

**Proceedings of
ASME Turbo Expo 2021: Turbomachinery
Technical Conference and Exposition**

Volume 1

**June 7-11, 2021
Virtual, Online**

Conference Sponsor
International Gas Turbine Institute

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
Two Park Avenue * New York, N.Y. 10016

© 2021, 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/journal-guidelines/rights-and-permissions>

ISBN: 978-0-7918-8489-8

CONTENTS

Proceedings of ASME Turbo Expo 2021: Turbomachinery Technical Conference and Exposition

Aircraft Engine

GT2021-58503	V001T01A001
A Mathematical Model for Windmilling of a Turbojet Engine	
<i>Erkan Abdulhamitbilal, Sinan Sal, and Elbrous M. Jafarov</i>	
GT2021-58658	V001T01A002
Influence of Atomization Characteristics on Lean Blow-Out Limits in a Gas Turbine Combustor	
<i>Xiwei Wang, Yong Huang, Lei Sun, Yunfeng Liu, and Donghui Wang</i>	
GT2021-58829	V001T01A003
Fan-Intake Coupling With Conventional and Short Intakes	
<i>E. J. Gunn, T. Brandvik, and M. J. Wilson</i>	
GT2021-58849	V001T01A004
Internal Aerodynamic Performance Evaluation of Double Entrance S-Duct Intake at Moderately High Subsonic Mach Number	
<i>Satpreet Sidhu, Asad Asghar, William D. E. Allan, R. A. Stowe, and R. Pimentel</i>	
GT2021-58905	V001T01A005
Sensitivity Analysis of an Aircraft Engine Model Under Consideration of Dependent Variables	
<i>Julian Salomon, Jan Göing, Sebastian Lück, Matteo Broggi, Jens Friedrichs, and Michael Beer</i>	
GT2021-58942	V001T01A006
Design and Analysis of an Aircraft Thermal Management System Linked to a Low-Bypass Ratio Turbofan Engine	
<i>Robert A. Clark, Mingxuan Shi, Jonathan Gladin, and Dimitri Mavris</i>	
GT2021-58945	V001T01A007
Multi-Objective Optimization of Aero Engine Combustor Adopting an Integrated Procedure for Aero-Thermal Preliminary Design	
<i>Carlo Alberto Elmí, Ignazio Vitale, Hauke Reese, and Antonio Andreini</i>	
GT2021-58964	V001T01A008
Study of Oil Film Heat Transfer in Gas Turbine Engine Bearing Chamber	
<i>Illia Petukhov, Taras Mykhailenko, Oleksii Lysytsia, and Artem Kovalov</i>	
GT2021-58988	V001T01A009
Numerical Investigation of Air-Oil Two-Phase Flow Pattern Transition in the Scavenge Line of an Aeroengine	
<i>Ghofrane Sekrani, Jean-Sebastien Dick, Sébastien Poncet, and Sravankumar Nallamothu</i>	
GT2021-59079	V001T01A010
Inlet Flow Distortion in an Advanced Civil Transport Boundary Layer Ingesting Engine Installation	
<i>D. K. Hall, E. M. Greitzer, A. Uranga, M. Drela, and S. A. Pandya</i>	
GT2021-59089	V001T01A011
Evolutionary Algorithm for Enhanced Gas Path Analysis in Turbofan Engines	
<i>T. O. Rootliep, W. P. J. Visser, and M. Nollet</i>	
GT2021-59418	V001T01A012
A Method of Solving Three Temperature Problem of Turbine With Adiabatic Wall Temperature	
<i>Zeyu Wu, Xiang Luo, Jianqin Zhu, Zhe Zhang, and Jiahua Liu</i>	
GT2021-59489	V001T01A013
Estimation of Design Parameters and Performance for a State-of-the-Art Turbofan	
<i>Oliver Sjögren, Carlos Xisto, and Tomas Grönstedt</i>	
GT2021-59500	V001T01A014
On the Shaft Speed Selection of Parallel Hybrid Aero Engines	
<i>Michael Sielemann, Jesse Gohl, Xin Zhao, Konstantinos Kyprianidis, Giorgio Valente, and Sharmila Sumsurooah</i>	

GT2021-59526	.....	V001T01A015
On the Use of an Inflatable Rubber Lip to Improve the Reverse Thrust Flow Field in a Variable Pitch Fan		
<i>David John Rajendran and Vassilios Pachidis</i>		
GT2021-59992	.....	V001T01A016
Transient Analysis of Aircraft Oil Supply System With Fuel-Oil Heat Exchangers During Abrupt Change in Engine Operating Modes		
<i>Viktor Yevlakhov, Leonid Moroz, Andrii Khandrymailov, and Yuriy Hyrka</i>		
GT2021-60029	.....	V001T01A017
The Use of Enhanced Nozzle Maps for Gas-Turbine Performance Modelling		
<i>Aws A. Al-Akam, Theoklis Nikolaidis, David G. MacManus, and Alvise Pellegrini</i>		
GT2021-60230	.....	V001T01A018
Investigation of a Passive Flow Control Device in an S-Duct Inlet at High Subsonic Flow		
<i>Courtney Rider, Asad Asghar, William D. E. Allan, Grant Ingram, Robert Stowe, and Rogerio Pimentel</i>		
GT2021-60335	.....	V001T01A019
Aerodynamic Characteristics of a Blended-Wing-Body Aircraft With A Serpentine Inlet Using Flow Control Techniques		
<i>Min-Sik Youn and Youn-Jea Kim</i>		

Fans and Blowers

GT2021-58505	.....	V001T10A001
Feasibility Study on the Effect of Blade Inclination for Heavy Duty Centrifugal Fans – Aerodynamic Aspects		
<i>Till M. Biedermann, Youssef Moutamassik, and Frank Kameier</i>		
GT2021-58728	.....	V001T10A002
Study of CFD-Based Raised-Floor Data Center Cooling With Parametric CRAC Turbofan Blower Airflow Patterns		
<i>Zhihang Song and Wan Chen</i>		
GT2021-58735	.....	V001T10A003
Effect of Tip Vortex Reduction on Air-Cooled Condenser Axial Flow Fan Performance: An Experimental Investigation		
<i>J. P. Pretorius and J. A. Erasmus</i>		
GT2021-58967	.....	V001T10A004
Optimization of a High Pressure Industrial Fan		
<i>Edward De Jesús Rivera, Fanny Besem-Cordova, and Jean-Charles Bonaccorsi</i>		
GT2021-59130	.....	V001T10A005
Preliminary Evaluation of the 24 Ft. Diameter Fan Performance In the MinWaterCSP Large Cooling Systems Test Facility		
<i>S. J. van der Spuy, D. N. J. Els, L. Tieghi, G. Delibra, A. Corsini, F. G. Louw, A. Zapke, and C. J. Meyer</i>		
GT2021-59277	.....	V001T10A006
Cascade With Sinusoidal Leading Edges: Identification And Quantification of Deflection With Unsupervised Machine Learning		
<i>Alessandro Corsini, Giovanni Delibra, Lorenzo Tieghi, and Francesco Aldo Tucci</i>		
GT2021-59465	.....	V001T10A007
Optimization of a Tip Appendage for the Control of Tip Leakage Vortices in Axial Flow Fans		
<i>Thomas O. Meyer, Sybrand J. van der Spuy, Christiaan J. Meyer, and Alessandro Corsini</i>		
GT2021-59491	.....	V001T10A008
Overview of the Best 2020 Axial-Flow Fan Data and Inclusion in Similarity Charts for the Search of the Best Design		
<i>Massimo Masi, Piero Danieli, and Andrea Lazzaretto</i>		

GT2021-59554	.....	V001T10A009
Morphing of Reversible Axial Fan Blade: A FSI-FEM Study		
<i>Valerio F. Barnabei, Alessio Castorini, Alessandro Corsini, and Franco Rispoli</i>		
GT2021-59821	.....	V001T10A010
Analysis and Design of Centrifugal Blowers for the Pressure Ratio Range 1.2 - 1.8		
<i>Jonathon Howard and Abraham Engeda</i>		
GT2021-59832	.....	V001T10A011
Performance Modification of an Erosion-Damaged Large-Sized Centrifugal Fan		
<i>Nicola Aldi, Nicola Casari, Michele Pinelli, Alessio Suman, Alessandro Vulpio, and Paolo Saccenti</i>		

Marine

GT2021-00379	.....	V001T18A001
Case Closed: The Completion of the United States Navy 501-K34 Gas Turbine Engine RADCON Program (2011 - 2019)		
<i>Jeffrey S. Patterson, Kevin Fauvell, Dennis Russom, Willie A. Durosseau, Phyllis Petronello, and Javier O. Moralez</i>		
GT2021-01719	.....	V001T18A002
Upgrading Marine Engine Materials for Future Navy Ships		
<i>David A. Shifler and Donald Hoffman</i>		
GT2021-03523	.....	V001T18A003
Hybrid Electric Drive Systems in the United States Navy		
<i>Gianfranco Buonomici</i>		
GT2021-59075	.....	V001T18A004
The OP16 Gas Turbine Gen-Set for Marine Power Generation		
<i>Jan Horvath</i>		
GT2021-59788	.....	V001T18A005
Research on Matching Characteristics of Ship-Engine-Propeller of COGAG		
<i>Zhitao Wang, Jiayi Ma, Haichao Yu, and Tielei Li</i>		

Wind Energy

GT2021-59102	.....	V001T40A001
A Robust Procedure to Implement Dynamic Stall Models Into Actuator Line Methods for the Simulation of Vertical-Axis Wind Turbines		
<i>Pier Francesco Melani, Francesco Balduzzi, and Alessandro Bianchini</i>		
GT2021-59156	.....	V001T40A002
Machine Learning Aided Prediction of Rain Erosion Damage on Wind Turbine Blade Sections		
<i>Alessio Castorini, Paolo Venturini, Fabrizio Gerboni, Alessandro Corsini, and Franco Rispoli</i>		
GT2021-59664	.....	V001T40A003
High Efficiency Wind Turbine Using Co-Flow Jet Active Flow Control		
<i>Kewei Xu and Gecheng Zha</i>		
GT2021-60237	.....	V001T40A004
Influence of Yawed Wind Flow on the Blade Forces/Bending Moments and Blade Elastic Torsion for an Axial-Flow Wind Turbine		
<i>Mohammad H. B. Ahmadi and Zhiyin Yang</i>		
GT2021-60280	.....	V001T40A005
Condition Monitoring of Wind Turbines Based on the Scattering Transform of Vibration Data		
<i>Junyu Qi, Alexandre Mauricio, and Konstantinos Gryllias</i>		

Scholar Lecture

GT2021-60864	.....	V001T41A001
Instabilities Everywhere! Hard Problems in Aero-Engines		
<i>Zoltán S. Spakovszky</i>		