Control of a Three Degree of Freedom Quadcopter Stand Using Linear Quadratic Integral Based on the Differential Game Theory

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Abstract—In this paper, a quadcopter stand with three degrees of freedom was controlled using game theory-based control. The first player tracks a desired input, and the second player creates a disturbance in the tracking of the first player to cause an error in the tracking. The move is chosen using the Nash equilibrium, which presupposes that the other player made the worst move.. In addition to being resistant to input interruptions, this method may also be resilient to modeling system uncertainty. This method evaluated the performance through simulation in the Simulink environment and implementation on a three-degree-of-freedom stand.

Index Terms—Quadcopter, Differential Game, Game Theory, Nash Equilibrium, Three Degree of Freedom Stand, Model Base Design, Linear Quadratic Regulator

I. INTRODUCTION

Quadcopter is a type of helicopter with four rotors.

II. DIFFERENTIAL GAME

Differential games are a series of problems that arise while examining and simulating dynamic systems in game theory. Differential equations are used to simulate how a state variable or set of state variables changes over time.

A. An introduction to the differential game

It is considered that two players are involved in this paper. The space states of a continuous linear system are shown below.

$$\dot{\mathbf{x}}(t) = \mathbf{A}\mathbf{x}(t) + \mathbf{B_1}\mathbf{u_1}(t) + \mathbf{B_2}\mathbf{u_2}(t)$$

$$\mathbf{y}(t) = \mathbf{C}\mathbf{x}(t) + \mathbf{D_1}\mathbf{u_1}(t) + \mathbf{D_2}\mathbf{u_2}(t)$$
(1)

where x is the vector of all the state variables, \dot{x} is the time derivative of the state vector, u_1 is the firts player (controller) input vector, u_2 is the second player (disturbance) input vector, y is the output vector, y is the state matrix, y is firts player the input matrix, y is the second player input matrix, y is the output matrix, y is first player the output matrix and y is second player the output matrix. Equation (1) demonstrates how both participants have an impact on the system's dynamics. The second player may progress toward

In this paper we consider the case that players do not cooperate in order to realize their goals. The situation where players do not work together (non-cooperative) to achieve their objectives is examined in the paper.

III. MATHEMATICAL MODELING

the goal as a result of the first player's exertion, or vice versa.

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Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, ac, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

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- Use a zero before decimal points: "0.25", not ".25". Use "cm³", not "cc".)

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Number equations consecutively. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

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Please use "soft" (e.g., \eqref{Eq}) cross references instead of "hard" references (e.g., (1)). That will make it possible to combine sections, add equations, or change the order of figures or citations without having to go through the file line by line.

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F. Authors and Affiliations

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Head	Table column subhead	Subhead	Subhead
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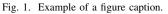


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ACKNOWLEDGMENT

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