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Control of a Quadcopter Using Genetic Algorithm Methods

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Abstract : This paper concerns the control of a nonlinear system using two different methods, reference model and genetic algorithm. The quadcopter is a nonlinear unstable system, which is a part of aerial robots. It is constituted by four rotors placed at the end of a cross. The center of this cross is occupied by the control circuit. Its motions are governed by six degrees of freedom: three rotations around 3 axes (roll, pitch and yaw) and the three spatial translations. The control of such system is complex, because of nonlinearity of its dynamic representation and the number of parameters, which it involves. Numerous studies have been developed to model and stabilize such systems. The classical PID and LQ correction methods are widely used. If the latter represent the advantage to be simple because they are linear, they reveal the drawback to require the presence of a linear model to synthesize. It also implies the complexity of the established laws of command because the latter must be widened on all the domain of flight of these quadcopter. Note that, if the classical design methods are widely used to control aeronautical systems, the Artificial Intelligence methods as genetic algorithms technique receives little attention. In this paper, we suggest comparing two PID design methods. Firstly, the parameters of the PID are calculated according to the reference model. In a second phase, these parameters are established using genetic algorithms. By reference model, we mean that the corrected system behaves according to a reference system, imposed by some specifications: settling time, zero overshoot etc. Inspired from the natural evolution of Darwin's theory advocating the survival of the best, John Holland developed this evolutionary algorithm. Genetic algorithm (GA) possesses three basic operators: selection, crossover and mutation. We start iterations with an initial population. Each member of this population is evaluated through a fitness function. Our purpose is to correct the behavior of the quadcopter around three axes (roll, pitch and yaw) with 3 PD controllers. For the altitude, we adopt a PID controller.

Keywords : quadcopter, genetic algorithm, PID, fitness, model, control, nonlinear system
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