



UNIVERSITÀ DEGLI STUDI DI NAPOLI  
**FEDERICO II**



**itee**<sup>PhD</sup>  
information technology  
electrical engineering



# MICHELA RUSSO

**‘Artificial Intelligence & Gait Analysis for Neurological Diseases’**

Tutor: Maria Romano

Cycle XXXVII

Year: First

# My Background

## Education

M.Sc in Biomedical Engineering (University of Naples, Federico II)

**“Implementation of machine learning algorithms for the recognition of gait-pattern in Parkinson’s disease patients with mild cognitive impairment”**

## Ph.D in Information Technology and Electrical Engineering

1 November 2021

## Partner company



Azienda Ospedaliero Universitaria

**San Giovanni di Dio Ruggi d'Aragona**

Scuola Medica Salernitana

# Summary of study activities

## Ad hoc courses:

- ❖ Ultra-High Field Magnetic Resonance Imaging
- ❖ Statistical Data Analysis for Science and Engineering
- ❖ Big Data Architecture & Analytics
- ❖ Data Science for Patient Records Analysis
- ❖ Imprenditorialità accademica
- ❖ Machine Learning for Science and Engineering Research

## Conferences/ Events attended:

- 22° Annual Conference of Società Italiana di Analisi del Movimento in Clinica (SIAMOC); 5-8 October 2022.
- IEEE International conference on Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering (2022IEEEEMetroXRINE); 26-28 October 2022
- Neural Data Processing Contest

**Award** : The best performance of classification on EEG datasets acquired through the Helmate headset provided by AB MEDICA.

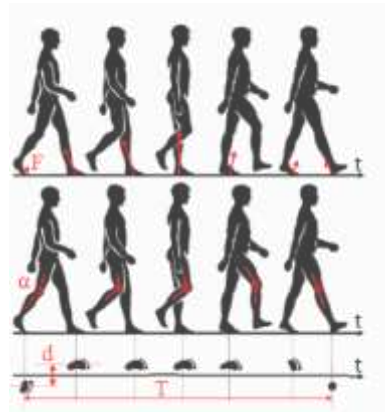
# Research fields of Interest

My research topic concerns the study of **Gait and Postural Control** in **Neurological field**, and the implementation of **Machine Learning Algorithms** on gait cycle variables for identifying gait patterns to support clinical decision making.

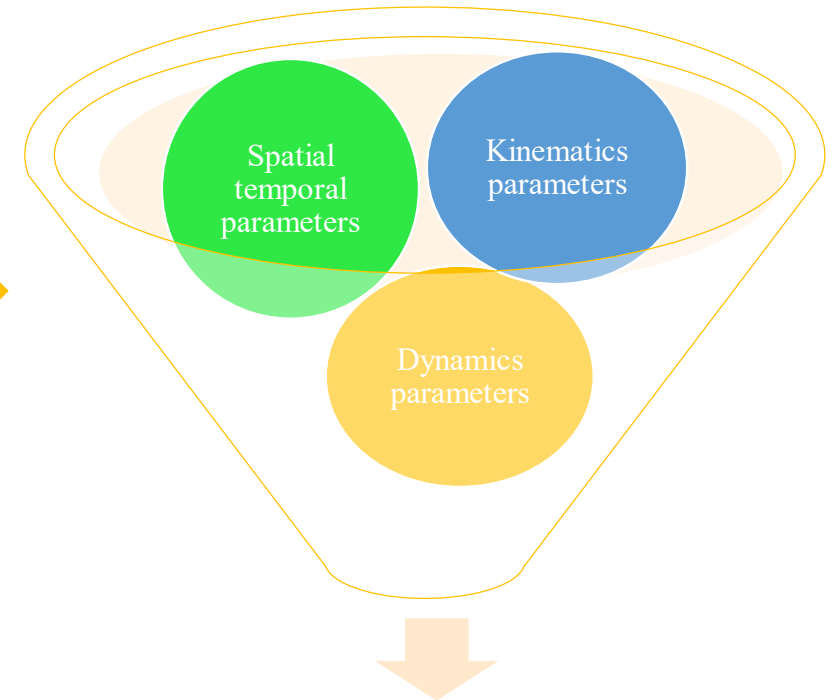
## Parkinsonisms



## Gait Analysis



## Machine Learning Classification Model



Support Decision Making in Neurological Field  
Improve the quality-of-life patients

# Research activity: Overview (1/3)

- **Problem**

**Parkinson's disease (PD)** is the second most common neurodegenerative disorder. The disease is characterized by the presence of **motor symptoms** including tremor, slow movement, limb rigidity, postural instability which are even more prominent in patients with atypical Parkinsonisms.

Moreover, **non-motor mental symptoms**, such as mood and cognitive disorders worsen as disease progresses. A growing body of evidence suggests the association between cognitive decline and several gait dysfunctions.



The early identification of postural instability and gait dysfunctions allow to avoid delays in the diagnosis and misdiagnosis with the aim to improve the quality of life patients.

# Research activity: Overview (2/3)

- **Objective**

Use of gait sensing technologies, organized in terms of wearable, non-wearable and hybrid approaches in order to provide a quantitative assessment and recognition of motor and non-motor symptoms, in combination with qualitative analysis with traditional clinical tests.

The aim of my research is identify a subset of gait cycle variables, through the Statistical and the Machine Learning approach, in order to define a gait-patterns for:

- Distinguish Parkinsonisms (typical and atypical) in the early stage of disease
- Predict motor and non-motor symptoms
- Classify different stages of disease
- Identify surrogate biomarkers of gait that capture the early abnormalities of disease and progression of disease over time
- Monitoring the results of pharmacological treatment

# Research activity: Overview (3/3)

- Methodology

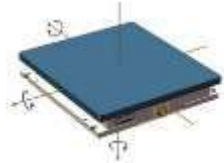
## Acquisition of data in the Motion Analysis Laboratory:



Optoelectronic System



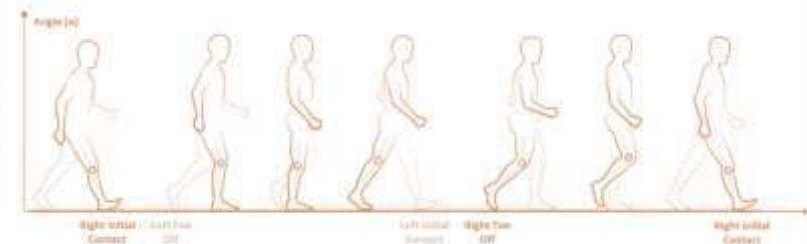
Force Platforms



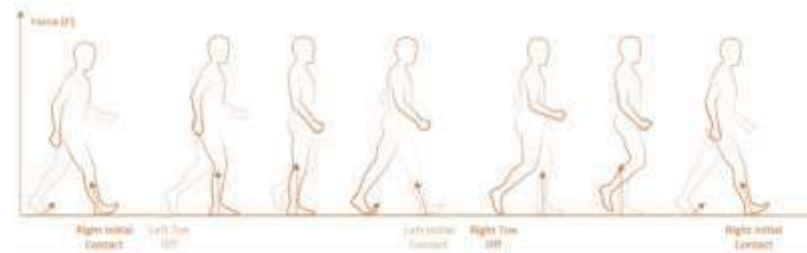
Spatial & Temporal Variables



Kinematic Variables



Kinetic Variables & Sway Variables



## Pre-processing of data



## Classification Analysis

- Statistical Analysis
- Machine Learning Analysis



# Main Study Activities

- ❖ Study of the scientific literature on human locomotion.
- ❖ Study on gait analysis and on wearable and non-wearable sensors used for the analysis.
- ❖ Study on biomechanics of gait (study of spatial-temporal parameters, kinematics and kinetics variables of gait).
- ❖ Investigation of gait analysis in patients with neurodegenerative diseases.
- ❖ Study on motor and non-motor symptoms of Parkinsonisms.
- ❖ Study on stabilometric analysis of typical and atypical Parkinsonisms.
- ❖ Acquisition of data in the motion analysis laboratory of the hospital “San Giovanni di Dio Ruggi d’Aragone”, Salerno.



# First Year Production

## Journal Contributions

[J-1] **Michela Russo**, Marianna Amboni, Antonio Volzone, Gianluca Ricciardelli, Giuseppe Cesarelli, Alfonso Maria Ponsiglione, Paolo Barone, Maria Romano, Carlo Ricciardi. **Interplay between gait and neuropsychiatric symptoms in Parkinson's Disease**; Eur J Transl Myol; 2022 Jun. DOI: [10.4081/ejtm.2022.10463](https://doi.org/10.4081/ejtm.2022.10463)

[J-2] **Michela Russo**, Carlo Ricciardi, Marianna Amboni, Marina Picillo, Gianluca Ricciardelli, Filomena Abate, Maria Francesca Tepedino, Maria Consiglio Calabrese, Mario Cesarelli, Maria Romano. **Postural control in Parkinsonisms during a short static sway**; 22° Congresso annuale della società italiana di analisi del movimento in clinica (SIAMOC); Conference Abstract on Gait&Posture; 5-8 October 2022. <https://doi.org/10.1016/j.gaitpost.2022.09.022>

## Conference Contributions

[C-1] **Michela Russo**, Carlo Ricciardi, Marianna Amboni, Marina Picillo, Gianluca Ricciardelli, Filomena Abate, Maria Francesca Tepedino, Maria Consiglio Calabrese, Mario Cesarelli, Maria Romano. **Performing a shorter sway to distinguish Parkinsonisms**; IEEE International conference on Metrology for extended reality, artificial intelligence and neural engineering (IEEEMetroXRINE); Conference Paper; 26-28 October 2022.

## Awards

**Neural Data Processing Contest** - The best performance of classification on EEG datasets acquired through the Helmate headset provided by ab medica.

**THANK YOU FOR ATTENTION!**

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