Controller Design for Automatic Aiming System of a Demonstrative Prototype of Multiple Launch Rocket System Using MATLAB/Simulink and Programmable Logic Controller (PLC)

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Abstract

This paper presented the controller design for Automatic Aiming System (AAS) of a demonstrative prototype of Multiple Launcher Rocket System (MLRS) using MATLAB/Simulink to analyze the performance and improve the operating performance. The controller design started from modeling the plant, validating the system model, analyzing the performance in open-loop plant and closed-loop plant in time and frequency domains. Then, the root locus and pole placement techniques were applied to design the controller via Programmable Logic Controller (PLC) to control the Automatic Aiming System. The control performance of automatic aiming system mainly includes turning and elevating mechanism control performances. Both the hydraulic turning and elevating mechanism control systems provide good performance of control stability, high response speed and control accuracy. Overall, this analysis yielded a good percentage best fit that compared the experiment results and also met the user requirements

Keywords: Automatic Aiming System, Multiple Launch Rocket System, Programmable Logic Control

1. INTRODUCTION

This paper aim to research and development a demonstrative prototype for platform of Multi-Launcher Rocket System (MLRS) at Defence Technology Institute (DTI), Thailand. In order to design the controller for any dynamical system, a suitable dynamic model of the system needs to be formulated and its parameters need to be accurately identified. The important parameters were obtained with various methods. Some parameters were obtained by research and development as well as manufacturer specifications, and some parameters needed to be obtained through experiments and test. This also holds for a demonstrative prototype for platform of Multi-Launcher Rocket System (MLRS), this paper proposes the system identification using Lagrange's equation and control simulation analysis tool were identified and the model was developed, then the model was employed to simulate the multi-sine input signal and the simulation results were compared to the experimental results for validation model. This paper was organized in the following manner: Section 2 Plant; Section 3 Modeling of the plant; Section 4 Validation; Root locus and stability analysis; Section 5 Results and discussion; finally, Section 6 is the conclusion.

2. PLANT

The plant used in this research is the demonstrative prototype for platform of MLRS as shown in Fig. 1. The platform consists of three major parts as following: (i) the turning use for construction of azimuth angle parts that has diameter 1600 mm. height 637 mm., of width length and thickness respectively and the total weight is 2,879 kg. (ii) The cradle uses for construction of elevation angle platform is the all of the elevation control devices and rocket pod that has dimension 1,500 mm. 4,210 mm. and 250 mm. of width, length and thickness respectively. The total weight is 928 kg. (iii) The rocket pod includes launch tube 6 tube that has dimension 1,500 mm. 3,965 mm. 797 mm. and the total weight is 838 kg. The pressurized fluid flow is controlled by using the programmable logic controller. This control solenoid valve is the proportional and directional types. The hydraulic drive system is driven by the user pressurized pump and solenoid valve are regulated fluid source. Also this research applies CATIA V6 simulation to simulate and determine the parameters used for Lagrange's equations for plant modeling.