PhD in Aerospace Engineering

Research Title:

GN&C sub-system definition for stratospheric Hybrid platform

HHAA – Hybrid High Altitude Airship (for Earth Observation & Telecommunications)

Funded by	DIMEAS/Ateneo fondi CRT

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Contact	Bando premiale ASI, Progetto **STOPP - Strumenti e Tecniche di Osservazione della Terra in Prossimità e Persistenza** CIRA: Hybrid High Altitude Airschips as HAPS Platform for Earth Observation & Telecommunications

Context of the research activity	The Stratosphere ideally marks the conceptual convergence point between aeronautical sciences and space disciplines. In this area of the atmosphere, above 60,000 feet (about 18 km), today one of the most interesting matches is being played for the substantial evolution of the methods of observation, management and control of the territory. The availability of stratospheric platforms of the High Altitude Pseudo Satellite type would make it possible to target new application horizons and to conceive new applications in terms of monitoring the territory and the environment, thanks to their ability to observe persistence (weeks-months) and proximity (altitude of 18-20km). The general research project aims to investigate both the problems associated with the development of new HAPS-type platforms and the study of new environmental monitoring techniques on a local scale based on remote observation in proximity and persistence. The contribution of our research activity consists in the development of an ADS (Air Data Syatem) suitable for this type of platform and its interface with the control system of the platform itself.

Objectives	As far as the GN&C subsystem of a stratospheric platform, this research activity will investigate the problems relating to the systems for measuring and/or estimating the platform position and attitude and the air speed. The purposes of this study is the design of the Navigation and control system for these platforms operating in unconventional environments. In particular, the following activities will be developed: 1. Analysis of the problems connected to flight in the stratosphere and related to the measurement / estimate of the quantities of interest (i.e. low density, low speed, great accuracy in estimating the positioning of the payload on board, etc ...). 2. Study of the state of the art of applicable technologies for measuring / estimating the quantities of interest with particular attention to systems used in the space sector (ie star tracker, sun sensors, inertial sensors, etc ...) and innovative systems for aeronautical use based for example on virtual measures. 3. Analysis of the adaptability of the most promising technologies to the stratospheric platform and evaluation of the problems (i.e. environmental aspects, weight / size and cost / performance). 4. Design of an integrated system, based on the use of several systems among those identified, for the estimation of the parameters of interest. 5. Realization of a simulation model and consequent sensor fusion algorithms (for example in Matlab / Simulink environment) of the system designed for the measurement / estimation of the quantities of interest for the evaluation of its performance. 6. Design and implementation of the interface with the guidance and control system.

Skills and competencies for the development of the activity	• Programming in Matlab-Simulink environment • Knowledge of sensor-fusion problems. • Basic knowledge in the design of guidance and control systems. • Knowledge in the use of Kalman filters and filtering systems with neural techniques.