Work Packages. Definition and Gantt diagram.

v.1.0 - 28/09/2025

This section includes the different work packages of the bachelor's degree final thesis. Each of these work packages is included in the Gantt diagram on the following page.

WP0. Project management.

- Minutes of meetings.
- Workspace environment (LaTeX, GitHub, Drive, report draft, and project charter draft).
- Preparation of deliverables (project charter, report, appendices, and code).
- Schedule and organisation of the work packages. Gantt's diagram.
- Wording of the deliverables (project charter, report, appendices).
- Review of the deliverables by the thesis's tutors.

WP1. Literature review and conceptual understanding.

- State-of-the-art related concepts. Investigation and review of actual algorithms, trajectory optimisation concepts, and an analysis of existing tools to examine their advantages and drawbacks. Identify the research gaps.
- Study of the fundamentals of the optimal control problem and the typical approaches used to address optimisation problems. Comparison of direct and indirect methods. Understanding of the PMP and the direct collocation method.
- Study and review of the adjoint problem and its application to solve the optimal control problem. Study of the gradient method applied to the optimal control problem.
- Review of the flight mechanics applied to a vertical plane restringed problem under 3DOF.

WP2. Benchmark problems definition and MATLAB implementation. (09/2025 -

- Definition of Flyox data for the benchmark problems.
- Definition of the equations of motion that have to be integrated. Implementation of the equations of motion in MATLAB (integration scheme only, free trajectory for a predefined amount of time).
- Definition of the equations of motion alongside the trajectory restriction between two different points, A and B, in MATLAB.
- Review of the flight mechanics to a coordinated turn contained in the horizontal plane. Definition of the equations of motion for a coordinated turn in MATLAB.

- Implementation of a function that discretises the continuous trajectory into a set of waypoints, which converts the relative position into an absolute GPS position for a given initial point (let's imagine, for instance, it is the point where the water drop manoeuvre starts). The output of the function has to be in FLY file format.
- Validation of the code in each scenario.
- Verification of the three implementations through SIL/QHWIL and validation of the discretisation of waypoints (which is the correct number of waypoints to feed the autopilot? mesh discretisation)
- Comments and conclusions of the implementation of the benchmark scenarios.

WP3. Water-drop manoeuvre.

- Review of the requirements stipulated by the project manager regarding the water-drop manoeuvre.
- Review and definition of the flight mechanics that affect the water-drop manoeuvre when restricted to the vertical plane.
- Review and definition of the different constraints and the sensor source from which the information will be provided. Mathematical formulation and implementation of the different constraints that will be added.
- Review and definition of Flyox performances and operational limits.
- Implementation of the MATLAB algorithm capable of performing the water-drop manoeuvre.
- Validation of the code with one of the benchmark problems.
- Fly file generation and verification through SIL/QHWIL. Minimum time or minimum fuel consumption cases.
- Comments and conclusions of the implementation and verification. List of the gaps of the actual solution and notes about the time performance and computation.

WP4. Water-drop manoeuvre in different planes. GO/NO-GO implementation. (Feasibility of mission accomplishment)

- Implementation of a GO/NO-GO logic based on obtaining all the vertical plane trajectories. In function of the actual heading and height of the aircraft. GO if the trajectory is feasible to enter, descend, discharge and climb safely. NOGO if not.
- Plot of all the planes in green (GO) or red (NOGO) for a set of headings and heights. Different test constraints.
- Comments and conclusions of the implementation and verification. List of the gaps of the actual solution and notes about the time performance and computation.

WP5. Algorithm performance.

- Recapitulation of the detected issues. Computation performance analysis and documentation.
- Proposal of solutions to increase the computation performance and to get better results. Advantages and disadvantages of the issues and solutions proposed.

WP6. Real mission scenario. (Simulation of an actual water-drop manoeuvre in a real aircraft.) (IF TIME, OPTIONAL)

- Mission definition to perform the real simulation. Flyox I/VI / UltraStick performances definition and operational limits. GPS coordinates of the discharging point. FLY file generation using the algorithm.
- Test flight procedure definition. Logs, operation procedures, checklists, etc.
- Test flight. Comments, suggestions and conclusions.

GANTT DIAGRAM

	23/06	**30/06**	**07/07**	**14/07**	**21/07**	**28/07**	**04/08**	**11/08**	**18/08**	**25/08**
WP1										
WP2										
WP3										
WP4										
WP5										
WP6										
WP0										

	01/09	**08/09**	**15/09**	**22/09**	**29/09**	**06/10**	**13/10**	**20/10**	**27/10**	**03/11**
WP1										
WP2					25h	30h	15h			
WP3							15h	33h	33h	33h
WP4										
WP5										
WP6										
WP0					10h	**PC 10/10 10h**		2h	2h	2h

	10/11	17/11	24/11	01/12	08/12	15/12	22/12	29/12	05/01	12/01
WP1										**DEAD LINE OF THE TFE**
WP2										
WP3	33h	20h	20h	20h	20h	20h				
WP4		6.5h	6.5h	6.5h	6.5h	6.5h				
WP5		6.5h	6.5h	6.5h	6.5h	6.5h				
WP6					IF	TIME				
WP0	2h	2h	2h	2h	**WOR**	**DING**	**REP**	**ORT**	**:)**	**REPORT**

15 weeks. 7 days a week (Monday to Sunday). 5h/day (Monday to Friday. 2h 30’ at job, 2h 30’ at home. Saturdays and Sundays, 5h distributed between morning and noon). Gives a total of 525h.