

**Proceedings of ASME Turbo Expo 2022:
Turbomachinery Technical
Conference and Exposition**

(GT2022)

Volume 10D

**June 13-17, 2022
Rotterdam, The Netherlands**

Conference Sponsor
International Gas
Turbine Institute

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Two Park Avenue * New York, N.Y. 10016

© 2022, The American Society of Mechanical Engineers, 2 Park Avenue, New York, NY 10016, USA
(www.asme.org)

All rights reserved. Printed in the United States of America. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of the publisher.

INFORMATION CONTAINED IN THIS WORK HAS BEEN OBTAINED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS FROM SOURCES BELIEVED TO BE RELIABLE. HOWEVER, NEITHER ASME NOR ITS AUTHORS OR EDITORS GUARANTEE THE ACCURACY OR COMPLETENESS OF ANY INFORMATION PUBLISHED IN THIS WORK. NEITHER ASME NOR ITS AUTHORS AND EDITORS SHALL BE RESPONSIBLE FOR ANY ERRORS, OMISSIONS, OR DAMAGES ARISING OUT OF THE USE OF THIS INFORMATION. THE WORK IS PUBLISHED WITH THE UNDERSTANDING THAT ASME AND ITS AUTHORS AND EDITORS ARE SUPPLYING INFORMATION BUT ARE NOT ATTEMPTING TO RENDER ENGINEERING OR OTHER PROFESSIONAL SERVICES. IF SUCH ENGINEERING OR PROFESSIONAL SERVICES ARE REQUIRED, THE ASSISTANCE OF AN APPROPRIATE PROFESSIONAL SHOULD BE SOUGHT.

ASME shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B7.1.3). Statement from the Bylaws.

For authorization to photocopy material for internal or personal use under those circumstances not falling within the fair use provisions of the Copyright Act, contact the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923, tel: 978-750-8400, www.copyright.com.

Requests for special permission or bulk reproduction should be addressed to the ASME Publishing Department, or submitted online at: <https://www.asme.org/publications-submissions/journals/information-for-authors/journalguidelines/rights-and-permissions>

ISBN: 978-0-7918-8612-0

CONTENTS

Proceedings of ASME Turbo Expo 2022: Turbomachinery Technical Conference and Exposition Volume 10D

Turbomachinery: Multidisciplinary Design Approaches, Optimization, and Uncertainty Quantification

GT2022-77969	V10DT34A001
From Concept to Wind Tunnel Model: Efficient Design Methodology for Innovative Low-Noise Propellers	
<i>Lieven Baert, Gabriele Grasso, Caroline Sainvitu, Ingrid Lepot, Marinus J. van Enkhuizen, Karel Lammers, and Nicholas Bown</i>	
GT2022-78306	V10DT34A002
Machine-Learning Assisted Optimization of Generalized K-Omega (GEKO) Turbulence Model Parameters for Turbocharger Radial Compressor	
<i>Patrick Amstad, Kwok Kai So, and Magnus Fischer</i>	
GT2022-78309	V10DT34A003
The Validation of a Parametric Leading Edge Model for Probabilistic CFD Analyses of Post-Service Compressor Airfoils	
<i>Lukas Schlüter, Paul Voigt, Matthias Voigt, Ronald Mailach, Robin Schmidt, Mirco Rostamian, and Bernd Becker</i>	
GT2022-80490	V10DT34A004
Multi-Objective Aerodynamic and Aeroelastic Coupled Design Optimization Using a Fully Turbulent Discrete Adjoint Harmonic Balance Method	
<i>Hangkong Wu, Dingxi Wang, and Xiuquan Huang</i>	
GT2022-80634	V10DT34A005
Automated Component Preliminary Design and Evaluation in the Overall Engine Using Fully Coupled Approaches	
<i>Jens Schmeink and Markus Schnoes</i>	
GT2022-80806	V10DT34A006
Application of Adjoint-Enhanced First Order Second Moment Method for Robust Design Optimization of a High Pressure Compressor Rotor	
<i>Max Dittmann, Robin Schmidt, and Marcus Meyer</i>	
GT2022-80876	V10DT34A007
Machine Learning-Based Multi-Disciplinary Optimization of Transonic Axial Compressor Blade Considering Aeroelasticity	
<i>Hyun-Su Kang and Youn-Jea Kim</i>	
GT2022-80906	V10DT34A008
CAD Integrated Gradient-Based Aero Optimization of the NASA Rotor 37	
<i>Thanh-Son Tran, Tom De Bruyn, and Tom Verstraete</i>	
GT2022-81779	V10DT34A009
Digital Shadow and Robust Optimization of in Service Squealer Tip Turbine Blades	
<i>Irene Virdis, Tiziano Ghisu, Shahrokh Shahpar, Iñaki de la Puerta, and Haidong Li</i>	
GT2022-81836	V10DT34A010
Improved Design Space Exploration by Machine Learning Estimation for a Parametric Turbofan Model	
<i>Chad Foster and Jack Moore</i>	

GT2022-82130	V10DT34A011
Multi Operating Point Aerodynamic Optimization of a Radial Compressor Impeller for an Application in High Temperature Heat Pump	
<i>Robert Schaffrath, Maximilian Kriese, Bojan Kajasa, Martino Köhler, Eberhard Nicke, and Christian Voß</i>	
GT2022-82144	V10DT34A012
Turbine Endwall Contouring Through Advanced Optimization Techniques	
<i>Matteo Burigana, Tom Verstraete, and Sergio Lavagnoli</i>	
GT2022-82218	V10DT34A013
Comparing Gradient-Free and Gradient-Based Multi-Objective Optimization Methodologies on the VKI-LS89 Turbine Vane Test Case	
<i>Romain Hottois, Arnaud Châtel, Grégory Coussement, Tom Verstraete, and Tom De Bruyn</i>	
GT2022-82530	V10DT34A014
Aerodynamic Optimization of the SRV2 Radial Compressor Using an Adjoint-Based Optimization Method	
<i>Arnaud Châtel and Tom Verstraete</i>	
GT2022-82579	V10DT34A015
Impact of Epistemic Uncertainty on Performance Parameters of Compressor Blades	
<i>Andriy Prots, Lukas Schlüter, Matthias Voigt, Ronald Mailach, and Marcus Meyer</i>	
GT2022-82688	V10DT34A016
Mean-Line Design and Optimization of Axial-Flow Turbines Based on Mixed Integer Nonlinear Programming	
<i>Vincenzo Dipierro, Matteo Martinelli, Giacomo Persico, and Emanuele Martelli</i>	
GT2022-82848	V10DT34A017
Adjoint Optimization of Centrifugal Compressor Rotor Accounting for Manufacturing Uncertainties	
<i>Mohamed H. Aissa, Alberto Racca, Lasse Mueller, Tom Verstraete, and Carnell E. Williams</i>	
GT2022-82917	V10DT34A018
Investigating the Nature and Invariance of Field Inversion Based on Transition in a Turbine Cascade	
<i>Alexander Bleh, Jan Backhaus, and Christian Morsbach</i>	
GT2022-83005	V10DT34A019
Optimal Blade Design of Stator Based on Adjoint Fluid Topology Optimization Method in a Torque Converter	
<i>Tianlang Tao, Zhifang Ke, Wei Wei, Cheng Liu, and Qingdong Yan</i>	
GT2022-83050	V10DT34A020
Design Optimization of Blade Tip in Subsonic and Transonic Turbine Stages - Part I: Stage Design and Preliminary Tip Optimization	
<i>P. H. Duan and L. He</i>	
GT2022-83063	V10DT34A021
Rotor37 Aerodynamic Optimization: A Machine Learning Approach	
<i>Klajdi Beqiraj, Andrea Perrone, Marco Sanguineti, Luca Ratto, and Gianluca Ricci</i>	
GT2022-83322	V10DT34A022
Evolution of Turbine Rear Frame Design for Aero Derivative Engine	
<i>Srinidhi Katti, Vishnu Vardhan Reddy, Anil Kumar Chippa, S. Babu, and Federico Casadio</i>	
GT2022-83467	V10DT34A023
Design Optimization of Blade Tip in Subsonic and Transonic Turbine Stages - Part II: Flow Physics and Augmented Aerothermal Integral Objective Function	
<i>Penghao Duan and Li He</i>	

GT2022-84296 **V10DT34A024**
The Road to a Digital Twin for Fan-Blade Off and Thermally Enabled Structural
Analyses of Aero Engines
Akin Keskin and Rob Fox

Turbomachinery: Turbomachinery General Interest

GT2022-80698 **V10DT36A001**
Accelerating the Development of a New Turbomachinery Concept in an Environment
With Limited Resources and Experimental Data: Challenges
*Dylan Rubini, Nikolas Karefylidis, Liping Xu, Budimir Rosic, and Harri
Johannesdahl*

Turbomachinery: Unsteady Flows in Turbomachinery

GT2022-78007 **V10DT37A001**
Unsteady Flow Simulations of an Axial Compressor Cascade Subjected to Free
Stream Wakes
Benjamin Duda and Gregory M. Laskowski

GT2022-78033 **V10DT37A002**
Impact of Upstream and Downstream Excitation and Multi-Row Interaction on the
Mistuned Forced Response Behavior of an Embedded Compressor Rotor: Higher-
Order Mode Aeromechanics
Shreyas Hegde, Laith Zori, Rubens Campregher, and Robert Kielb

GT2022-78056 **V10DT37A003**
An Efficient Unsteady 1-Way Coupling Method of Combustor and Turbine
Jonathan Gründler, Heinz-Peter Schiffer, and Knut Lehmann

GT2022-78101 **V10DT37A004**
Impact of Aerodynamic Asymmetry on the Embedded Rotor Forcing and Mistuned
Blade Response
Shreyas Hegde, Laith Zori, Rubens Campregher, and Robert Kielb

GT2022-79393 **V10DT37A005**
Application of the Harmonic Balance Method for Large Spread Multiple Frequency
Scales
*Thomas Biesinger, Maximilian Kölzer, Alexander Schukmann, Harald Roclawski,
Marc Kainz, Philippe Godin, Juan Carlos Morales, and Laith Zori*

GT2022-80251 **V10DT37A006**
The Effect of Partial-Load Operation on a Gas Turbine Compressor of an Advanced
Combined Cycle Power Plant
*Yasuharu Hagita, Hironori Miyazawa, Takashi Furusawa, Satoru Yamamoto, Koichi
Yonezawa, Shuichi Umezawa, Shuichi Ohmori, and Takeshi Suzuki*

GT2022-80277 **V10DT37A007**
A Fluid-Structure Interaction Tool Using a Van der Pol Based Reduced-Order Model
for Buffet and Non-Synchronous Vibrations
Richard Hollenbach, Robert Kielb, and Kenneth Hall

GT2022-80383 **V10DT37A008**
Numerical Investigation of Unsteady Flow Phenomena in a Centrifugal Compressor
Operating Near Surge With a Geometrically Reduced Model
Dominik Paul and Werner Eißler

GT2022-80399 **V10DT37A009**
Unsteady Rotor-Stator Interaction in a Four-Stage Axial Turbine: An Experimental
Investigation
Florian von Gosen, Benjamin Winhart, and Francesca di Mare

GT2022-81270	V10DT37A010
An Investigation of Non-Linear Surge Characteristic in a High-Speed Centrifugal Compressor <i>Yoshihiro Hayashi and Teng Cao</i>	
GT2022-81673	V10DT37A011
Highly Resolved Large-Eddy Simulations of a Transonic Compressor Stage Midspan Section Part I: Effect of Inflow Disturbances <i>Christoph Bode, Pawel J. Przytarski, John Leggett, and Richard D. Sandberg</i>	
GT2022-81707	V10DT37A012
The Role of Turbine Operating Conditions on Combustor-Turbine Interaction – Part 1: Change in Expansion Ratio <i>Andrea Notaristefano and Paolo Gaetani</i>	
GT2022-82072	V10DT37A013
On the Mode Characteristics of Rotating Instability With Different Tip Clearances <i>Zeyuan Yang, Lele Ming, Si Wu, Yadong Wu, Jie Tian, and Hua Ouyang</i>	
GT2022-82101	V10DT37A014
Influence of Casing Groove on Rotating Instabilities in a Low-Speed Axial Compressor <i>Xiangyi Chen, Björn Koppe, Martin Lange, Wuli Chu, and Ronald Mailach</i>	
GT2022-82103	V10DT37A015
Free-Stream Turbulence Induced Boundary-Layer Transition in Low-Pressure Turbines <i>Luca De Vincentiis, Kristina Đurović, Davide Lengani, Daniele Simoni, Jan Pralits, Dan S. Henningson, and Ardeshir Hanifi</i>	
GT2022-82256	V10DT37A016
The Role of Turbine Operating Conditions on Combustor-Turbine Interaction – Part 2: Loading Effects <i>Andrea Notaristefano and Paolo Gaetani</i>	
GT2022-82335	V10DT37A017
Numerical Investigation of the Effect of Trailing Edge Thickness of Simulated CMC Blades on Loss Profiles <i>Kenji Miki and Ali Ameri</i>	
GT2022-82370	V10DT37A018
High-Fidelity Simulation Study of the Unsteady Flow Effects on High-Pressure Turbine Blade Performance <i>John Leggett, Yaomin Zhao, and Richard D. Sandberg</i>	
GT2022-82474	V10DT37A019
Highly Resolved Large-Eddy Simulations of a Transonic Compressor Stage Midspan Section - Part II: Effect of Rotor-Stator Gap <i>Pawel J. Przytarski, John Leggett, Richard Sandberg, and Christoph Bode</i>	
GT2022-82594	V10DT37A020
The Effects of Swirling Flows in Entropy Wave Convection Through High Pressure Turbine Stage <i>Lorenzo Pinelli, Michele Marconcini, Roberto Pacciani, Andrea Notaristefano, and Paolo Gaetani</i>	
GT2022-82664	V10DT37A021
Characterizing Flow Instabilities During Transient Events in the Turbine Rim Seal Cavity <i>Maria Rozman, Eric T. DeShong, Reid A. Berdanier, Karen A. Thole, and Christopher Robak</i>	

GT2022-82682	V10DT37A022
Investigation of Surge in a Transonic Centrifugal Compressor With Vaned Diffuser: Part 1 – Surge Signature <i>Fangyuan Lou, Herbert M. Harrison, and Nicole L. Key</i>	
GT2022-82686	V10DT37A023
Investigation of Surge in a Transonic Centrifugal Compressor With Vaned Diffuser: Part 2 – Correlation With Subcomponent Characteristics <i>Fangyuan Lou, Herbert M. Harrison, William J. Brown, and Nicole L. Key</i>	
GT2022-82828	V10DT37A024
A Study of Stall Process in an Axial Flow Compressor With Foam Metal Casing Treatment <i>Jia Li, Dakun Sun, Ruize Xu, Xu Dong, and Xiaofeng Sun</i>	
GT2022-82861	V10DT37A025
Interaction Mechanism of Impeller and Diffuser Stall in a Centrifugal Compressor <i>Nobumichi Fujisawa, Momoko Naitou, and Yutaka Ohta</i>	
GT2022-82884	V10DT37A026
Modification of Pump Turbine Characteristics With Fluid Injection in Pump Operating Mode <i>Sabri Deniz and Simon In Albon</i>	
GT2022-83018	V10DT37A027
Acoustic Signature of Flow Instabilities Present in Industrial Centrifugal Compressor <i>Grzegorz Liskiewicz, Andrzej Jaeschke, and Władysław Kryłłowicz</i>	
GT2022-83036	V10DT37A028
Method of the Vaneless Diffuser Rotating Stall Cell Size Assessment Based on the PIV Measurements <i>Filip Grapow, Grzegorz Liśkiewicz, and Władysław Kryłłowicz</i>	
GT2022-83045	V10DT37A029
Transition of a Laminar Separated Boundary Layer Under Varying Adverse Pressure Gradient <i>Ravi Kumar, Pradeep Singh, and S. Sarkar</i>	
GT2022-83103	V10DT37A030
Turbulence Model Impact on Predicting Precursors to Surge Flow Instabilities in a Turbocharger Compressor <i>E. Trigell and M. Mihaescu</i>	
GT2022-83197	V10DT37A031
Investigation on Strain and Stress Principal Axes in Unsteady DNS Turbine Data <i>D. Lengani, D. Simoni, L. De Vincentiis, K. Đurović, J. Pralits, D. S. Henningson, and A. Hanifi</i>	
GT2022-83391	V10DT37A032
An Improved Preliminary Design Tool for Turbomachinery Blades Using Van der Pol Based Reduced-Order Model for Non-Synchronous Vibrations <i>Richard Hollenbach, Robert Kielb, and Kenneth Hall</i>	
GT2022-83497	V10DT37A033
Turbulence Characteristic and Loss of Transonic Turbine Tip Leakage Vortex With Endwall Motion Effect <i>Kai Zhou and Chao Zhou</i>	
GT2022-84386	V10DT37A034
Investigation of Unsteady Rotor-Stator Interaction and Deterministic Correlation Analysis in a Transonic Compressor Stage <i>Yangwei Liu, Xindi Wei, and Yumeng Tang</i>	