ABSTRACT

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Autonomous vehicles have proven themselves as agents of change and innovation in several areas. In urban centers, for example, they have great potential to solve several problems in the modern transport of goods and people, contributing to the development of smart cities. In agriculture, they they are applied in applications ranging from monitoring of plantations to soil fertilization. In industry, they carry out inspections, footage, transport equipment, etc. In this scenario, unmanned aerial vehicles are a promising class of mobile robots, with possible applications in monitoring and security, inspection of structures and equipment, emergency medical care, product delivery, search and rescue in remote areas, among others. Quadcopters stand out. Put in motion by four propellers, they offer freedom of movement in any direction, the ability to hover in the air and fly with low engine speed, in addition to the ease of landing and taking off from any flat surface. It is, however, an underactuaed system which presents challenges to be controlled. Several strategies are found in the literature to control the position and attitude of quadcopters, among which the most popular is the use of proportional-integral-derivative controllers. However, the proper choice of parameters for these controllers is still a complicated task. In this context, this Dissertation aims to contribute to the theme of autonomous movement of quadcopters, presenting the mathematical modeling of their kinematics and dynamics, the planning of feasible trajectories and especially, the implementation of controllers to track them. The proportional-integral-derivative controller scheme, initially tuned by the Ziegler-Nichols method, then has its 18 gains optimized using a genetic algorithm. Computational validation is performed using trajectories with distinct characteristics and evaluating the quadrotor ability and performance in tracking them with and without the influence of disturbances. The results prove the feasibility of the model and the control scheme, as well as the better performance of the tuning performed by the genetic algorithm. In addition, they provide a comparison basis for future experiments.

Keywords: Quadrotors. Motion planning. PID control. Genetic algorithm.