy due to the production of Mozzarella di Bufala Campana DOP.

The research concentrated on four main areas:

1. the lack of reliable and scalable tools for diagnosing subclinical mastitis;
2. the need for systems to detect early stress in animals through cortisol measurement in milk;
3. the absence of precise tools to quantify feed intake in buffaloes;
4. the lack of accurate technologies for measuring methane and ammonia emissions in buffalo farms.

The adopted methodology is based on the use of innovative technologies such as thermal cameras, environmental sensors, sniffers, and biochemical analyses. The data, collected directly in real-world contexts, were analyzed using quantitative methods, including statistical models and artificial intelligence, ensuring an accurate validation of the proposed solutions.

The main results include:

- early diagnosis of subclinical mastitis - A methodology based on artificial intelligence was developed, using infrared thermography to diagnose subclinical mastitis in Italian Mediterranean buffaloes, significantly improving the reliability and scalability of detection;
- animal stress detection - An innovative approach to analyze cortisol levels in biological samples enabled the identification of environmental and management factors affecting animal stress;
- feed intake measurement - A system based on 3D cameras was developed to accurately measure the volume and weight of feed rations, providing useful data for optimizing nutrition;
- gas emission monitoring - Systems were designed for measuring enteric methane emissions and wireless sensor networks for monitoring ammonia, improving the environmental sustainability of farms.

This research demonstrates how the integrated use of advanced technologies and data analysis can improve animal health and welfare, increase production efficiency, and reduce the environmental impact of buffalo farming. The proposed solutions represent a significant contribution to promote sustainable and innovative livestock farming, capable of meeting future challenges while respecting animals and the environment.

The integration of the developed data collection systems into a single platform marks a crucial step toward creating an integrated system, conceived according to a holistic vision. This approach aims to develop a *Digital Twin of the Farm*, a virtual model that represents the ideal farm, optimizing management processes, animal welfare, and environmental sustainability.

Research products

Research results appear in **8** papers published in international journals, **1** paper submitted in international journal and under review process, **5** contributions to international conferences, **1** contribution to national conferences, **1** patent application.

List of scientific publications

International journal papers

1. Alessio Cotticelli, Maria Teresa Verde, Roberta Matera, Isabella Pividori, Alberto Prandi, Gianluca Neglia, Tanja Peric (2022)

“Validation of a radioimmunoassay method for cortisol in buffalo milk whey. A preparatory step for future sensor technology”

Italian Journal of Animal Science

21:1, 1622-1631

DOI: 10.1080/1828051X.2022.2147868

International journal papers

Nadia Piscopo, Oscar Tamburis, Francesco Bonavolontà, **Maria Teresa Verde**, Maria Manno, Marianna Mancusi, Luigi Esposito

“Assessing wild boar presence and activity in a monitoring specific area of Campania region using camera traps”

ACTA IMEKO

ISSN: 2221-870X, December 2023, Volume 12, Number 4, 1 – 5,

DOI: <https://doi.org/10.21014/actaimeko.v12i4.1617>

International journal papers

Maria Teresa Verde, Pierluigi Guerriero, Francesco Bonavolontà, Leopoldo Angrisani, Francesco Lamonaca, Ioan Tudosa, Oscar Tamburis, Gianluca Neglia

“A measurement system for enteric CH₄ emissions monitoring from ruminants in livestock farming”,

ACTA IMEKO, ISSN: 2221-870X, December 2023, Volume 12, Number 4, 1 – 6,

DOI: <https://doi.org/10.21014/actaimeko.v12i4.1618>

International journal papers

Alessio Cotticelli, **Maria Teresa Verde**, Annalisa Liccardo, Giorgio de Alteriis, Francesco Lamonaca, Roberta Matera, Gianluca Neglia, Tanja Peric, Alberto Prandi, Francesco Bonavolontà

“On the use of 3D camera to accurately measure volume and weight of dairy cow feed”

ACTA IMEKO

ISSN: 2221-870X, December 2023, Volume 12, Number 4, 1 – 6,

DOI: <https://doi.org/10.21014/actaimeko.v12i4.1633>

International journal papers

Maria Teresa Verde, Francesco Bonavolontà, Annalisa Liccardo, Francesco Lamonaca, Emilio Di Stasio, Giampaolo Raimondi

“A smart combination of IoT and blockchain enabling technologies to measure and improve workplace safety in dairy farm”

ACTA IMEKO

ISSN: 2221-870X, December 2023, Volume 12, Number 4, 1 – 7, DOI:

<https://doi.org/10.21014/actaimeko.v12i4.1634>

International journal papers

Maria Teresa Verde, Roberta Matera, Francesco Bonavolontà, Francesco Lamonaca, Leopoldo Angrisani, Concettina Fezza, Luca Borzacchiello, Alessio Cotticelli, Gianluca Neglia

“Comparative performance analysis between two different generations of an automatic milking system”

ACTA IMEKO

ISSN: 2221-870X, December 2023, Volume 12, Number 4, 1 – 6,

DOI: <https://doi.org/10.21014/actaimeko.v12i4.1646>

International journal papers

Leopoldo Angrisani, Angela Salzano, Roberta Matera, Francesco Bonavolontà, **Maria Teresa Verde**, Nadia Piscopo, Domenico Vistocco, Oscar Tamburis, **“Reliable Use of Smart Cameras for Monitoring Biometric Parameters in Buffalo Precision Livestock Farming”**

ACTA IMEKO

ISSN: 2221-870X, December 2023, Volume 12, Number 4, 1 - 7,

DOI: <https://doi.org/10.21014/actaimeko.v12i4.1638>

International journal papers

A. Cotticelli, G. Bifulco, I. Pividori, R. Matera, **M.T. Verde**, M. Santinello, T. Peric,(2024)

“Assessing cortisol concentration in different matrices: predictive potential and relationship with production levels, lactation stage and parity in dairy buffaloes”

Italian Journal of Animal Science

23(1), 802–812.

DOI: <https://doi.org/10.1080/1828051X.2024.2354502>

International journal papers

M.T. Verde, L. Angrisani, F. Amato, M. Fonisto, R. Matera, G. Neglia, F. Bonavolontà

“AI-Driven Large-Scale Early Detection System of Subclinical Mastitis in Italian Mediterranean Buffalo Based on Infrared Imaging”

Submitted to

IEEE Transactions on Instrumentation & Measurement

Manuscript Number TIM-24-10525.

International conference abstract

Birolo M., Petracci M., Lacetera N., Marco M., Di Iacovo F., Bonavolontà F., Verde M.T., Provolo G., Cartoni Mancinelli A., Sturaro E.

“Living labs for assessing the overall sustainability of livestock systems through Life Cycle Assessment – SOLSTICE”, abstract presented at the 75th EAAP Annual Meeting 1-5 September 2024 - Florence, Italy. Proceedings unpublished.

International conference abstract

*R. Matera**, A. Calanni Macchio, F. D’Acerno, M. T. Verde, F. Bonavolontà, S. Lauriola, G. Neglia,

“Influence of an Automatic milking system on milk yield and quality in Italian Mediterranean buffaloes”, abstract presented at the 75th EAAP Annual Meeting 1-5 September 2024 - Florence, Italy. Proceedings unpublished.

International conference abstract

*Kosior M.A.**, Verde M.T., Staropoli A., Piscopo F., Esposito R., Masiello L., Defelice D., Vinale F., Gasparri B., S. Lauriola, G. Neglia,

“Uncovering the metabolomic fingerprint of metritis in dairy buffalo: preliminary results”, abstract presented at the 75th EAAP Annual Meeting 1-5 September 2024 - Florence, Italy. Proceedings unpublished.

International conference abstract

*Mattia Fonisto**, Flora Amato, Francesco Bonavolontà, Annalisa Liccardo, Roberta Matera, Gianluca Neglia, Rosario Schiano Lo Moriello, Maria Teresa Verde,

“Uncovering the metabolomic fingerprint of metritis in dairy buffalo: preliminary results”, abstract presented at IEEE 2024 International Workshop on Measurements and Applications in Veterinary and Animal Sciences (IEEE 2024 International Workshop MEAVEAS) held in Torino from 22 to 24 April 2024. Proceedings unpublished.

International conference abstract

Maria Teresa Verde, Flora Amato, Leopoldo Angrisani, Mattia Fonisto, Annalisa Liccardo, Roberta Matera, Gianluca Neglia, Rosario Schiano Lo Moriello, Francesco Bonavolontà,

“First Steps Toward an Innovative Measurement Sensors, Based on Infrared Camera and Artificial Intelligence, to Detect Subclinical Mastitis in Italian Mediterranean Buffalo” abstract presented at IEEE 2024 International Workshop on Measurements and Applications in Veterinary and Animal Sciences (IEEE 2024 International Workshop MEAVEAS) held in Torino from 22 to 24 April 2024. Proceedings unpublished.

National conference paper

M.T. Verde, F. Bonavolontà, L. Angrisani, G. Neglia,

“Nuovi strumenti e metodologie di misura per il miglioramento del benessere, della qualità, e della sostenibilità delle produzioni animali”, paper presented at the XLI National Congress of Electrical and Electronic Measurements held in Pisa from 12 to 14 September 2024. Published in the conference proceedings.

Patents and/or spin offs

Patent Application No. 102023000019425 dated September 21, 2023, titled “System and Method for Capturing Wild Boars.” The analysis conducted by the Patent Office and detailed in the Search Report yielded a “non-negative” outcome, demonstrating the innovation of the proposal. The deadline to respond to the objections raised is June 21, 2025.

Awards and Prizes

Best Poster Award “Artificial Intelligence-enhanced infrared imaging for early detection of subclinical mastitis”, Università degli Studi di Napoli “Federico II” – Dipartimento di Ingegneria Elettrica e delle Tecnologie dell’Informazione, **WORKSHOP Precision Livestock Farming per l’adattamento e la mitigazione del cambiamento climatico: applicazioni e nuove frontiere della ricerca**. Il contributo dello Spoke 5 del National Center for Technology in Agriculture (Agritech). Evento patrocinato da AGRITECH, nell’ambito della conferenza internazionale European Conference on Precision Livestock Farming 2024. Bologna, Italy.

Prize for presenting the tutorial titled “Innovative Technologies for a Buffalo Smart Farm” at the first **IEEE International Workshop 2023 on “Measurement and Applications on Veterinary and Animal Sciences”** (MeAVeAS 2023), Friday, April 28, 2023, Naples, Italy

Date 12/12/2024

PhD student signature



Supervisor signature

