Modeling and control of a demonstrative prototype for platform multi-launcher rocket system using Lagrange's equation and CATIA simulation

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Abstract. This article presents the modeling of a demonstrative prototype for platform Multi-Launcher Rocket System (MLRS) using Lagrange's equation and CATIA V6 simulation. Then improve the controller to the closed-loop feedback control using pole placement method. The model was developed was simulate the multi-sine signal input response and the simulation results were comparison to the experimental result. It was found that the model was developed using Lagrange's equation having a good percentage best fit and the step response of the closed-loop plant have improved and met the requirement.

Keywords: modeling, Lagrange's equation, multi-sine signals.

1. Introduction

This paper will describes research and development a demonstrative prototype for platform of Multi-Launcher Rocket System (MLRS) at laboratory in Defence Technology Institute of Thailand. In order to design the controller for any dynamical system, a suitable dynamical 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 research and developed, 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 the model. This paper was organized in the following manner: Section 2 – plant; Section 3 – modeling of the plant; Section 4 – root locus and stability analysis; Section 5 – controller design; Section 6 – experimental results and discussion; finally, Section 7 is the conclusion.

2. Plant

The plant used of this research is the demonstrative prototype for platform of MLRS as shown in Fig. 1. The platform consists of three major parts as following: 1) The turning use for construction of azimuth angle parts that has diameter 1600 mm height 637 mm in width length and thickness respectively and the total weight is 2,879 kg; 2) The cradle use 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 in width, length and thickness respectively and the total of weight is 928 kg; 3) The rocket pod include launch tube 6 tube that has dimension 1,500 mm, 3,965 mm, 797 mm and the total weight 838 kg. The pressurized fluid flow is controlled by using the programmable logic controller. This control solenoid valve is the proportional and directional type that have analog input voltage 0-10 VDC with current 0-20 mA. The hydraulic drive system is driven by the user pressurized pump and solenoid valve are regulate fluid source of up to 2200 psi or 150 bars. The Also this research studies together with CATIA V6 simulation to simulate and determine the parameters use for Lagrange's equation as shown in Fig. 1.