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Application of Fuzzy Logic in Missile Guidance System

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***Abstract*: This paper discusses the application of fuzzy logic in defence systems. A. Özguru Vular has given the design parameters for the fuzzy missile along with the mathematical calculations. Smith, Erik S. studied the design parameters and the effectiveness of this method. A summary of these papers is presented in this paper.**

***Keywords*: Fuzzy logic, Missile.**

1. Introduction

The military tracking problem is one that has been well studied, and many solutions using various means of control have been successfully implemented. These control methods, however, are reaching the limits of their application. Fuzzy logic offers an exciting alternative solution to this problem. This system used information about a target laser's position and rate of change of position with respect to the tracking platform in two dimensions - elevation and azimuth - in order to arrive at its control decisions.

2. About fuzzy logic

Fuzzy logic is an emerging field of theory and application which holds great promise for the control of systems - especially those systems which cannot be described mathematically, or which are nonlinear in nature. Fuzzy logic's strength lies in its heuristic approach to control. Instead of requiring complex mathematical equations which describe a system's behavior, fuzzy logic allows systems designers to use a set of common sense, plain-English rules to invoke a desired system response. Fuzzy logic is a way of mathematically analyzing the uncertainty of information; that is, fuzzy logic is a way of dealing with information that is "gray" in nature. Fuzzy logic excels in dealing with information that cannot be described as being a full member of just one category, but can be described as being a partial member of two or more categories. The method fuzzy logic uses to achieve this result is by breaking information into well-defined categories and by determining the degree of membership of the information within those categories. Fuzzy logic control extends the principles of fuzzy logic to the solution of a control problem. A fuzzy logic system is thus sometimes called an "expert" system because the rule base (also called the Fuzzy Associative Matrix, or FAM) describes the decisions a human operator would make in the control of a system. Fuzzy logic is a way of fuzzy, which is a term used to describe a value describing the world around that is ambiguous in nature. Us in shades of "gray". This is i. contrast to Boolean logic, which is only capable of viewing the world in crisp term of absolute black and absolute white, having no allowance for transition between these two extremes. In fact, it can be proven that Boolean logic is a special case of fuzzy logic, with fuzzy logic being the more general form of logic.

3. Implementation of fuzzy in missile guidance

The fuzzy logic missile control system can be examined with the help of figure. It has two types of variables. Physical variables are defined in numerical values and linguistic variables are descriptions of the physical variables Guidance is the unit that drives the missile. Getting information about the missile and the target, guidance decides what to do to get to the target. A good guidance system is the system that can hit different types of targets, with minimum control effort, at minimum time, through the minimum flight path. There are many types of targets such as stationary targets, constant speed targets, accelerating targets, highly maneuvering targets. Guidance design highly depends 31 on the intended target type and mission of the missile.

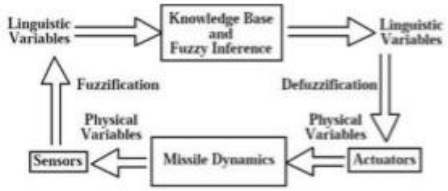

Fig. 1. Fuzzy logic

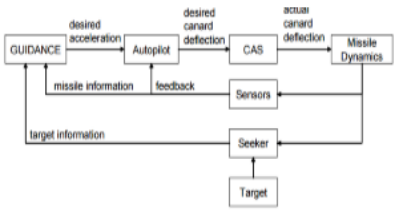

Fig. 2. Proportional Navigation

In this paper, a canard controlled, surface to air missile is considered, and guidance is done separately in pitch and yaw planes. Fuzzy logic guidance is designed to fill in the guidance box in the Fig. 1. The aim of the designed fuzzy guidance is to make improvements on the well-known and commonly used

guidance system named Proportional Navigation Guidance (PNG).

4. Conclusion

On the basis of missile guidance strategy initially the convergence of angle of attack is negligible to velocity error angle and heading error angle. And after reaching in terminal phase the rate of convergence of angle of attack is at faster rate because of minimization of distance between missile and target. So from the simulated graphs in the previous chapter we see that the small slopes provide the low rate of meeting of angle of attack. So from the graphs of triangular, trapezoidal, Gaussian and other combinations of membership functions, in the simulated graph of combination of triangular, generalized bell, and two sided Gaussian membership functions the larger slopes provide the preferred rate of meeting of angle of attack. So the combination of triangular, trapezoidal and two sided Gaussian membership functions provide the preferred performance guidance strategy.

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