



UNIVERSITÀ DEGLI STUDI DI NAPOLI  
FEDERICO II

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



DIE  
TI

UNI  
NA

# PhD student Julien Mellet

## Multi-Robots for Haptic Aerial Manipulation

Tutor: prof. Lippiello

Cycle: XXXVII

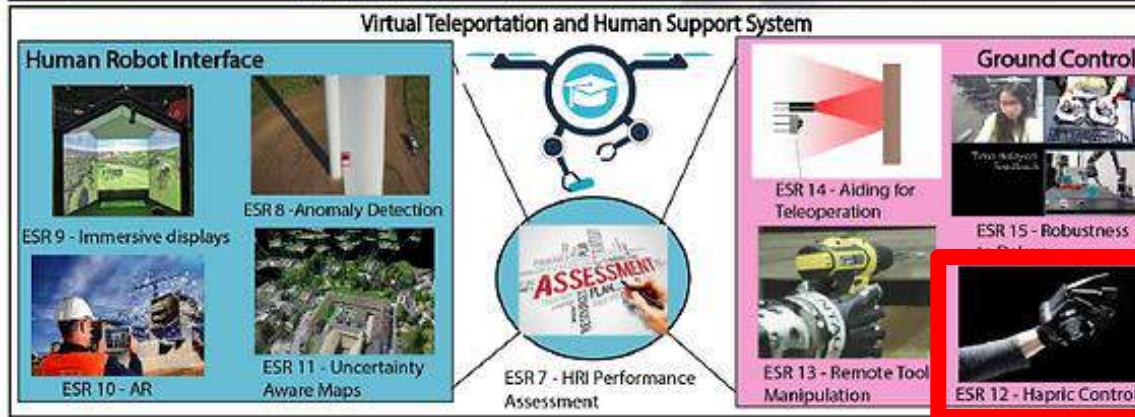
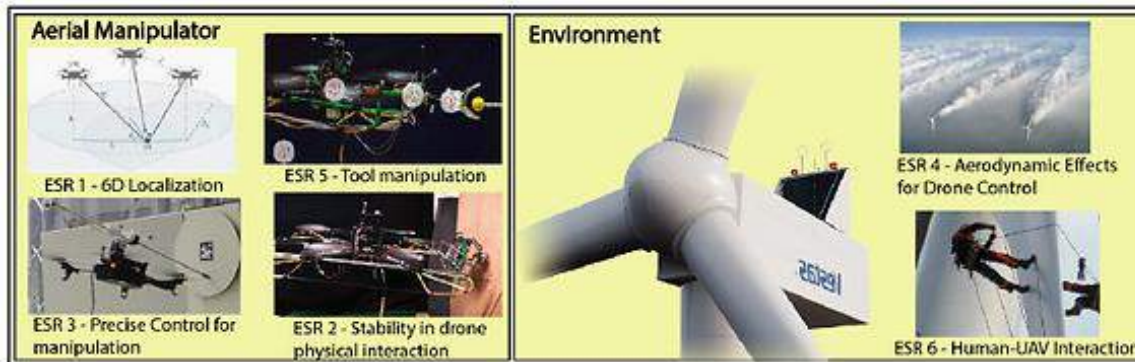
Year: 2023

# My background

- MSc degree
  - Industrial Engineering (INSA, France) → **System**
  - Navigation, Guidance and Control (NPU, China) → **Control**
- Experience
  - Software Developer for **Ground Control** of drone swarm, Thales, France
- Research group/laboratory
  - PRISMA Lab → **Aerial Robotics Group**
- PhD start date
  - November 1<sup>st</sup>, 2021
- Scholarship type
  - Horizon 2020 Marie Skłodowska-Curie Innovative Training Network (ITN)

# Research field of interest

- **Operations and maintenance** industry of civil and industrial infrastructures
- Bridge gap between research and industry, innovative **aerial robotic** solutions
  - Reduce risks and costs associated to field operations by humans
  - Increase efficiency while reducing workload of operators



I am here

# Summary of study activities

- Courses

- Training School 3 of AERO-TRAIN on Autonomous Aerial Field Robotics, Lulea
- First Integration Week of AERO-TRAIN project, Tampere University, Finland
- Second Integration Week of AERO-TRAIN project, Eurecat, Cerdanyola

- Seminars

- Control of aerial robots, AI, Advanced Robotics, Authorship, Inspection-based robotics, Migration of IT...

# Research activity: Overview

- **Problem: multi-robot system for haptic aerial manipulation**
- Control of a **team of aerial robot** from a single operator
  - Reduce control complexity
  - Distribute the weight of the payload
- **Haptic** teleoperation
  - Increase environmental awareness
  - Give to the operator the sense of touch for aerial manipulation
- **Aerial Physical Interaction (APhI)**
  - Ensure stability of the system at contact
  - Estimate properly the force interaction

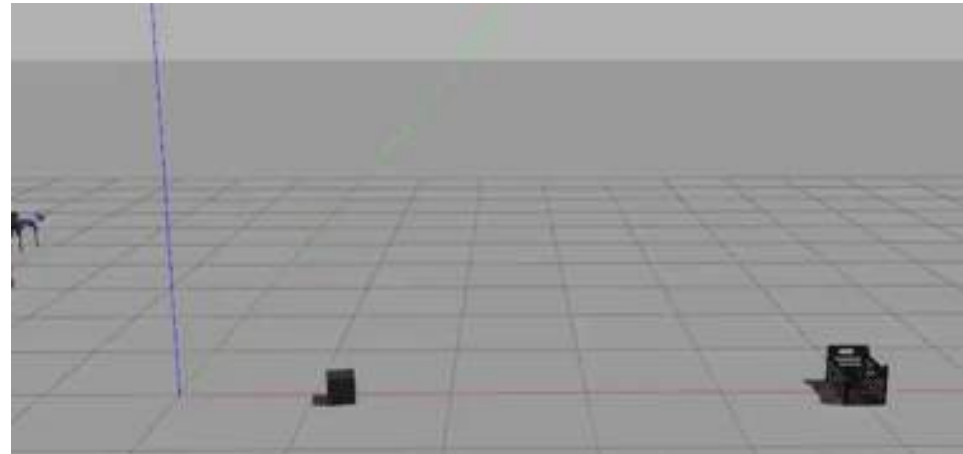
# Research activity: Overview

- **Objective: multimodal control framework for distributed robots in APhI**
- **Aerial manipulator** to handle physical interaction with the environment
- Feedforward distributed **control strategy** from operator input to aerial robots
- **Multimodal feedback** information to enhance environmental awareness while reducing workload

# Research activity: Overview

## Methodology:

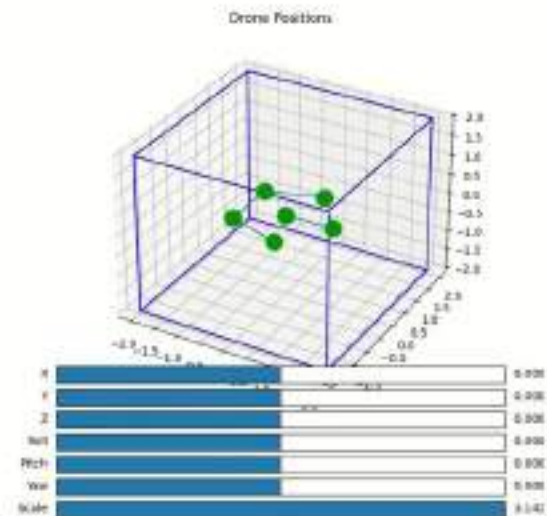
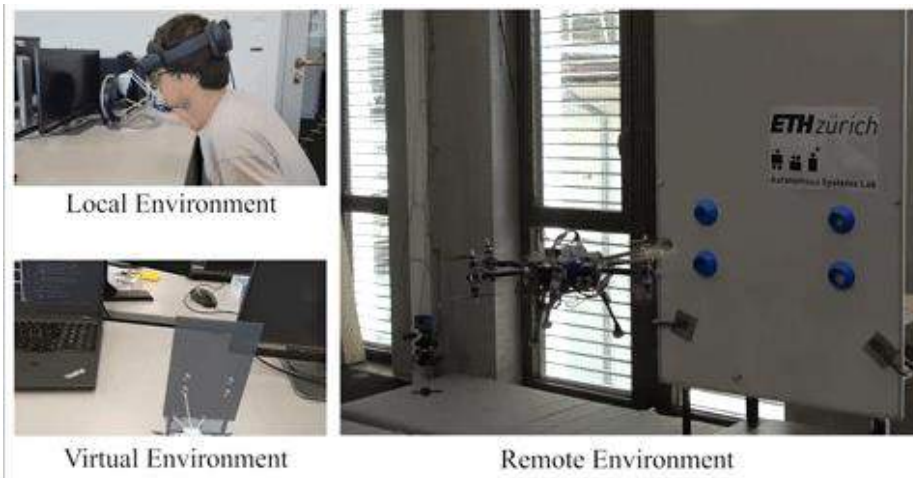
1. Design aerial manipulators
2. Minimal robot sensing state estimation → Neural Estimator



# Research activity: Overview

## Methodology:

1. Design aerial manipulators
2. Minimal robot sensing state estimation → Neural Estimator
3. Bilateral control of one omnidirectional vehicle
4. Study effect of multimodality on the operator
5. Bilateral teleoperation with multiple robots





# Products

[P1] *Prototype: Study of Human-Robot Interfaces based on 2D/3D Visual and Haptic Feedback for Aerial Manipulation (almost ready to be published)*

[P2] **Conference Paper: Neural-Network for Position Estimation of a Cable-Suspended Payload Using Inertial Quadrotor Sensing – ICINCO23 – Best paper overall award finalist**

[P3] *Prototype: Compliant Robot Arm for Aerial Physical Interaction*

