Design And Analysis Of Propeler Blade

The PSU Zephyrus Human Powered Airplane is a student-built aircraft created to contend for the Kremer International Sporting Competition. The propulsion system for the aircraft comprises of a cycling pilot, along with the drive-train and propeller aircraft components. The propeller for the PSU Zephyrus has previously been a difficult aspect of the aircraft to design and manufacture, and has been a source of weakness for the performance of the aircraft. Of several tests conducted with the current design, none have been successful in performing as required. Furthermore, the design and use of an efficient and reliable propeller for the aircraft is an important aspect of achieving the necessary flight speed for the Zephyrus. Of several tests conducted with the current design, none have been successful in performing as required. Furthermore, the design and use of an efficient and reliable propeller for the aircraft is an important aspect of achieving the necessary flight speed for the Zephyrus. Therefore, the following paper presents an analysis of the failure of the current propeller design, as well as a proposed new design and manufacturing process. This includes a description of the airfoil selection process, a description of the design and analysis methods used in the new propeller design process, a comparison of the current and new propeller, and suggested manufacturing techniques.

This report prsents the design and anlysis of propellers applied to mini-remotely piloted vehicles. Modifications to the airfoil data used for predicting the profile drag losses were necessary to account for operation at the low reynolds number encountered by mini-RPV propellers. Due to the lack of two-dimensional airfoil data, the correction to the drag coefficient

is ' Using the revised methods of propeller analysis, six optimum propellers were designed and analyzed for two different RPV's. The analysis showed that improved performance can be obtained with the new designs. A ducted propeller with sufficiently low blade tip clearances was also analyzed. This configuration appears to have superior performance to the open type propellers considered, as well as a potential for reduced noise. Propellers with variable blade angles also appear to offer advantages from both the noise and performance standpoints. Volume II presents the ducted-propeller design for the Mini-RPV.

Propeller Design A Simple System Based on Model Propeller Test Data

Analysis of ducted-propeller design

Proceedings of the 6th International Conference on Marine Structures (MARSTRUCT 2017), May 8-10, 2017, Lisbon, Portugal

Progress in the Analysis and Design of Marine Structures

Marine Propellers and Propulsion

Marine Propellers and Propulsion, Fourth Edition, offers comprehensive, cutting edge coverage to equip marine engineers, naval architects or anyone involved in propulsion and hydrodynamics with essential job knowledge. Propulsion technology is a complex, multidisciplinary topic with design, construction, operational and research implications. Drawing on experience from a long and varied career in consulting, research, design and technical investigation, John Carlton examines hydrodynamic theory, materials and mechanical considerations, and design, operation and

performance. Connecting essential theory to practical problems in design, analysis and operational efficiency, the book is an invaluable resource, packed with hard-won insights, detailed specifications and data. Features comprehensive coverage of marine propellers, fully updated and revised, with new chapters on propulsion in ice and high speed propellers Includes enhanced content on full-scale trials, propeller materials, propeller blade vibration, operational problems and much more Synthesizes otherwise disparate material on the theory and practice of propulsion technology from the past 40 years' development, including the latest developments in improving efficiency Written by a leading expert on propeller technology, essential for students, marine engineers and naval architects involved in propulsion and hydrodynamics

Recently, the High-Altitude Long-Range aircraft [has been developed] for reconnaisance or observation. If airplanes do an endurance flight at high altitude, reciprocating engines have an advantage from a point of fuel efficiency and weight of engines. Therefore, the birthplace of thrust is propeller [sic]. And the airplane is going to cruise in Low-Reynolds number. So, the way of design and analysis of propellers in Low-Reynolds number should be established. In this study, a wind-tunnel-test mdoel of [a] propeller was made by Adkins and Liebeck's method of propellers, and wind-

tunnel tests were conducted with it. By analyzing [the] characteristics of a test model and comparing [them] with analyses and results of wind-tunnel tests, the way of revision against the design and analysis of propellers were examined [sic].

Summary of Propeller Design Procedures and Data. Volume II. Structural Analysis and Blade Design

OPTIMIZATION FOR ENGINEERING DESIGN

III

Numerical Methods for Propeller Design and Analysis in Steady Flow

Hub Effects in Propeller Design and Analysis

This report presents the design and analysis of two open propellers and two ducted propellers for use on advanced Remotely Piloted Vehicles, RPV's. One of the two open propellers was designed for use on a direct-drive engine with a maximum rpm of 8000. The other open propeller was designed for a geared engine of the same power output, but with a maximum rpm of 5860. Two ducted propellers were designed for the same engines. The open and ducted propellers were designed based on a procedure that was established for determining the lowest power and rpm to meet the performance requirements at any operating condition.

The geometric characteristics of the four propellers designed based on this procedure are presented so that the blades of these propellers can be fabricated.

OPENPROP, an open-source computational tool for the design and analysis of propellers and horizontal-axis turbines, is extended to provide estimates of normal stresses in the blades for both on- and off-design operating conditions. The numerical model is based on propeller lifting theory, and the present implementation of the code includes an analysis capability to estimate the off-design performance of the propeller or turbine and to make blade stress predictions. As an example, we present the design and performance of a two-bladed propeller. Experimental measurements of the propeller performance over a wide range of off-design operating conditions agree with performance predictions. Estimates of the blade stress are given for on-design and off design operating states of the propeller.

Performance and Optimum Design Analysis/ Computation for Propeller Type Wind Turbines

Practical Estimation of Propulsive Power

Some Developments in Methods of Analysis and Design of Propeller

Pumps

Propeller design and analysis for an unmanned aeronautical vehicle

Proceedings of the Fourth International Conference in Ocean Engineering (ICOE2018)

A Rigorous Mathematical Approach To Identifying A Set Of Design Alternatives And Selecting The Best Candidate From Within That Set, Engineering Optimization Was Developed As A Means Of Helping Engineers To Design Systems That Are Both More Efficient And Less Expensive And To Develop New Ways Of Improving The Performance Of Existing Systems.Thanks To The Breathtaking Growth In Computer Technology That Has Occurred Over The Past Decade, Optimization Techniques Can Now Be Used To Find Creative Solutions To Larger, More Complex Problems Than Ever Before. As A Consequence, Optimization Is Now Viewed As An Indispensable Tool Of The Trade For Engineers Working In Many Different Industries, Especially The Aerospace, Automotive, Chemical, Electrical, And Manufacturing Industries.In Engineering Optimization, Professor Singiresu S. Rao Provides An Application-Oriented Presentation Of The Full Array Of Classical And Newly Developed Optimization Techniques Now Being Used By Engineers In A Wide Range Of Industries. Essential Proofs And Explanations Of

The Various Techniques Are Given In A Straightforward, User-Friendly Manner, And Each Method Is Copiously Illustrated With Real-World Examples That Demonstrate How To Maximize Desired Benefits While Minimizing Negative Aspects Of Project Design.Comprehensive, Authoritative, Up-To-Date, Engineering Optimization Provides In-Depth Coverage Of Linear And Nonlinear Programming, Dynamic Programming, Integer Programming, And Stochastic Programming Techniques As Well As Several Breakthrough Methods, Including Genetic Algorithms, Simulated Annealing, And Neural Network-Based And Fuzzy Optimization Techniques.Designed To Function Equally Well As Either A Professional Reference Or A Graduate-Level Text, Engineering Optimization Features Many Solved Problems Taken From Several Engineering Fields, As Well As Review Questions, Important Figures, And Helpful References.Engineering Optimization Is A Valuable Working Resource For Engineers Employed In Practically All Technological Industries. It Is Also A Superior Didactic Tool For Graduate Students Of Mechanical, Civil, Electrical, Chemical And Aerospace Engineering.
This report, the third of a series of four, describes a simple system for designing propellers of a standard form. In this report, the system is based on tests of a family of model propellers of standard Navy form, the data from which have been extended by means of calculations to cover the complete range likely to be found in

practice. However, it can be worked out for any family having propellers of on general form. This system can also be applied as given to propellers of different forms by means of form factors. Modifications are made for full scale flight conditions, i.e., the particular tip speed of the propeller, the body or fuselage interference.

Design of the Zephyrus Human Powered Airplane Propellers

Summary of Propeller Design Procedures and Data. Volume 2. Structural Analysis and Blade Design

Hydrodynamics of Ship Propellers

Twenty-Second Symposium on Naval Hydrodynamics

Algorithms and Examples

Ship Resistance and Propulsion provides a comprehensive approach to evaluating ship resistance and propulsion. Informed by applied research, including experimental and CFD techniques, this book provides guidance for the practical estimation of ship propulsive power for a range of ship types. Published standard series data for hull resistance and propeller performance enables practitioners to make ship power predictions based on material and data contained within the book. Fully worked examples illustrate applications of the data and powering methodologies; these include cargo and container

ships, tankers and bulk carriers, ferries, warships, patrol craft, work boats, planing craft and yachts. The book is aimed at a broad readership including practising naval architects and marine engineers, seagoing officers, small craft designers, undergraduate and postgraduate students. Also useful for those involved in transportation, transport efficiency and ecologistics who need to carry out reliable estimates of ship power requirements.

This well-received book, now in its second edition, continues to provide a number of optimization algorithms which are commonly used in computer-aided engineering design. The book begins with simple single-variable optimization techniques, and then goes on to give unconstrained and constrained optimization techniques in a step-by-step format so that they can be coded in any user-specific computer language. In addition to classical optimization methods, the book also discusses Genetic Algorithms and Simulated Annealing, which are widely used in engineering design problems because of their ability to find global optimum solutions. The second edition adds several new topics of optimization such as design and manufacturing, data fitting and regression, inverse problems, scheduling and routing, data mining, intelligent system design, Lagrangian duality theory, and quadratic programming and its extension to sequential quadratic programming. It also

extensively revises the linear programming algorithms section in the Appendix. This edition also includes more number of exercise problems. The book is suitable for senior undergraduate/postgraduate students of mechanical, production and chemical engineering. Students in other branches of engineering offering optimization courses as well as designers and decision-makers will also find the book useful. Key Features Algorithms are presented in a step-by-step format to facilitate coding in a computer language. Sample computer programs in FORTRAN are appended for better comprehension. Worked-out examples are illustrated for easy understanding. The same example problems are solved with most algorithms for a comparative evaluation of the algorithms.

Propeller Design & Analysis at Low Reynolds Numbers

Theory and Practice

Structural analysis and blade design

Design and Analysis of an Internally Ringed Ducted Propeller

Ducted Propeller Design and Analysis

Development of a performance analysis for propeller type wind turbines is presented. The analysis uses a strip theory approach that includes tip-loss and blade interference. A

comparison is presented between analysis and test data. The comparison indicates that the analysis predicts wind turbine performance to an accuracy that is within experimental uncertainty. Design procedures for optimum wind turbines are shown to be different than those used for propellers. An optimum design generation approach for wind turbines is developed from a modified strip theory that includes tip-loss. The approach entails a local optimization of blade element parameters to maximize power output. Examples are presented that illustrate the optimum design generation procedure and off- design performance characteristics. The design analysis and optimum design generation approaches have been programmed on a digital computer using the Fortran IV language. Program listings, operating instructions, and sample outputs are included.

Progress in the Analysis and Design of Marine Structures collects the contributions presented at MARSTRUCT 2017, the 6th International Conference on Marine Structures (Lisbon, Portugal, 8-10 May 2017). The MARSTRUCT series of

Conferences started in Glasgow, UK in 2007, the second event of the series having taken place in Lisbon, Portugal in March 2009, the third in Hamburg, Germany in March 2011, the fourth in Espoo, Finland in March 2013, and the fifth in Southampton, UK in March 2015. This Conference series deals with Ship and Offshore Structures, addressing topics in the areas of: - Methods and Tools for Loads and Load Effects - Methods and Tools for Strength Assessment - Experimental Analysis of Structures - Materials and Fabrication of Structures - Methods and Tools for Structural Design and Optimisation, and - Structural Reliability, Safety and Environmental Protection Progress in the Analysis and Design of Marine Structures is essential reading for academics, engineers and all professionals involved in the design of marine and offshore structures.

Propeller Analysis and Design

Design of propellers in Low-Reynolds number

Summary of Propeller Design Procedures and Data

Aerodynamic Design and Analysis of Propellers for Mini-

Remotely Piloted Air Vehicles. Volume 2. Ducted Propellers
Propeller Design/analysis Using Advanced Blade Element Theory

The Twenty-Second Symposium on Naval Hydrodynamics was held in Washington, D.C., from August 9-14, 1998. It coincided with the 100th anniversary of the David Taylor Model Basin. This international symposium was organized jointly by the Office of Naval Research (Mechanics and Energy Conversion S&T Division), the National Research Council (Naval Studies Board), and the Naval Surface Warfare Center, Carderock Division (David Taylor Model Basin). This biennial symposium promotes the technical exchange of naval research developments of common interest to all the countries of the world. The forum encourages both formal and informal discussion of the presented papers, and the occasion provides an opportunity for direct communication between international peers.

The necessary technology for designing and installing propellers is presented in three volumes. This volume presents the theory and data for detailed structural and vibration analysis of propellers. Esti-mating procedures for initial design purposes; the details for de-signing solid, hollow, and composite blades; and the manufacturing techniques used are all included.

Numerically-based Ducted Propeller Design Using Vortex Lattice Lifting Line Theory
Aerodynamic Design and Analysis of Propellers for Mini-Remotely Piloted Air Vehicles.

Volume 1 Open Propellers
The Analysis of Controllable Pitch Propeller Characteristics at Off-design Conditions
Aerodynamic Design and Analysis of Propellers for Mini-remotely Piloted Air Vehicles: Ducted propellers
Summary of Propeller Design Procedures and Data: Aerodynamic design and installation

This book comprises selected proceedings of the Fourth International Conference in Ocean Engineering (ICOE2018), focusing on emerging opportunities and challenges in the field of ocean engineering and offshore structures. It includes state-of-the-art content from leading international experts, making it a valuable resource for researchers and practicing engineers alike.

This thesis used vortex lattice lifting line theory to model an axisymmetrical-ducted propeller with no gap between the duct and the propeller. The theory required to model the duct and its interaction with the propeller were discussed and implemented in Open-source Propeller Design and Analysis Program (OpenProp). Two routines for determining the optimum circulation distribution were considered, and a method based on calculus of variations was selected. The results of this model were compared with the MIT Propeller Lifting Line Program (PLL) output for the purpose of validation.

Ducted propellers are prevalent in modem marine propulsion systems, and the application of this technology continues to expand. The theory associated with ducted propellers applies to a wide-range of devices which include azimuth thrusters, pumpjets, and tidal turbines. Regardless of the application, engineers need tools such as OpenProp to design these devices for their expected operating conditions. OpenProp is an open source MATLAB®-based suite of propeller numerical design tools. Previously, the program only designed open propellers. The code developed in this thesis extended OpenProp's capability to be able to design a propeller within an axisymmetrical duct.

Design and Analysis of Propeller Blade Geometry Using the PDE Method Volume 1

Engineering Optimization

Ship Resistance and Propulsion

A Propeller Design and Analysis Capability Evaluation for High Altitude Application

The early development of the screw propeller. Propeller geometry. The propeller environment. The ship wake field, propeller perfomance characteristics.

A numerical model is established for the design of propeller blade

shape for a prescribed circulation and a given hub geometry. The vortex lattice approach is adapted for blades and their wakes. The hub is represented by a distribution of dipoles which ends at the hub apex. It is shown that consideration of the hub results in a lower pitch and lower camber at the inner radii. An iterative method is developed for analyzing the interference between the blades and the hub. It is shown that the circulation at the root of a propeller with a hub. It is shown that the circulation at the root of a propeller with a hub is larger than the circulation at the root of a propeller without a hub. Two examples show that the increase in thrust due to hub effects has the same order of magnitude as the drag force effects on the hub for propellers which are moderately loaded at the hub. Experiments are carried out for comparison with the numerical results. Excellent agreement is obtained in the circulation distribution for a conventional propeller, and fair agreement for a controllable pitch propeller. Experimental results show what the circulation is, roughly speaking, conserved. A method for estimating the drag force of the hub due to the hub vortex is established by assuming that the circulation is conserved.

Propeller Design and Analysis by Lifting Surface Theory

Propeller Analysis and Design Study for a 26 M Stern Trawler

Propeller Design and Analysis for a Small, Autonomous UAV

Propeller Blade Stress Estimates Using Lifting Line Theory
Strategy of Propeller Design

An experimental study was performed to design and analyze a "pusher" propeller for use by a small, expendable, autonomous unmanned aerial vehicle (UAV) whose mission was to descend from 30,000 feet to sea level at an approximately constant descent rate over a 3-hour mission duration. The entire propeller design process, from airfoil selection to final part generation in the computer-aided drafting program SolidWorks is described. QMIL and QPROP were the programs of choice for producing a propeller design focused on yielding minimum induced losses for optimal aerodynamic efficiency given a conservative aerodynamic design point. The TA22 airfoil defined the propeller cross section and NEU-012-030-4000 DC brushless motor was selected to power the propeller. The initial propeller design was modified to comply with size constraints set by the mission. Wind tunnel tests were conducted to determine the effect of fuselage blanketing on propeller performance. Of particular interest was comparing the power required to propel the aircraft at a given airspeed for a configuration in which the propeller was mounted behind the fuselage, and one in which the propeller was not obstructed by an upstream object and instead isolated in the incoming airstream. It was empirically found

that fuselage blanketing had a significantly detrimental impact on each of the 4 propellers used in testing. It was therefore recommended that the hub section of the propeller be redesigned to mitigate drag and propulsive losses resulting from reduced momentum in the blanketed region of the propeller. This recommendation was applied to the included propeller design and propeller betas in the hub region were reduced using qualitative methods.
Technical introduction to ship propeller hydrodynamics, for researchers in ocean technology, naval architecture, mechanical engineering.