

[< Back to results](#) | 1 of 1[Download](#) [Print](#) [Save to PDF](#) [Add to List](#) [Create bibliography](#)*Journal of Marine Science and Application* • [Open Access](#) • Volume 14, Issue 4, Pages 399 - 405 • 1 December 2015**Document type**Article • [Green Open Access](#)**Source type**

Journal

ISSN

16719433

DOI

10.1007/s11804-015-1324-8

[View more](#)

Development of cubic Bezier curve and curve-plane intersection method for parametric submarine hull form design to optimize hull resistance using CFD

[Chrismianto, Deddy^a](#) ; [Zakki, Ahmad Fauzan^a](#); [Arswendo, Berlian^a](#); [Kim, Dong Joon^b](#) [Save all to author list](#)^a Department of Naval Architecture, Diponegoro University, Semarang, 50275, Indonesia^b Department of Naval Architecture and Systems Marine Engineering, Pukyong National University, Busan, 48513, South Korea15 ^{76th} percentile
Citations in Scopus1.22
FWCI 56
Views count [View all metrics](#) [Full text options](#) [Export](#) [Abstract](#)[Author keywords](#)[SciVal Topics](#)[Metrics](#)**Abstract**

Optimization analysis and computational fluid dynamics (CFDs) have been applied simultaneously, in which a parametric model plays an important role in finding the optimal solution. However, it is difficult to create a parametric model for a complex shape with irregular curves, such as a submarine hull form. In this study, the cubic Bezier curve and curve-plane intersection method are used to generate a solid model of a parametric submarine hull form taking three input parameters into account: nose radius, tail radius, and length-height hull ratio (L/H). Application program interface (API) scripting is also used to write code in the ANSYS design modeler. The results show that the submarine shape can be generated with some variation of the input parameters. An example is given that shows how the proposed method can be applied successfully to a hull resistance optimization case. The parametric design of the middle submarine type was chosen to be modified. First, the

Cited by 15 documents

Optimization of Submarine Resistance and Manoeuvrability Based on SBD Technique

Chen, G. , Wu, J. , [Wan, D.](#) (2022) *Proceedings of the International Offshore and Polar Engineering Conference*

Parametric hull design with rational Bézier curves and estimation of performances

Ingrassia, T. , Mancuso, A. , Nigrelli, V. (2021) *Journal of Marine Science and Engineering*

Parametric Hull Design with Rational Bézier Curves

Mancuso, A. , Saporito, A. , Tumino, D. (2021) *Lecture Notes in Mechanical Engineering*[View all 15 citing documents](#)

Inform me when this document is cited in Scopus:

[Set citation alert >](#)**Related documents**

Parametric bulbous bow design using the cubic Bezier curve and curve-plane intersection method for the minimization of ship resistance in CFD

Chrismianto, D. , Kim, D.-J. (2014) *Journal of Marine Science and Technology (Japan)*

A hydrodynamic optimization design methodology for a ship bulbous bow under multiple operating conditions

Lu, Y. , Chang, X. , Hu, A.-K. (2016) *Engineering Applications of Computational Fluid Mechanics*

Analysis of Effect of Bulbous Bow Shape to Ship Resistance in Catamaran Boat

Chrismianto, D. , Kiryanto , Arswendo Aditya, B. (2018) *MATEC Web of Conferences*[View all related documents based on references](#)

Find more related documents in Scopus based on:

Source details

Journal of Marine Science and Application

Scopus coverage years: from 2007 to 2022

Publisher: Haerbin Gongcheng Daxue/Harbin Engineering University

ISSN: 1671-9433 E-ISSN: 1993-5048

Subject area: Engineering: Ocean Engineering Engineering: Mechanical Engineering

Source type: Journal

CiteScore 2021
2.3

SJR 2021
0.488

SNIP 2021
1.006

[View all documents >](#)

[Set document alert](#)

[Save to source list](#)

[CiteScore](#) [CiteScore rank & trend](#) [Scopus content coverage](#)

Improved CiteScore methodology

CiteScore 2021 counts the citations received in 2018-2021 to articles, reviews, conference papers, book chapters and data papers published in 2018-2021, and divides this by the number of publications published in 2018-2021. [Learn more >](#)

CiteScore 2021

$$2.3 = \frac{506 \text{ Citations 2018 - 2021}}{217 \text{ Documents 2018 - 2021}}$$

Calculated on 05 May, 2022

CiteScoreTracker 2022

$$2.9 = \frac{651 \text{ Citations to date}}{225 \text{ Documents to date}}$$

Last updated on 05 April, 2023 • Updated monthly

CiteScore rank 2021

Category	Rank	Percentile
Engineering		
Ocean Engineering	#46/98	53rd
Engineering		
Mechanical Engineering	#313/601	48th

[View CiteScore methodology >](#) [CiteScore FAQ >](#) [Add CiteScore to your site &](#)



Journal of Marine Science and Application



 [Editorial board](#)  [Aims & scope](#)  [Journal updates](#)

The *Journal of Marine Science and Application* (JMSA) aims to provide a platform for scientists and engineers in a wide range of topics on marine science and engineering. JMSA publishes high-level peer-reviewed research on the subjects in the field of theoretical and experimental investigations, that explore naval architecture, ocean engineering, marine renewable energy, underwater technology, polar and arctic engineering, marine engineering, corrosion prevention, ocean acoustics, automatic navigation, marine environmental engineering, marine science among others. JMSA welcomes submissions of papers around the world on all the above topics, and it has no page limitations and no publication fees.

Journal of Marine Science and Application (JMSA) is co-published quarterly by the Chinese Society of Naval Architects and Marine Engineers (CSNAME), Harbin Engineering University (HEU), and Springer-Verlag.

CSNAME was established in 1943 with the aim of promoting the development of the scientific and technological level of Naval Architecture and Ocean Engineering in China. The number of members is nearly 30 000, mainly from China Shipbuilding Industry Corporation (CSIC), China State Shipbuilding Corporation (CSSC), China National Offshore

Oil Corporation (CNOOC), China Classification Society (CCS), Harbin Engineering University (HEU), and Shanghai Jiao Tong University. The society has conducted international cooperation and exchange with many countries such as the USA, UK, Germany, Holland, Russia, Ukraine, Japan, and Korea. Harbin Engineering University is one of the key universities in China with strong teaching and research & development capabilities in the field of naval architecture and ocean engineering.

- Covers research in naval architecture, ocean engineering, marine resource exploitation, marine engineering, marine power system, ocean acoustics, corrosion prevention, automatic navigation, polar and arctic engineering, marine science, and related topics;
- Provides a platform for current issues in the above fields and guide engineering application for scientists and engineers;
- Publishes high-level peer-reviewed papers;
- No page limits and no publication fees.

— [show less](#)

Associate Editor

Guoyong Jin

Editors-in-Chief

Wenyang Duan, Carlos Guedes Soares

Publishing model

Hybrid (Transformative Journal). [How to publish with us, including Open Access](#)

77,943 (2021)

Downloads

Latest issue

Electronic ISSN **Print ISSN**

1993-5048

1671-9433

Abstracted and indexed in

Astrophysics Data System (ADS)

Baidu

CLOCKSS

CNKI

CNPIEC

Dimensions

EBSCO Discovery Service

Emerging Sources Citation Index

Google Scholar

INIS Atomindex

INSPEC

Naver

OCLC WorldCat Discovery Service

Portico

ProQuest Aquatic Sciences and Fisheries Abstracts (ASFA)

ProQuest-ExLibris Primo

ProQuest-ExLibris Summon

SCImago

SCOPUS

TD Net Discovery Service

UGC-CARE List (India)

Wanfang

Copyright information

[Rights and permissions](#)

[Springer policies](#)

© Harbin Engineering University



Journal of Marine Science and Application



[Journal of Marine Science and Application](#) > [Editors](#)

Editors

Honorary Editor-in-Chief

William C. Webster, University of California at Berkeley, USA

Duanfeng Han, Harbin Engineering University, China

Editor-in-Chief

Wenyang Duan, Harbin Engineering University, China

Carlos Guedes Soares, Instituto Superior Técnico, Universidade de Lisboa, Portugal

Vice Editor-in-Chief

Guoyong Jin, Harbin Engineering University, China

Ye Li, Harbin Engineering University, China

Baoyu Ni, Harbin Engineering University, China

Hongde Qin, Harbin Engineering University, China

A-man Zhang, Harbin Engineering University, China

Editorial Board Members

Wei Bai, Manchester Metropolitan University, UK

Ermina Begovic, University of Naples, Italy

Kostas Belibassakis, NTUA, Greece

Wenping Bi, University of Le Mans, France

Stefano Brizzolara, Virginia Tech, USA

Chaohe Chen, South China University of Technology, China

Xiaobo Chen, Bureau Veritas, France

Weicheng Cui, Westlake University, China

Xiaoming Deng, Harbin Engineering University, China

Khac Duc Do, Curtin University, Australia

Guoxiang Dong, Shanghai Ship & Shipping Research Institute, China

Sheng Dong, Ocean University of China, China

Sören Ehlers, Hamburg University of Technology, Germany

R. Cengiz Ertekin, University of Hawaii at Manoa, USA

Odd M. Faltinsen, Norwegian University of Science and Technology, Norway

Masahiko Fujikubo, Osaka University, Japan

Antonio Carlos Fernandes, Federal University of Rio de Janeiro, Brasil

Shixiao Fu, Shanghai Jiao Tong University, China

Fuping Gao, Institute of Mechanics, Chinese Academy of Sciences, China

Zhen Gao, Norwegian University of Science and Technology, Norway

Hassan Ghassemi, Amirkabir University of Technology, Iran

John Grue, University of Oslo, Norway

Spyros Hirdaris, Aalto University, Finland

Changhong Hu, Kyushu University, Japan

Yan Huang, Tianjin University, China

Tomoki Ikoma, Nihon University, Japan

Jasmin Jelovica, The University of British Columbia, Canada

Xiaoli Jiang, Delft University of Technology, The Netherlands

Abbas Khayyer, Kyoto University, Japan

Yonghwan Kim, Seoul National University, Korea

Huajun Li, Ocean University of China, China

Xiukun Li, Harbin Engineering University, China
Yaan Li, Northwestern Polytechnical University, China
Zhijun Li, Dalian University of Technology, China
Dongqiang Lu, Shanghai University, China
Bin Liu, Wuhan University of Technology, China
Yong Liu, Ocean University of China, China
Torgeir Moan, NTNU, Norway
Bettar Ould el Moctar, Univ Duisbuig-Essen, Germany
Jakub Montewka, Katedra Transportu i Logistyki, Poland
Dezhi Ning, Dalian University of Technology, China
Muk Chen Ong, University of Stavanger, Norway
Jeom Kee Paik, Pusan National University, Korea
Josko Parunov, University of Zagreb, Croacia
Jasna Prpic-Orsic, University of Rijeka, Croacia
Wei Qiu, Memorial University, Canada
Jonas W. Ringsberg, Chalmers University of Technology, Sweden
Cesare Rizzo, University of Genova, Italy
Daniel Rouseff, University of Washington, USA
Kirill V. Rozhdestvensky, Saint-Petersburg State Marine Technical University, Russia
Debabrata Sen, IIT Karaghpur, India
Tarmo Soomere, Tallinn University of Technology, Estonia
Antonio Souto-Iglesias, Universidad Politécnica de Madrid, Spain
Yumin Su, Harbin Engineering University, China
Gopalan Subramanian, Central Electrochemical Research Institute, India
Wojciech Sulisz, Polish Academy of Sciences, Poland
Liping Sun, Harbin Engineering University, China
Yougang Tang, Tianjin University, China
Kristjan Tabri, Tallinn University of Technology, Estonia
Nikolay Taranukha, Komsomolsk-on-Amur State Technical University, Russia
Bin Teng, Dalian University of Technology, China
Feng Tong, Xiamen University, China
Decheng Wan, Shanghai Jiao Tong University, China
Lin Wan, University of Delaware, USA

George Wang, American Bureau of Shipping, USA
Hao Wang, Norwegian University of Science and Technology, Norway
Jin Wang, Liverpool John Moores University, UK
Zhongyi Wang, Harbin Engineering University, China
Guoxiong Wu, University College London, UK
Yeping Xiong, University of Southampton, UK
Yuwang Xu, Shanghai Jiao Tong University, China
Zheping Yan, Harbin Engineering University, China
Poojitha D. Yapa, Clarkson University, USA
Solomon Yim, Oregon State University, USA
Jingwei Yin, Harbin Engineering University, China
Dagang Zhang, DMAR Engineering, Inc., USA
Yao Zhao, Huazhong University of Science and Technology, China
Peilin Zhou, University of Strathclyde, UK
Zhi Zong, Dalian University of Technology, China

Associate Board Director

Jingwei Yin, Harbin Engineering University, China

Associate Board Members

Abbas Dashtimanesh, KTH Royal Institute of Technology, Sweden
Bahadir Ugurlu, Istanbul Technical University, Turkey
Constantine Michailides, Cyprus Univ. of Technology, Cyprus
Debabrata Karmakar, National Institute of Techn. Karnataka, India
Do Kyun Kim, Seoul National University, South Korea
Eddie Blanco Davis, Liverpool John Moores University, UK
Gabriele Bulian, University of Trieste, Italy
José Miguel Rodrigues, SINTEF Ocean, Norway
Laura Castro-Santos, Universidade da Coruña, Spain
Lorenzo Moro, Memorial University, Canada
Marco Klein, Hamburg University of Technology, Germany

Maria Acanfora, University of Naples "Federico II", Italy
Mihkel Kõrgesaar, Tallinna Univ. of Technology, Estonia
Momchil Terziev, Strathclyde University, UK
Nikolas Ventikos, NTUA, Greece
Osiris Valdez Banda, Aalto University, Finland
Pedram Edalat, Petroleum University of Technology, Iran
Radanev Datta, Indian Institute of Technology Kharagpur, India
Saad Eldeen, Port Said University, Egypt
Sarat Mohapatra, CENTEC/IST, Portugal
Shan Wang, CENTEC/IST, Portugal
Simone Mancini, FORCE Technology, Denmark
Stefano Gaggero, University of Genova, Italy
Suresh Rajendran, Indian Institute of Technology Madras, India
Vincenzo Piscopo, University of Naples "Parthenope", Italy
Vu Van Tuyen, Univ. of Haiphong, Vietnam
Jose Luis Mantari Laureano, Universidad Nacional de Ingeniería, Peru
Bing Chu, University of Southampton, UK
Manases Tello Ruiz, Hamburgische Schiffbau-Versuchsanstalt GmbH, Germany
Lokukaluge Prasad Perera, Arctic University of Norway, Norway
Baiqiao Chen, ISCTE-Lisbon University Institute, Portugal
Zhiming Yuan, University of Strathclyde, UK
Francesca Satta, University of Genoa, Italy
Miaomiao Wang, Lakehead University, Canada
Jian Deng, Zhejiang University, China
Yong Ma, Wuhan University of Technology, China
Lichuan Zhang, Northwestern Polytechnical University, China
Zhouhua Peng, Dalian Maritime University, China
Shenshen Yang, China Ship Scientific Research Center, China
Binbin Zhao, Harbin Engineering University, China
Lihao Yuan, Harbin Engineering University, China
Shiping Wang, Harbin Engineering University, China
Dong Han, Shanghai Jiao Tong University, China
Yu Wang, Wuhan University of Technology, China

Yibin Guo, Harbin Engineering University, China

Lei Zhu, Shanghai Jiao Tong University, China

Yulong Huang, Harbin Engineering University, China

Badong Chen, Xi'an Jiaotong University, China

Xianbo Xiang, Huazhong University of Science and Technology, China

Weisong Wen, The Hong Kong Polytechnic University, China

Songzuo Liu, Harbin Engineering University, China

Fengzhong Qu, Zhejiang University, China

Jianghui Li, Xiamen University, China

Bingchen Liang, Ocean University of China, China

Zhiyuan Wang, China University of Petroleum (East China), China

Jingchun Feng, Guangdong University of Technology, China

Wei Li, South China Sea Institute of Oceanology, CAS, China

Jun Liu, Beihang University

Liang Zhang, Harbin Engineering University, China



You have access to our articles

For authors

[Submission guidelines](#)

[Language editing services](#)

[Ethics & disclosures](#)

[Open Access fees and funding](#)

[Contact the journal](#)

[Calls for papers](#)

Submit manuscript



Journal of Marine Science and Application



[Journal of Marine Science and Application](#) > [Aims and scope](#)

Aims and scope

The aim of the *Journal of Marine Science and Application* (JMSA) is to provide a platform for current issues in a range of topics relevant to marine science and engineering, and to guide engineering application for scientists and engineers.

JMSA is a scholarly international journal, publishing high-level peer-reviewed research on the subjects in the field of theoretical and experimental investigations, that explore naval architecture, ocean engineering, marine renewable energy, underwater technology, marine engineering, corrosion prevention, ocean acoustics, automatic navigation among others. Topics include, but are not limited to:

Naval architecture

- Marine hydrodynamics
- Structural mechanics
- Design methodology & practice
- Ship resistance and propulsion
- Safety and reliability
- Marine equipment technology

Ocean engineering

- Coastal engineering
- Offshore engineering
- Marine drilling
- Pipelines and risers
- Cable, mooring, buoy technology

Marine renewable energy

- Offshore wind energy utilization
- Ocean wave energy utilization
- Ocean current energy utilization

Underwater technology

- Underwater vehicles
- Underwater explosion
- Ocean resources & mining
- Marine sensors

Marine engineering

- Marine engines and fuels
- Marine power engineering
- Vibration and noise control
- Heat transfer and fluid flow

Ocean acoustics

- Sonar and transducers
- Sound propagation and scattering
- Acoustical oceanography
- Signal coherence and fluctuation

Polar and arctic engineering

- Design of ice-going ships

- Arctic structures
- Ice loads and simulation of ice

Marine environmental engineering

- Oil spill prevention
- Marine pollution modeling

Marine corrosion and protection

- Corrosion and deterioration modeling
- Ship corrosion protection
- Pipeline corrosion protection

Automatic navigation

- Ship navigation system
- Marine navigation equipment
- System dynamics & control

Marine science

- Marine meteorology
- Ocean internal waves
- Extreme offshore environments

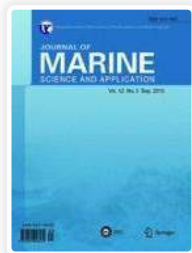
Experimental technology of above

Engineering application of above

The journal welcomes submissions of papers around the world on all the above topics. It also receives original works in the other emerging and interdisciplinary areas of the oceans.



You have access to our articles



Journal of Marine Science and Application



[Journal of Marine Science and Application](#) > [Volumes and issues](#) > [Volume 14, issue 4](#)

Search within journal

Volume 14, issue 4, December 2015

13 articles in this issue

[Path-tracking control of underactuated ships under tracking error constraints](#)

Khac Duc Do

OriginalPaper | Published: 27 October 2015 | Pages: 343 - 354

[Wave motion in an ice covered ocean due to small oscillations of a submerged thin vertical plate](#)

Paramita Maiti, Puspendu Rakshit & Sudeshna Banerjea

OriginalPaper | Published: 23 October 2015 | Pages: 355 - 365

[Wave interaction with dual circular porous plates](#)

Arpita Mondal & R. Gayen

OriginalPaper | Published: 16 October 2015 | Pages: 366 - 375

[Comparison of flow characteristics around refractive and right-angled groins in barotropic and baroclinic conditions](#)

Hamed Omdehghiasi, Alireza Mojtahedi & Mohammad Ali Lotfollahi-Yaghin

OriginalPaper | Published: 23 October 2015 | Pages: 376 - 388

[Reliability analysis based on a direct ship hull strength assessment](#)

Guoqing Feng, Dongsheng Wang ... C. Guedes Soares

OriginalPaper | Published: 23 October 2015 | Pages: 389 - 398

[Development of cubic Bezier curve and curve-plane intersection method for parametric submarine hull form design to optimize hull resistance using CFD](#)

Deddy Chrismianto, Ahmad Fauzan Zakki ... Dong Joon Kim

OriginalPaper | Published: 20 October 2015 | Pages: 399 - 405

[The application of a smartphone in ship stability experiment](#)

Mohamed Abdelkader Djebli, Benameur Hamoudi ... Lahouari Adjlout

OriginalPaper | Published: 16 October 2015 | Pages: 406 - 412

[A significant look at the effects of Persian Gulf environmental conditions on sound scattering based on small perturbation method](#)

Parviz Ghadimi, Alireza Bolghasi ... Rahim Zamanian

OriginalPaper | Published: 27 October 2015 | Pages: 413 - 424

[Underwater terrain-aided navigation based on multibeam bathymetric sonar images](#)

Ziqi Song, Hongyu Bian & Adam Zielinski

OriginalPaper | Published: 27 October 2015 | Pages: 425 - 433

[Acoustic MIMO communications in a very shallow water channel](#)

Yuehai Zhou, Xiuling Cao & Feng Tong

OriginalPaper | Published: 12 October 2015 | Pages: 434 - 439

[Energy harvesting from sea waves with consideration of airy and JONSWAP theory and optimization of energy harvester parameters](#)

Hadi Mirab, Reza Fathi ... Reza Hassannejad

OriginalPaper | Published: 12 October 2015 | Pages: 440 - 449

[Performance of marine power plant given generator, main and distribution switchboard failures](#)

Amit Kumar & Mangey Ram

OriginalPaper | Published: 27 October 2015 | Pages: 450 - 458

[Corrosion resistance of AA6063-Type Al-Mg-Si alloy by silicon carbide in sodium chloride solution for marine application](#)

Ojo Sunday Isaac Fayomi, Malik Abdulwahab ... Ferdinand Asuke

OriginalPaper | Published: 21 October 2015 | Pages: 459 - 462

Path-tracking Control of Underactuated Ships Under Tracking Error Constraints

Khac Duc Do *

Department of Mechanical Engineering, Curtin University, Kent Street, Bentley, WA 6102, Australia

Abstract: This paper presents a constructive design of new controllers that force underactuated ships under constant or slow time-varying sea loads to asymptotically track a parameterized reference path, that guarantees the distance from the ship to the reference path always be within a specified value. The control design is based on a global exponential disturbance observer, a transformation of the ship dynamics to an almost spherical form, an interpretation of the tracking errors in an earth-fixed frame, an introduction of dynamic variables to compensate for relaxation of the reference path generation, p -times differentiable step functions, and backstepping and Lyapunov's direct methods. The effectiveness of the proposed results is illustrated through simulations.

Keywords: underactuated ship; path-tracking; error constraint; Lyapunov method; backstepping method

Article ID: 1671-9433(2015)04-0343-12

1 Introduction

The main difficulty with controlling an underactuated ship is that only the yaw and surge axes are directly actuated while the sway axis is not. An application of Brockett's theorem (Brockett, 1983) shows nonexistence of pure-state feedbacks that are able to asymptotically stabilize an underactuated ship at a fixed point. Thus, the stabilization problem is often solved by either discontinuous or time-varying feedback (e.g., (Reyhanoglu, 1997; Pettersen and Egeland, 1996; Aguiar and Pascoal, 2001; Mazenc *et al.*, 2002; Do *et al.*, 2002b)).

A global exponential position tracking system without controlling the ship's yaw angle was proposed in (Godhavn *et al.*, 1998). In (Pettersen and Nijmeijer, 2001), a high-gain, local exponential tracking result was obtained based on the work in (Jiang and Nijmeijer, 1999). Based on cascade and passivity approaches, several global tracking results were obtained in (Lefeber *et al.*, 2003; Jiang, 2002). Note that in (Jiang, 2002; Lefeber *et al.*, 2003; Pettersen and Nijmeijer, 2001), the yaw velocity was required to be nonzero, i.e., a straight-line cannot be tracked. This restrictive assumption was removed in (Do *et al.*, 2002a; 2002b; Lee and Jiang, 2004), where various relaxations on the reference trajectory

and ship dynamics were made, see also (Chwa, 2011) for a solution to the tracking problem with input constraints. An assumption of low speed (nonlinear damping terms are ignored) is usually made in the above works due to the complex generation of the reference trajectories, and difficulties in stability analysis (especially stability analysis of the sway dynamics).

There are three main approaches to path-following control of ships. In the first approach, the Serret-Frenet frame is used to define the path-following (cross-track and yaw angle) errors, then the yaw moment control input is designed to stabilize these errors at the origin (e.g., (Skjetne and Fossen, 2001; Encarnação *et al.*, 2000; Do and Pan, 2004; Li *et al.*, 2009) for nonlinear (curved) paths, (Pettersen and Lefeber, 2001; Fredriksen and Pettersen, 2006; Moreira *et al.*, 2007) for linear (straight) paths). This approach results in local results (except for the linear path) due to singularity in the cross-track error dynamics. The second approach defines the path-following objective as one of controlling the vessel so that it is in the tube of nonzero diameter centered on the path, and moves along the path with a desired speed (e.g., (Aicardi *et al.*, 2001; Do *et al.*, 2004; Li *et al.*, 2008)). The control design aims to force the vessel to follow a virtual point moving along the path. This approach requires the vessel not be too close to the path. The third approach (referred to as path-tracking) is based on a combination of trajectory-tracking and path-following in the first approach. In the sense that the lateral path-following error is not always set to zero (to avoid singularity) and that the path parameter is used as an additional control to stabilize the lateral path-following error. Thus, global control results are often obtained (e.g., (Lapierre and Jouvencel, 2008; Do and Pan, 2006; Ghommam *et al.*, 2008)).

In all of the above works on trajectory-tracking and path-following control of underactuated ships, a hard constraint on the tracking/following errors has never been addressed. This problem is important since in practice it is desired to steer the ship to be within a certain distance from the reference path, especially in narrow waterways. Moreover, various conditions on the control gains and reference paths/trajectories were imposed in the existing mentioned works to ensure boundedness of the sway velocity instead of being directly controlled in the previous control designs. The above issues motivate contributions in this paper on new controllers for asymptotic path-tracking of

Received date: 2015-03-27.

Accepted date: 2015-07-17.

Foundation item: Supported in Part by the Australian Research Council Under Grant No. DP0988424.

***Corresponding author Email:** duc@curtin.edu.au

© Harbin Engineering University and Springer-Verlag Berlin Heidelberg 2015

Development of Cubic Bezier Curve and Curve-Plane Intersection Method for Parametric Submarine Hull Form Design to Optimize Hull Resistance Using CFD

Deddy Chrismianto^{1*}, Ahmad Fauzan Zakki¹, Berlian Arswendo¹ and Dong Joon Kim²

1. Department of Naval Architecture, Diponegoro University, Semarang 50275, Indonesia

2. Department of Naval Architecture and Systems Marine Engineering, Pukyong National University, Busan 48513, South Korea

Abstract: Optimization analysis and computational fluid dynamics (CFDs) have been applied simultaneously, in which a parametric model plays an important role in finding the optimal solution. However, it is difficult to create a parametric model for a complex shape with irregular curves, such as a submarine hull form. In this study, the cubic Bezier curve and curve-plane intersection method are used to generate a solid model of a parametric submarine hull form taking three input parameters into account: nose radius, tail radius, and length-height hull ratio (L/H). Application program interface (API) scripting is also used to write code in the ANSYS DesignModeler. The results show that the submarine shape can be generated with some variation of the input parameters. An example is given that shows how the proposed method can be applied successfully to a hull resistance optimization case. The parametric design of the middle submarine type was chosen to be modified. First, the original submarine model was analyzed, in advance, using CFD. Then, using the response surface graph, some candidate optimal designs with a minimum hull resistance coefficient were obtained. Further, the optimization method in goal-driven optimization (GDO) was implemented to find the submarine hull form with the minimum hull resistance coefficient (C_i). The minimum C_i was obtained. The calculated difference in C_i values between the initial submarine and the optimum submarine is around 0.26%, with the C_i of the initial submarine and the optimum submarine being 0.001 508 26 and 0.001 504 29, respectively. The results show that the optimum submarine hull form shows a higher nose radius (r_n) and higher L/H than those of the initial submarine shape, while the radius of the tail (r_t) is smaller than that of the initial shape.

Keywords: submarine hull form; parametric design; cubic Bezier curve; curve-plane intersection method; hull resistance coefficient; parametric design; goal-driven optimization (GDO); computational fluid dynamic (CFD); ANSYS

Article ID: 1671-9433(2015)04-0399-07

1 Introduction

Recently, the relationship between parametric design and

ship performance analysis using CFD has become a topic of interest, specifically, the method of obtaining an optimum ship hull form that will ensure good hydrodynamic performance of a ship. Several methods of parametric design have been used in ship modeling. The use of the control points of the cubic B-spline to generate the parameters of ship hull design has been introduced with successful results (Sarioz, 2006; Mancuso, 2006; Perez *et al.*, 2007; Ping *et al.*, 2008, Perez and Clemente, 2011). Campana *et al.* (2006) used the Bezier polynomial patches method, in which the shape modification was controlled by a given number of control points that were used as the design variables/input parameters for finding the optimum shape in the optimization process. Chen and Huang (2004) used a technique for parameter estimation using the B-spline surface fitting method in an inverse design problem of finding the optimal hull form. In addition, Kang and Lee (2010) implemented the parametric morphing technique to rapidly generate a hull form with some variations of the input parameters. Furthermore, Rodriguez and Jambrina (2012) developed a programmed design based on a programming language as a tool for parametric hull form generation. In general, these methods can be used to create the parametric design for surface modeling only. However, some CFD software (especially the RANSE solver) needs a solid modeling at the meshing stage before the CFD analysis stage can begin. Pecot *et al.* (2012) introduced the parametric design of ship hull shape for solid modeling in the optimization calculation using CFD. In this design, CAD is used to generate some bulbous bow shapes based on the parameters for each design of experiment (DOE). Blanchard *et al.* (2013) used the movement of control points to create bulbous bow shapes in solid modeling according to two parameters: bow length and bow thickness. However, neither of these authors considered how to automatically generate the hull or bulbous bow shape.

In this study, some previous studies concerning ship performance analysis using CFD, especially for the free surface case, are used as a reference for the calculation of ship resistance. Seo *et al.* (2010) investigated flexible meshing techniques (i.e., a hybrid meshing for complex

Received date: 2014-12-10.

Accepted date: 2015-04-08.

Foundation item: Supported by the Ministry of Research, Technology, and Higher Education Republic of Indonesia, through the Budget Implementation List (DIPA) of Diponegoro University, Grant No. DIPA-023.04.02.189185/2014, December 05, 2013.

*Corresponding author Email: deddychrismianto@yahoo.co.id

© Harbin Engineering University and Springer-Verlag Berlin Heidelberg 2015

Corrosion Resistance of AA6063-Type Al-Mg-Si Alloy by Silicon Carbide in Sodium Chloride Solution for Marine Application

Ojo Sunday Isaac Fayomi^{1,2}, Malik Abdulwahab^{1,3*}, Abimbola Patricia Idowu Popoola¹ and Ferdinand Asuke^{1,3}

1. Department of Chemical, Metallurgical and Materials Engineering, Tshwane University of Technology, X680, Pretoria, South Africa

2. Department of Mechanical Engineering, Covenant University, P.M.B 1023, Ota, Ogun State, Nigeria

3. Department of Metallurgical and Materials Engineering, Ahmadu Bello University, P.M.B 1045, Zaria, Nigeria

Abstract: The present work focused on corrosion inhibition of AA6063 type Al-Mg-Si alloy in sodium chloride (NaCl) solution with a silicon carbide inhibitor, using the potentiodynamic electrochemical method. The aluminium alloy surface morphology was examined, in the as-received and as-corroded in the un-inhibited state, with scanning electron microscopy equipped with energy dispersive spectroscopy (SEM-EDS). The results obtained via linear polarization indicated a high corrosion potential for the unprotected as-received alloy. Equally, inhibition efficiency as high as 98.82% at 10.0 g/v silicon carbide addition was obtained with increased polarization resistance (R_p), while the current density reduced significantly for inhibited samples compared to the un-inhibited aluminium alloy. The adsorption mechanism of the inhibitor aluminium alloy follows the Langmuir adsorption isotherm. This shows that the corrosion rate of aluminium alloy with silicon carbide in NaCl environment decreased significantly with addition of the inhibitor.

Keywords: corrosion resistance; silicon carbide; sodium chloride (NaCl); aluminium alloy; interface; inhibition efficiency; thin film; adsorption isotherm; potentiodynamic electrochemical method; marine application

Article ID: 1671-9433(2015)04-0459-04

1 Introduction

Corrosion is believed to be one of the major problems affecting the durability, performance, safety, and appearance of materials in most service conditions. In these conditions and in various industries, such as chemical and construction, safety and cost reduction are of great priority. Corrosion affects all areas of the economy and it has been estimated that the cost of corrosion in an industrialized nations is more than 4% of Gross National Product, as reported by Suleiman *et al.* (2013), Mohammed *et al.* (2013) and Singh *et al.* (2012). Here for example, the physical properties of this aluminium alloy can be obtained easily, but the effects of corrosion deter its selection. Also, an increase in corrosion

resistance comes with an increase in cost. Aluminium alloys have considerable corrosion resistance in most environments; however, their resistance to corrosion in some aggressive environments like chloride is still a research concern. In the efforts toward identifying corrosion control method(s), the use of inhibitors often offers an alternative low cost way of combating corrosion, as stated by Fouda *et al.* (2009), Oguzie *et al.* (2004), Rahim and Kassim (2008), Rahim *et al.* (2007) and Amin and Khaled (2010). However, most inhibitors are considered to be toxic, expensive, and not eco-friendly. With increasing environmental awareness and the disadvantages of some chemicals, recent research is now tailored towards exploring some organic and non-toxic inhibitors. This leads to developing cheap and environmentally acceptable corrosion inhibitors, according to Obot *et al.* (2011) and Ogoko *et al.* (2009). In our previous studies: Abdulwahab *et al.* (2013), Fayomi *et al.* (2013) and Popoola *et al.* (2012a), various eco-friendly inhibitors have been used successfully for aluminium based alloy in different experimental conditions producing a high level of inhibition. This clearly showed that continued effort toward identifying new but promising corrosion inhibitors is important. This study, used polarization techniques to evaluate silicon carbide as a corrosion inhibitor for an aluminium alloy in sodium chloride solution.

2 Experimental procedures

2.1 Materials and methods

Aluminium alloy type AA6063, sized 20 mm×20 mm×3 mm with the chemical composition shown in Table 1, was sourced from the Surface Engineering Research Centre (SERC) of Tshwane University of Technology, Pretoria. The aluminium alloy was in the form of corrosion coupons to be immersed in 3.5% NaCl static solution with and without silicon carbide (SiC) inhibitor. In preparation, the coupons were abraded mechanically with 220, 400, 600, 800 and 1 000 grid emery paper, degreased with acetone and rinsed with distilled water. The initial weight of each sample coupon was then recorded. The silicon carbide was obtained in powdered form from the Technology Innovation Agency,

Received date: 2015-07-12.

Accepted date: 2015-09-28.

Foundation item: Supported by the National Research Foundation for the Department of Chemical, Metallurgical and Materials Engineering, Tshwane University of Technology, Pretoria with respect to equipment and funding.

*Corresponding author Email: mabdulwahab@abu.edu.ng

© Harbin Engineering University and Springer-Verlag Berlin Heidelberg 2015



Submit Your Research Today

Learn More

Dove Medical Press Ltd

Journal of Marine Science and Application

COUNTRY

China



Universities and research institutions in China



Media Ranking in China

SUBJECT AREA AND CATEGORY

Engineering
Mechanical Engineering
Ocean Engineering

PUBLISHER

Harbin Engineering University

H-INDEX

27

Call for Paper ChatGPT

JMIR Medical Education | Theme Issue Call for Papers

× ⓘ

PUBLICATION TYPE

Journals

ISSN

19935048, 16719433

COVERAGE

2007-2022

INFORMATION

[Homepage](#)
[How to publish in this journal](#)

Call for Paper ChatGPT

JMIR Medical Education | Theme Issue
Call for Papers

x ⓘ

JM

SCOPE

The aim of the JMSA is to provide a platform for current issues in a range of topics relevant to marine science and engineering, and to guide engineering application for scientists and engineers. JMSA is a scholarly international journal, publishing high-level peer-reviewed research on the subjects in the field of theoretical and experimental investigations, that explore naval architecture, ocean engineering, marine renewable energy, underwater technology, marine engineering, corrosion prevention, ocean acoustics, automatic navigation among others.

🗨 Join the conversation about this journal

Download Flutter SDK

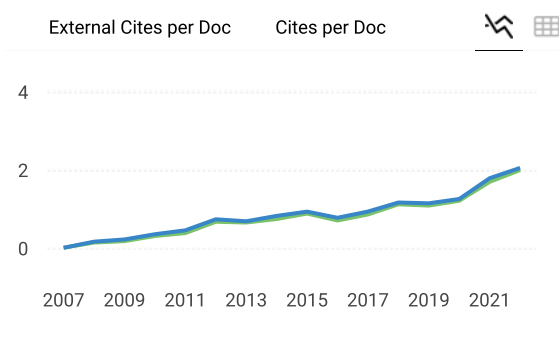
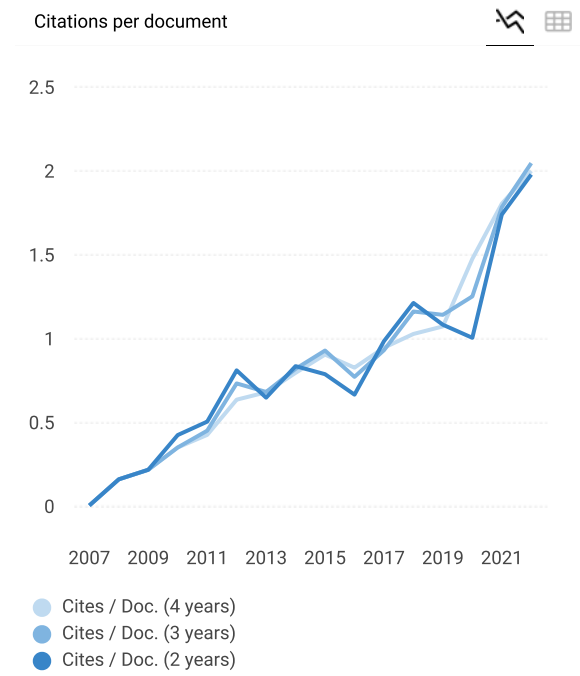
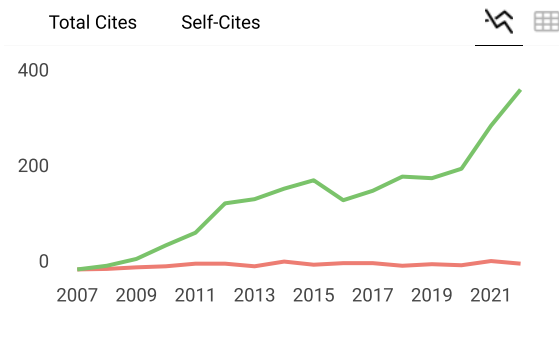
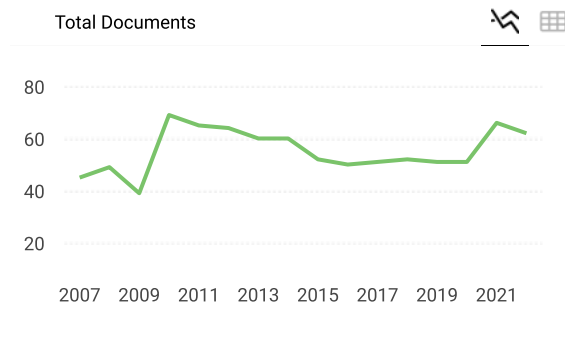
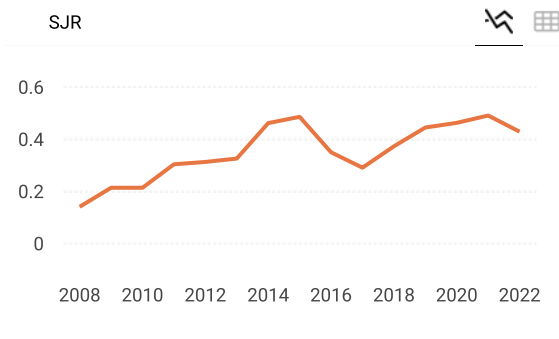
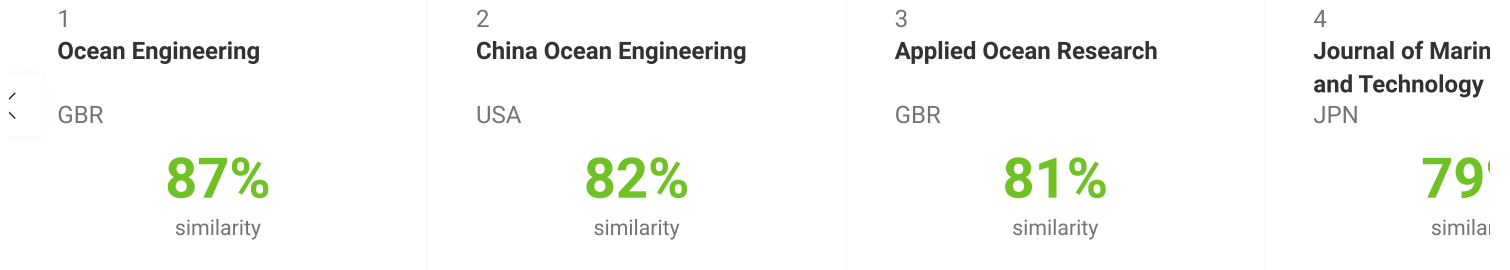
Control every pixel to create customized & adaptive designs that look good on any screen.

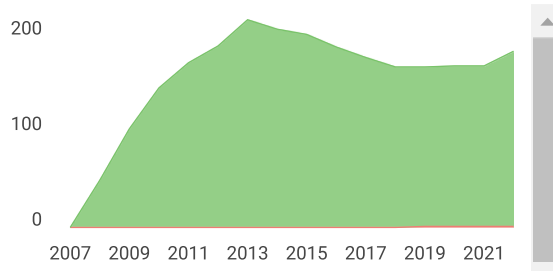
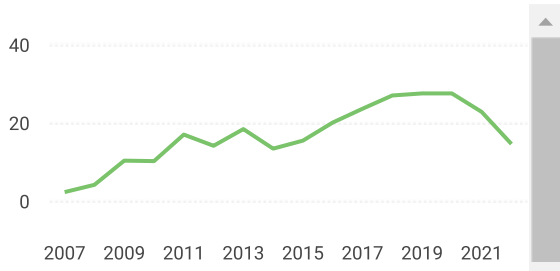
Flutter

[Learn More](#)

📄 Quartiles

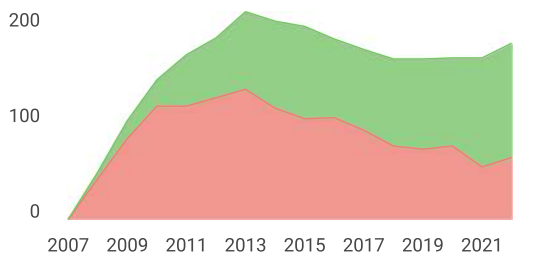






Cited documents

Uncited documents



Journal of Marine Science and Application

Q2 Mechanical Engineering
best quartile

SJR 2022
0.43

powered by scimagojr.com

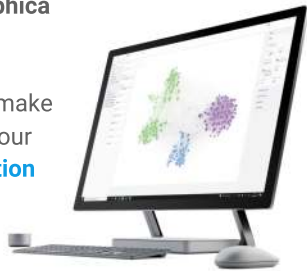
← Show this widget in your own website

Just copy the code below and paste within your html code:

`https://www.scimagojr.com`

SCImago Graphica

Explore, visually communicate and make sense of data with our [new data visualization tool](#).



Metrics based on Scopus® data as of April 2023

Leave a comment

Name

Email

(will not be published)