Proceedings of the ASME

FLUIDS ENGINEERING DIVISION SUMMER MEETING

- 2020 -

VOLUME 3

COMPUTATIONAL FLUID DYNAMICS

MICRO AND NANO FLUID DYNAMICS

presented at

ASME 2020 FLUIDS ENGINEERING DIVISION SUMMER MEETING

JULY 13-15, 2020

ONLINE

sponsored by

FLUIDS ENGINEERING DIVISION, ASME

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

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571

Some format issues inherent in the e-media version may also appear in this print version.

Statement from By-Laws: The Society shall not be responsible for statements or opinions Advanced in papers. . .or printed in its publications (7.1.3)

INFORMATION CONTAINED IN THIS WORK HAS BEEN OBTAINED BY ASME 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.

For authorization to photocopy material for internal or personal use under 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

Requests for special permission or bulk reproduction should be addressed to permissions@asme.org.

ISBN NO. 978-0-7918-8373-0

© 2020 ASME
All rights reserved.
Printed in U.S.A with permission by Curran Associates, Inc. (2020)

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

CONTENTS

COMPUTATIONAL FLUID DYNAMICS; MICRO AND NANO FLUID DYNAMICS

APPLICATIONS OF CFD IN MEDICINE AND BIOMEDICAL SYSTEMS

FEDSM2020-20042..... V003T05A001
Blood Flow Simulations of Particle Trapping in Models of Arterial Bifurcations
Qihang Xu, Ramesh K. Agarwal

FEDSM2020-20048..... V003T05A002
CFD Evaluation of Blood Flow in an Improved Blalock-Taussig Shunt Using Patient Specific Geometries
Zhenghao Lin, Ramesh K. Agarwal, Vijay Govindarajan, Noah Schultz, David Hoganson, Peter Hammer

FEDSM2020-20052..... V003T05A003
Analysis of Blood Flow Patterns to Estimate Atherosclerosis Formation in the Left Carotid Artery by CFD Simulation
Marzia Momin, Nusrat Ara, M. Tarik Arafat

FEDSM2020-20339..... V003T05A004
Fluid-Structure Interaction Modeling and Validation of Idealized Left Ventricular Blood Flow
Megan Laughlin, Sam Stephens, Hanna Jensen, Morten Jensen, Paul Millett

FEDSM2020-20407..... V003T05A005
Modeling Microbubble Microvessel Interaction for Sonoporation Application
Aswin Gnanaskandan, Xiaolong Deng, Chao-Tsung Hsiao, Georges Chahine

APPLIED CFD

FEDSM2020-20001..... V003T05A006
Turbulence Modeling Using Z-F, RSM, LES and WMLES for Flow Analysis in Z-Shape Ducts
Mohammed Karbon, Ahmad K. Sleiti

FEDSM2020-20019..... V003T05A007
ALEvo: Development of a New Wind Turbine Actuator Line Numerical Model
Murphy Leo O'Dea, Laila Guessous

FEDSM2020-20038..... V003T05A008
Machine Learning for Turbulence Modeling and Predictions
S. Bhushan, Greg W. Burgreen, D. Martinez, Wes Brewer

FEDSM2020-20055..... V003T05A009
Feasibility Study for Flow-Induced Vibration in Stud Pipe Using Computational Fluid Dynamics
Khac-Ha Nguyen, Won-Tae Kim, Seung-Pyo Hong, Haein Lee, Ahram Lee

FEDSM2020-20092..... V003T05A010
Simulation on Flow Pattern Transition With Liquid Nitrogen and its Vapor Using a Droplet Entrainment Model
Rui Zhou, Tao Xia, Xiaobin Zhang

FEDSM2020-20093..... V003T05A011
A Comparative Numerical Study on Two-Phase Boiling Fluid Flow and Heat Transfer in the Microchannel Heat Sink With Different Manifold Arrangements
Yang Luo, Jingzhi Zhang, Wei Li

FEDSM2020-20111..... V003T05A012
CFD Modeling of Multi-Fuel Suspension Co-Combustion and Calcination Processes Within a DDF Precalciner of Cement Kiln
Eugen-Dan Cristea, Pierangelo Conti

FEDSM2020-20120..... V003T05A013
CFD Simulation of Wall-Bounded Laminar Flow Through Screens: Part II -- Mixing Characterization
W. Abou Hweij, F. Azizi

FEDSM2020-20157..... V003T05A014
Wake Patterns in a Dual-Rotor Wind Turbine
K. Asfar, A. Mahasneh

FEDSM2020-20166..... V003T05A015
A Computational Study of a Biomass Cookstove With Forced Secondary Air Injection
Liam Cassidy, Nordica MacCarty

FEDSM2020-20171..... V003T05A016
Simulation of Ventilation Flow Through a Room Fitted With a Windcatcher Incorporating Phase Change Materials
Peter Abdo, Angel Reyes-Cubas

FEDSM2020-20172..... V003T05A017
Assessment of Computational Fluid Dynamics for Predicting Possible Cavitation and Choked Flow Inside Excess Flow Valves
Nafiseh Banazadeh-Neishabouri, Siamack A. Shirazi, Jud Smalley, Mike Lybarger

FEDSM2020-20212..... V003T05A018
Performance Assessment of a NACA-2412 Surrogate Model Using Non-Intrusive Polynomial Chaos Method
Houssam El Dine Matbouli, Iyad Fayssal

FEDSM2020-20228..... V003T05A019
The Effect of Varying Viscosity in Turbulent Channel Flow
Victor Coppo Leite, Elia Merzari

FEDSM2020-20241..... V003T05A020
Evaporative Emissions From Automotive Gasoline Fuel Tank Refueling: Experimental Activity and Numerical Simulation
Luca Romagnuolo, Emma Frosina, Assunta Andreozzi, Adolfo Senatore, Francesco Fortunato, Vincenzo Mirante

FEDSM2020-20244..... V003T05A021
Using Computational Fluid Dynamics to Analyze Convection in Pin-to-Plane Plasma Discharge
Robert Galvez, Kamau Wright, Ivana Milanovic

FEDSM2020-20247..... V003T05A022
Large Eddy Simulation of Active Flow Control Over SD7003 at Reynolds Number of 60,000
Djavad Kamari, Mehran Tadjfar, Ali Tarokh

FEDSM2020-20269..... V003T05A023
Investigation of Turbulence Model Performance in Computational Fluid Dynamics Simulations of Horizontal Axis Wind Turbines
Keaton Mullenix, D. Keith Walters, Arturo Villegas, F. Javier Diez

FEDSM2020-20284..... V003T05A024
Comparative Analysis of Shell and Tube Type Heat Exchanger Based on Bell Delaware, Flow Stream and Numerical Methods
Tariq S. Khan, Hasan Fawad, Kashif Nawaz

FEDSM2020-20304..... V003T05A025
Performance Evaluation of a Non-Linear Explicit Algebraic Reynolds Stress Model for Surface Mounted Obstacles
Benjamin H. Taylor, Tausif Jamal, D. Keith Walters

FEDSM2020-20336..... V003T05A026
A LES Study of Ventilation Flow Through a 3-D Room Fitted With Solar Chimney
B. Phuoc Huynh

FEDSM2020-20350..... V003T05A027
Experimental and Numerical Analysis on the Performance of Spiral Two-Fluid Atomizer Using DPM Method
Jin-Woo Lee, Kuk Jin Jung, Morely Sherman, Hyun Sin Kim, Youn-Jea Kim

FEDSM2020-20370..... V003T05A028
Modeling the Effect of Spacer Grid and Mixing Vanes in Coupled CFD Simulations of Small Modular Reactors
Jun Fang, Dillon Shaver, Elia Merzari

FEDSM2020-20394..... V003T05A029
Influence of a Yield-Shear-Thinning Rheology on the Flow Behavior of Submerged Annular Jets
Khaled J. Hammad

FEDSM2020-20398..... V003T05A030
On the Application of the Full Reynolds Stress Model for Unsteady CFD in Hydraulic Turbomachines
Ernesto Casartelli, Luca Mangani, David Roos, Armando Del Rio

FEDSM2020-20416..... V003T05A031
Two-Dimensional CFD Study on the Enhancement of Tube Bank Configuration Heat Exchanger
Ahmed M. Nagib Elmekawy, Abdalrahman M. Shahin, Alaa A. Ibrahim, Sara Al-Ali

FEDSM2020-20433..... V003T05A032
Optimized Gun Barrel Based on Numerical Simulation to Produced Oil With Low BSW Content
Silvia Araujo Daza, Urbano Montanez Villamizar

CFD DEVELOPMENT

FEDSM2020-20053..... V003T05A033
Performance of Francis Turbine Operating at Excess Load Condition
Muhannad Altimemy, Justin Caspar, Alparslan Oztekin

FEDSM2020-20054..... V003T05A034
Computational Study of Pump Turbine: Partial Load Operations
Muhannad Altimemy, Justin Caspar, Alparslan Oztekin

FEDSM2020-20088..... V003T05A035
Evaluation of Reattaching Shear-Layer in Compressible Turbulent Flows: A Large Eddy Simulation Approach
Rozie Zangeneh

FEDSM2020-20165..... V003T05A036
Large Eddy Simulation of Flow Over a Hemispherical Obstacle Within a Cylindrical Tube
Amit Sharma, Urmila Ghia, Leonid A. Turkevich

FEDSM2020-20264..... V003T05A037
A Combined CFD-Mechanistic Approach for Predicting Solid Particle Erosion in Annular Flow in Pipe Fittings and Elbows
Farzin Darihaki, Elham Fallah Shojaie, Jun Zhang, Siamack A. Shirazi

FEDSM2020-20295..... V003T05A038
Numerical Simulation of Non-Stationary Turbulent Flows Using Double Exponential Dynamic Time Filtering Technique
Tausif Jamal, Shanti Bhushan, D. Keith Walters

FEDSM2020-20297..... V003T05A039
Order of Accuracy and Sensitivity to Freestream Conditions of a Modified k-[omega] Turbulence Model for High-Order Finite Element Methods
Nojan Bagheri-Sadeghi, Brian T. Helenbrook, Kenneth D. Visser

FEDSM2020-20302..... V003T05A040
Large Eddy Simulation of Slurry Erosion in Submerged Impinging Jets
Qiuchen Wang, Qiyu Huang, Xu Sun, Jun Zhang, Soroor Karimi, Siamack A. Shirazi

FEDSM2020-20345..... V003T05A041
A Computational Fluid Dynamic Study of a Momentum and Energy Method on Rough Surfaces
Jose Urcia, Michael Kinzel

FEDSM2020-20354..... V003T05A042
Investigation of an Algebraic Reynolds Stress Model for Simulation of Wall-Bounded Turbulent Flows With and Without Buoyancy Effects
Tausif Jamal, D. Keith Walters

FEDSM2020-20376..... V003T05A043
Evaluation of a Statistically Targeted Forcing Method for Synthetic Turbulence Generation in Large-Eddy Simulations and Hybrid RANS-LES Simulations
Olalekan O. Shobayo, D. Keith Walters

FEDSM2020-20404..... V003T05A044
MPI Parallelization for Two-Way Coupled Euler-Lagrange Simulation of Microbubble Enhanced HIFU
Jingsen Ma, Aswin Gnanaskandan, Chao-Tsung Hsiao, Georges L. Chahine

FEDSM2020-20486..... V003T05A045
Open-Source Accelerated Vortex Particle Methods for Unsteady Flow Simulation
Mark J. Stock, Adrin Gharakhani

COMPUTATIONAL MARINE HYDRODYNAMICS

FEDSM2020-20316..... V003T05A046
Effect of Formation Pattern on Schooling Energetics in Fish-Like Swimming
Yu Pan, Pan Han, Jing Huang, Haibo Dong

FLUID STRUCTURE INTERACTION (INCLUDING IBM)

FEDSM2020-20007..... V003T05A047
Numerical Simulation of Twin-Parachute Inflation Process for Aircraft Ejection Escape
Liwu Wang, Mingzhang Tang, Sijun Zhang

FEDSM2020-20206..... V003T05A048
Vortex-Induced Rotations of a Pair of Laterally Arranged Square Cylinder in a Two-Dimensional Microchannel
Lichun Li, Shanshan Li, Zhe Yan, Zhenhai Pan

FEDSM2020-20260..... V003T05A049
Experimental Validation of Fluid-Structure Interaction Co-Simulations Using ANSYS via Wind Tunnel Testing of Cantilevered Plate
Thomas G. Shepard, Kyle Schneider, Sarah Baxter, William Schwartz

FEDSM2020-20300..... V003T05A050
Wake Comparison of Open and Ducted Wind Turbines Using Actuator Disc Simulations
Nojan Bagheri-Sadeghi, Brian T. Helenbrook, Kenneth D. Visser

MULTI-PHYSICS SIMULATION

FEDSM2020-20063..... V003T05A051
Application of FMI in Metal Casting Press-Forming Process
Zhong Xingli, Ji Linhong, Li Sheng, Lu Yijia

FEDSM2020-20077..... V003T05A052
A Verification and Validation Study With Respect to Simulating Undulating Propulsion
George Loubimov, Michael P. Kinzel

OPTIMIZATION, DATA-BASED SIMULATIONS, AND MACHINE LEARNING

FEDSM2020-20126..... V003T05A053
Characterization of Flow Regimes in Gas-Solid Fluidized Beds via a Data Driven Framework
V. M. Krushnarao Kotteda, Anitha Kommu, Vinod Kumar

FEDSM2020-20159..... V003T05A054
Heat Transfer Prediction With Unknown Thermal Boundary Conditions Using Physics-Informed Neural Networks
Shengze Cai, Zhicheng Wang, Chryssostomos Chryssostomidis, George Em Karniadakis

FEDSM2020-20184..... V003T05A055
Investigation of Applying Physics Informed Neural Networks (PINN) and Variants on 2D Aerodynamics Problems
Wee-Beng Tay, Murali Damodaran, Zhi-Da Teh, Rahul Halder

FEDSM2020-20196..... V003T05A056
Investigating the Effect of Configuration and Reduced Frequency on SD7003 Airfoils Performance in Tandem
Niloofar Hosseini, Mehran Tadjfar

FEDSM2020-20344..... V003T05A057
Adaptive Simulation Based on URANS and Ensemble Kalman Filter for Resolving Turbulent Flow on LES
Sasuga Ito, Masato Furukawa, Yamada Kazutoyo, Kaito Manabe

FEDSM2020-20348..... V003T05A058
Optimal Design of Thermally Stressed Turbocharger Blade Using Response Surface Method
Kuk Jin Jung, Jin-Woo Lee, Youn-Jea Kim

FEDSM2020-20391..... V003T05A059
Parametric Optimization of a Dry Powder Inhaler
V. M. Krushnarao Kotteda, Antara Badhan, Vinod Kumar

MICRO- AND NANOSCALE THERMOFLUIDIC SCIENCE AND DEVICES

FEDSM2020-20130..... V003T06A001
Evaluation of Frictional Pressure Drop Correlations During Flow Boiling of Refrigerants in Micro-Fin Tubes
Weiyu Tang, Wei Li, Jianxin Zhou

FEDSM2020-20307..... V003T06A002
Experimental and Numerical Analysis of Fluid Flow Through a Micromixer With the Presence of Electric Field
Md Fazlay Rubby, Mohammad Salman Parvez, Prosanto Biswas, Hasina Huq, Nazmul Islam

FEDSM2020-20379..... V003T06A003
Development of Ball-Enabled Miniaturized Valves for Sample Preparation and Microheaters for Pathogen Detection
Carlos Manzanas, Xiao Jiang, John A. Lednicky, Z. Hugh Fan

MICRO-TOTAL-ANALYSIS SYSTEMS (MICROTAS) AND LAB-ON-A-CHIP APPLICATIONS

FEDSM2020-20073..... V003T06A004
Micro Machined Slit Between Ridge and Groove in Micro Fluid-Channel to Measure Floating Cell Deformability
Shigehiro Hashimoto

FEDSM2020-20096..... V003T06A005
Oblique Micro Grooves on Bottom Wall of Flow Channel to Sort Cells
Shigehiro Hashimoto

MODELLING AND SIMULATION IN MICROFLUIDICS

FEDSM2020-20332..... V003T06A006
Rheological Measurement of the Gelation Temperature of Thermoresponsive Hydrogels: A Tutorial Using Pluronic F127
Haipeng Zhang, Sangjin Ryu, Rongguo Ren, Dong Wang

SENSORS AND TRANSDUCERS FOR MICROFLUIDIC APPLICATIONS

FEDSM2020-20305..... V003T06A007
Micro Flow Direction Analysis Using Gold Sputtered Planar V-Shaped Electrode Pattern
Mohammad Salman Parvez, Md Fazlay Rubby, Sajid Mahfuz Ucchyash, Prosanto Biswas, Hasina Huq, Nazmul Islam

FEDSM2020-20352..... V003T06A008
Pressure Drop Study in Cylindrical Microchannels: Using Graphene Oxide and Magnesia Nanofluids
Abdallah Y. M. Ali, Mohammed Fuseini, Essam M. Abo-Zahhad, M. F. El-Kady, A. H. El-Shazly

FEDSM2020-20356..... V003T06A009
Fabrication of a Microchannel Device With a Three-Dimensional Pore Network Using a Sacrificial Sugar Template
Haipeng Zhang, Tomer Palmon, Seunghee Kim, Sangjin Ryu