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APPLIED PHYSICS OF HEXACOPTER TYPE MULTI-ROTOR DRONES: PERFORMANCE ANALYSIS, DESIGN AND CONTROL OPTIMIZATION

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Abstract: The main objective of the research work presented in this thesis is to improve the flight performance of a Hexacopter UAV dedicated to the field of precision agriculture subject to external disturbances (wind gusts, inertia variation, etc.) and to make a good design capable of satisfying the needs of farmers, which will allow spreading products such as bio-controls on agricultural plots with precision logs containing auxiliary insects allowing to reduce considerably the number of insects and to make a good design capable of satisfying the needs of farmers, which will make it possible to spread products such as bio-controls on agricultural plots with precision logs containing auxiliary insects allowing to considerably reduce the damage of Borer on the agricultural crop and to improve the yield and sanitary quality, with a totally secure, geo-localized process and an innovative extraction modulation allowing to cover several tens of hectares per hour. This problem was extremely enriching and formative since the knowledge required to solve it goes far beyond automation. In a nutshell, the research work undertaken in this thesis mainly revolves around four chapters. The first chapter is devoted to a bibliographical study of the technology of the newly known UAVs (fixed and rotary wing), a description of their main classifications according to their size and wing, as well as the different applications, both military and civil. The second chapter was devoted to the study of the requirements analysis using the SysML language. To describe the design of all the essential elements constituting the UAV in order to measure all the details of the product development. The third chapter of this work is devoted to the optimization of the choice of parameters and the analysis of the performance of the design of a Hexacopter UAV. With a payload lifting capacity of up to 12 kg and a total drone weight of 15 kg with a range of up to 20 min. For the fourth chapter. Fractional order control methods were applied to a Hexacopter UAV attitude control system. To show the advantages of this method, a comparative study was made between the said method, a linear-quadratic regulator LQR and a PID corrector. The objective of this study is to establish an efficient control, which satisfies a given specification and maintains stability even under the strong effects of intrinsic parameter uncertainties, as well as external disturbances. Two fractional control strategies have been proposed and investigated to stabilise the attitude of the Hexacopter UAV. The fractional order controllers are more flexible and they gave a better adaptation to the

dynamic properties of the fractional order system control, which in turn improves the quality of the control. Although the results of the thesis are generally satisfactory, some problems remain open.

Keywords: Drone, UAV, Hexacopter, Fractional control, FOC, LQR, PID, SysML, stability.