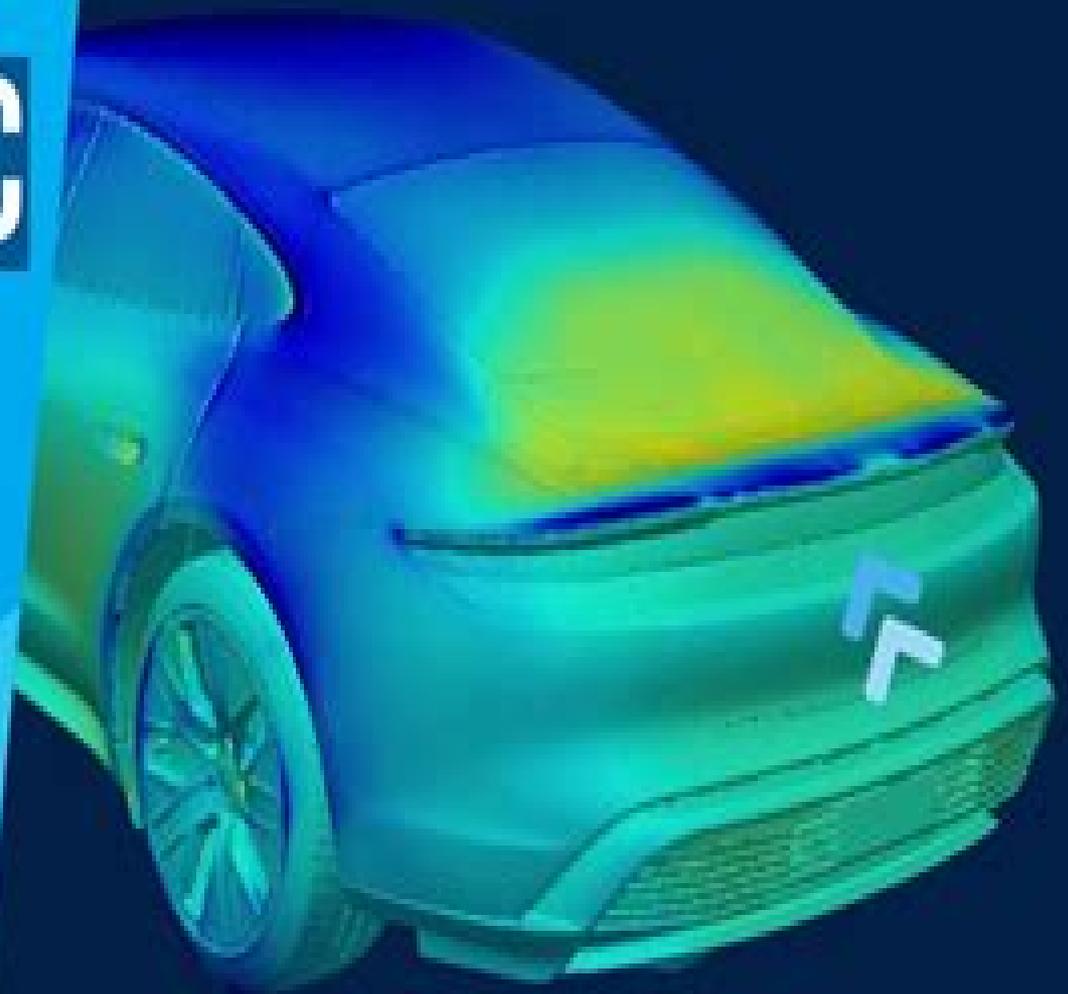


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Aerodynamic Shape Optimization With The Adjoint Method

Tao Wei



Aerodynamic Shape Optimization With The Adjoint Method:

Adjoint Methods for Aerodynamic Shape Optimization Gábor Povorai, 2020 This master thesis investigated the applicability of the Hicks Henne bump functions and Free Form Deformation as shape deformation methods used for aerodynamic shape optimization by the adjoint method In order to alleviate user effort in the setup of simulations and post processing of results a MatLab framework has been developed This framework integrated shape definition meshing file management flow solver and post processing tools The external tools were open source software to allow the use of arbitrary cell and processor core numbers The computational fluid dynamics solver SU2 was used to obtain direct flow and adjoint solutions and to perform shape deformations using the built in nonlinear constrained optimization function Automatic mesh generation was done using GMSH The thesis focused on inviscid and viscous 2D problems in the transonic and supersonic flow regimes The definition of the initial aerodynamic shapes was done using the Class Shape Transformation method The test cases optimization problems with the NACA0012 airfoil as the initial airfoil for deformation with drag reduction as the objective function The test cases involved different constraints e g airfoil thickness lift coefficient and pitching moment coefficient Comparisons were made between the two methods in terms of performance in the minimization of the objective function The results of the optimization problems were compared to reference airfoils from literature Both deformation methods proved to be effective clear superiority of one method over the other could not be shown This master thesis investigated the applicability of the Hicks Henne bump functions and Free Form Deformation as shape deformation methods used for aerodynamic shape optimization by the adjoint method In order to alleviate user effort in the setup of simulations and post processing of results a MatLab framework has been developed This framework integrated shape definition meshing file manage

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Advanced Computational Methods and Design for Greener Aviation Tero Tuovinen, Jacques Periaux, Dietrich Knoerzer, Gabriel Bugada, Jordi Pons-Prats, 2024-07-30 This book presents a selection of scientific and technical results utilizing new computational methods tools and technologies in Aeronautical Design Delve into

the forefront of aerospace technology with this collection of articles featuring insights from the from the ECCOMAS CM3 2021 Thematic Conference in Barcelona and from the Special Technology Sessions of the ECCOMAS Congress 2022 in Oslo Explore advancements in aeronautics design numerical methods and industrial technologies including aerodynamic optimization and additive manufacturing with contributions from leading experts and from research projects funded by the European Union Whether you re a seasoned professional or a student this volume offers invaluable insights into the future of aviation and transportation

2023 Asia-Pacific International Symposium on Aerospace Technology (APISAT 2023) Proceedings Song Fu,2024-07-04 This book is a compilation of peer reviewed papers from the 2023 Asia Pacific International Symposium on Aerospace Technology APISAT2023 The symposium is a common endeavour among the four national aerospace societies in China Australia Korea and Japan namely Chinese Society of Aeronautics and Astronautics CSAA Royal Aeronautical Society Australian Division RAeS Australian Division Japan Society for Aeronautical and Space Sciences JSASS and Korean Society for Aeronautical and Space Sciences KSAS APISAT is an annual event initiated in 2009 It aims to provide the opportunity to Asia Pacific nations for the researchers of universities and academic institutes and for the industry engineers to discuss the current and future advanced topics in aeronautical and space engineering This is the volume II of the proceedings

An adjoint-based shape-optimization method for aerodynamic design Giampietro Carpentieri,2009

Aerodynamic Shape Optimization of Complex Aircraft Configurations Via an Adjoint Formulation James Reuther,1996 Abstract This work describes the implementation of optimization techniques based on control theory for complex aircraft configurations Here control theory is employed to derive the adjoint differential equations the solution of which allows for a drastic reduction in computational costs over previous design methods 13 12 43 38 In our earlier studies 19 20 22 23 39 25 40 41 42 it was shown that this method could be used to devise effective optimization procedures for airfoils wings and wing bodies subject to either analytic or arbitrary meshes Design formulations for both potential flows and flows governed by the Euler equations have been demonstrated showing that such methods can be devised for various governing equations 39 25 In our most recent works 40 42 the method was extended to treat wing body configurations with a large number of mesh points verifying that significant computational savings can be gained for practical design problems In this paper the method is extended for the Euler equations to treat complete aircraft configurations via a new multiblock implementation New elements include a multiblock multigrid flow solver a multiblock multigrid adjoint solver and a multiblock mesh perturbation scheme Two design examples are presented in which the new method is used for the wing redesign of a transonic business jet

Advances in Energy Science and Equipment Engineering Shiquan Zhou,Aragona Patty,Shiming Chen,2015-11-05 *Advances in Energy Equipment Science and Engineering* contains selected papers from the 2015 International Conference on Energy Equipment Science and Engineering ICEESE 2015 Guangzhou China 30 31 May 2015 The topics covered include Advanced design technology Energy and chemical engineering

Energy and environmental engineering Energy scienc *Aerodynamic Shape Optimization of Supersonic Aircraft Configurations Via an Adjoint Formulation on Parallel Computers* Research Institute for Advanced Computer Science (U.S.),1996 Abstract This work describes the application of a control theory based aerodynamic shape optimization method to the problem of supersonic aircraft design The design process is greatly accelerated through the use of both control theory and a parallel implementation on distributed memory computers Control theory is employed to derive the adjoint differential equations whose solution allows for the evaluation of design gradient information at a fraction of the computational cost required by previous design methods 13 12 44 38 The resulting problem is then implemented on parallel distributed memory architectures using a domain decomposition approach an optimized communication schedule and the MPI Message Passing Interface Standard for portability and efficiency The final result achieves very rapid aerodynamic design based on higher order computational fluid dynamics methods CFD In our earlier studies the serial implementation of this design method 19 20 21 23 39 25 40 41 42 43 9 was shown to be effective for the optimization of airfoils wings wing bodies and complex aircraft configurations using both the potential equation and the Euler equations 39 25 In our most recent paper the Euler method was extended to treat complete aircraft configurations via a new multiblock implementation Furthermore during the same conference we also presented preliminary results demonstrating that this basic methodology could be ported to distributed memory parallel computing architectures 24 In this paper our concern will be to demonstrate that the combined power of these new technologies can be used routinely in an industrial design environment by applying it to the case study of the design of typical supersonic transport configurations A particular difficulty of this test case is posed by the propulsion airframe integration **Shape Optimization Governed by the Euler Equations Using an Adjoint Method** Institute for Computer Applications in Science and Engineering,Angelo Iollo,1993 *Aerodynamic Shape Optimization Using Control Theory* James John Reuther,Research Institute for Advanced Computer Science (U.S.),1996 Abstract Aerodynamic shape design has long persisted as a difficult scientific challenge due to its highly nonlinear flow physics and daunting geometric complexity However with the emergence of Computational Fluid Dynamics CFD it has become possible to make accurate predictions of flows which are not dominated by viscous effects It is thus worthwhile to explore the extension of CFD methods for flow analysis to the treatment of aerodynamic shape design Two new aerodynamic shape design methods are developed which combine existing CFD technology optimal control theory and numerical optimization techniques Flow analysis methods for the potential flow equation and the Euler equations form the basis of the two respective design methods In each case optimal control theory is used to derive the adjoint differential equations the solution of which provides the necessary gradient information to a numerical optimization method much more efficiently than is done by conventional finite differencing Each technique uses a quasi Newton numerical optimization algorithm to drive an aerodynamic objective function toward a minimum An analytic grid perturbation method is developed to modify body fitted meshes to accommodate

shape changes during the design process Both Hicks Henne perturbation functions and B spline control points are explored as suitable design variables The new methods prove to be computationally efficient and robust and can be used for practical airfoil design including geometric and aerodynamic constraints Objective functions are chosen to allow both inverse design to a target pressure distribution and wave drag minimization Several design cases are presented for each method illustrating its practicality and efficiency These include non lifting and lifting airfoils operating at both subsonic and transonic conditions

The Variational Method for Aerodynamic Optimization Using the Navier-Stokes Equations / Bambang Soemarwoto,1997

A Preconditioning Method for Shape Optimization Governed by the Euler Equations Eyal Arian, Institute for Computer Applications in Science and Engineering,1998 *A Preconditioning Method for Shape Optimization Governed by the Euler Equations* ,1998 **Computational Algorithms for High-fidelity Multidisciplinary Design of Complex Aerospace**

Systems Antony Jameson, Juan José Alonso,2005 **SIAM Journal on Scientific Computing** ,2009 AIAA Aerospace Sciences Meeting and Exhibit, 42nd ,2004 AIAA Journal American Institute of Aeronautics and Astronautics,2008

Journal of Aircraft ,2009 *Proceedings of the GAMM Workshop Discrete Modelling and Discrete Algorithms in Continuum Mechanics* Thomas Sonar, Ingo Thomas,2001 **04-2326 - 04-2434** ,2004

The Top Books of the Year Aerodynamic Shape Optimization With The Adjoint Method The year 2023 has witnessed a remarkable surge in literary brilliance, with numerous engrossing novels enthraling the hearts of readers worldwide. Lets delve into the realm of top-selling books, exploring the fascinating narratives that have enthralled audiences this year. The Must-Read : Colleen Hoover's "It Ends with Us" This poignant tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover masterfully weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can triumph. Aerodynamic Shape Optimization With The Adjoint Method : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This spellbinding historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids compelling storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Aerodynamic Shape Optimization With The Adjoint Method : Delia Owens "Where the Crawdads Sing" This mesmerizing coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens spins a tale of resilience, survival, and the transformative power of nature, captivating readers with its evocative prose and mesmerizing setting. These top-selling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of captivating stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a exceptional and thrilling novel that will keep you speculating until the very end. The novel is a warning tale about the dangers of obsession and the power of evil.

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