

Modeling and controller design of manta-type
unmanned underwater test vehicle[†]Seung-Keon Lee¹, Kyoung-Ho Sohn², Seung-Woo Byun² and Joon-Young Kim^{3,*}¹Department of Naval Architecture and Ocean Engineering, Pusan National University, Busan 609-735, Korea²Division of Naval Architecture and Ocean Engineering, Korea Maritime University, Busan, 605-791, Korea³Department of Ocean System Engineering, Sogang National University, Sogwi, 490-756, Korea

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Abstract

This paper describes the mathematical model and controller design for Manta-type unmanned underwater test vehicle (MLUTV) with 6 DOF nonlinear dynamic equations. The mathematical model contains hydrodynamic forces and moments expressed in terms of a set of hydrodynamic coefficients which were obtained through the PMM (planar motion mechanism) test. Based on the 6 DOF dynamic equations, numerical simulations have been performed to analyze the dynamic performance of the MLUTV. In addition, using the mathematical model PID and sliding mode controller are constructed for the diving and steering maneuver. Simulation results show that the control performance of the MLUTV designed with that of CNPS (Naval Postgraduate School) AUV II.

Keywords: Manta-type unmanned underwater test vehicle; Mathematical model; Planar motion mechanism; Controller design

1. Introduction

The unmanned underwater vehicle (UUV) has two kinds of purposes. One is a non-military purpose; it can be used in deep sea terrain for survey, mineral resources investigation and underwater structure maintenance. The other is a military purpose; for example, MDP (mine disposal vehicle) and underwater precision-guided munitions. Since 1996 the US Navy's NUWC (Naval Undersea Warfare Center) has been developing a concept for undersea warfare in the new century. This new unmanned undersea vehicle is called MTV (Mine Test Vehicle) [2]. These vehicles are intended to be multi-mission, re-configurable UUVs that will be capable of carrying surveillance, tactical oceanography, mine warfare, and anti-submarine warfare payloads. This MTV can be used

as a tool of data acquisition and mission prosecution, but normally the MTV is a part of a submarine.

This paper deals with the dynamic and control performance of the MLUTV (Manta-type unmanned underwater test vehicle) using a mathematical model including hydrodynamic coefficients. Section 2 develops a 6DOF mathematical model using hydrodynamic coefficients from a PMM (planar motion mechanism) test. Section 3 designs simulation programs based on modeling. Section 4 discusses the control performance of the MLUTV. Finally, Section 5 presents the conclusions.

2. Mathematical model

The mathematical model of an underwater vehicle is comprised of a vehicle body, thrusters, and control surfaces. To simulate the 3-dimensional motion, the mathematical model is presented with 6DOF equations of motion with hydrodynamic coefficients [6].

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Autonomous driving algorithms and Its IC Design Jianfeng Ren,Dong Xia,2023-08-09 With the rapid development of artificial intelligence and the emergence of various new sensors autonomous driving has grown in popularity in recent years The implementation of autonomous driving requires new sources of sensory data such as cameras radars and lidars and the algorithm processing requires a high degree of parallel computing In this regard traditional CPUs have insufficient computing power while DSPs are good at image processing but lack sufficient performance for deep learning Although GPUs are good at training they are too power hungry which can affect vehicle performance Therefore this book looks to the future arguing that custom ASICs are bound to become mainstream With the goal of ICs design for autonomous driving this book discusses the theory and engineering practice of designing future oriented autonomous driving SoC chips The content is divided into thirteen chapters the first chapter mainly introduces readers to the current challenges and research directions in autonomous driving Chapters 2 6 focus on algorithm design for perception and planning control Chapters 7 10 address the optimization of deep learning models and the design of deep learning chips while Chapters 11 12 cover automatic driving software architecture design Chapter 13 discusses the 5G application on autonomous driving This book is suitable for all undergraduates graduate students and engineering technicians who are interested in autonomous driving

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Zain,Rosmiwati Mohd-Mokhtar,Maziyah Mat Noh,Zool H. Ismail,Ahmad Anas Yusof,Ahmad Faisal Mohamad Ayob,Syed Saad Azhar Ali,Herdawatie Abdul Kadir,2021-09-24 This book comprises the proceedings of the 12th National Technical Symposium on Unmanned System Technology 2020 NUSYS 20 held on October 27 28 2020 It covers a number of topics including intelligent robotics novel sensor technology control algorithms acoustics signal processing imaging techniques biomimetic robots green energy sources and underwater communication backbones and protocols and it appeals to researchers developing marine technology solutions and policy makers interested in technologies to facilitate the exploration of coastal and oceanic regions

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X-Planes: Pushing the Envelope of Flight Steve Pace, 2003 [A survey of the development of biomimetic intelligence and robotics](#) YÜCEL BEYAZIT, 2021-10-30 Keywords Biomimetics Robotics Biomimetic intelligence Biomimetic robotics Biomimetics is the development of novel theories and technologies by emulating the models and systems of nature The transfer of function from biological science into engineering promotes emerging research areas across many disparate disciplines Recently advances in biomimetic intelligence and robotics have gained great popularity Biomimetic robotics are designed with biological characteristics and functions to be applied in different scenarios such as humanoid robots in the home environment quadruped robots in the field and bird like flying robots in the sky Biomimetic intelligence aims to solve many complex problems by studying the principles of biological systems resulting in a series of efficient algorithms such as the genetic algorithm and neural network Biomimetic intelligence further facilitates the performance of biomimetic robotics making it possible to be deployed in more and more practical applications

Aeronautical Engineering: A Cumulative Index to a Continuing Bibliography (supplement 261), 1991 **Information and Communication Technologies** Jorge Herrera-Tapia, Germana Rodriguez-Morales, Efraín R. Fonseca C., Santiago Berrezueta-Guzman, 2022-09-30 This book constitutes refereed proceedings of the 10th Ecuadorian Conference on Information and Communication Technologies TICEC 2022 held in Manta Ecuador in October 2022 The 20 full papers were carefully reviewed and selected from 150 qualified submissions The papers cover a great variety of topics such as wireless communication immersive environments artificial intelligence data mining neural networks augmented reality cyberphysical systems telemedicine cybersecurity software architecture data processing software development and others The contributions are divided into the following thematic blocks ICT s Applications Data Science Software Development

Encyclopedia of Fish Physiology, 2011-06-01 Fish form an extremely diverse group of vertebrates At a conservative estimate at least 40% of the world s vertebrates are fish On the one hand they are united by their adaptations to an aquatic environment and on the other they show a variety of adaptations to differing environmental conditions often to extremes of temperature salinity oxygen level and water chemistry They exhibit an array of behavioural and reproductive systems Interesting in their own right this suite of adaptive physiologies provides many model systems for both comparative vertebrate and human physiologists This four volume encyclopedia covers the diversity of fish physiology in over 300 articles and provides entry level information for students and summary overviews for researchers alike Broadly organised into four themes articles cover Functional Thematic and Phylogenetic Physiology and Fish Genomics Functional articles address the traditional aspects of fish physiology that are common to all areas of vertebrate physiology including Reproduction Respiration Neural Sensory Central Effector Endocrinology Renal

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