Dynamic Mathematical Modeling and Simulation Study of Small Scale Autonomous Hovercraft

M. Z. A. Rashid[1], M. S. M. Aras[1], M. A. Kassim[1], Z. Ibrahim[1] and A. Jamali[2]

[1]*Faculty of Electrical Engineering,*
Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya,
76100 Durian Tunggal, Melaka, Malaysia
[2]*Faculty of Mechanical And Manufacturing Engineering,*
Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia
zamzuri@utem.edu.my

Abstract

Nowadays, various mechanical, electrical systems or combination of both systems are used tohelp or ease human beings either during the daily life activity or during the worst condition faced by them. The system that can be used to increase human life quality are such as in military operations, pipeline survey, agricultural operations and border patrol. The worst condition that normally faced by human are such as earthquake, flood, nuclear reactors explosion and etc. One of the combinations of both systems is unmanned hovercraft system which is still not thoroughly explored and designed. Hovercraft is a machine that can move on the land surface or water and it is supported by cushion that has high compressed air inside. The cushion is a close canvas and better known as a skirt. A hovercraft moves on most of surfaces either in rough, soft or slippery condition will be developed. The main idea for this project is to develop a dynamic modelling and controller for autonomous hovercraft. The model of the hovercraft will be initially calculated using Euler Lagrange method. The model of the hovercraft is derived using Maple software. The model that is developed then needs to be tested with open loop simulation in the MATLAB/Simulink environment. The LQR controller to regulate the small scale autonomous hovercraft then will be developed and tested with MATLAB.

Keywords: *Autonomous, Hovercraft, Dynamic Modelling, LQR regulator*

1. Introduction

Hovercraft is a transport that can travel to other places where it can move on the water surface or land surface. The hovercraft consists of fans and cushion. There is air pressure inside the cushion to enable the hovercraft to float and move smoothly in any land surface. The pressure inside the cushion needs to be maintained at all time while the lift fan capable to operate in the long duration to ensure the hovercraft can move forward at certain speed. The advantages of unmanned hovercrafts are; the hovercrafts able to operate in all types of climates such as in Arctic, in the Tropics and Asian climates. Furthermore, the unmanned hovercraft has less friction compared to other land or water transportation due to the air pressure inside the hovercraft's cushion. This air reduces the friction between land or water surface that has direct contact with the hovercraft's skirt. This system also can be launched from ship or any places where a larger vehicle cannot reach these certain places. The disadvantages using hovercraft are; they require a lot of air and has quite loud noise due to fans or propellers rotation during the operation. In addition, the hovercraft also has potential