

Proceedings of the ASME

**INTERNATIONAL MECHANICAL ENGINEERING
CONGRESS AND EXPOSITION
- 2019 -**

**VOLUME 2B
ADVANCED MANUFACTURING**

presented at
ASME 2019 INTERNATIONAL MECHANICAL ENGINEERING CONGRESS AND EXPOSITION
NOVEMBER 11-14, 2019
SALT LAKE CITY, UTAH, USA

sponsored by
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. 978-0-7918-5938-4

© 2019 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

ADVANCED MANUFACTURING

DIGITAL MANUFACTURING FOR INDUSTRY 4.0 APPLICATIONS

| | |
|--|--------------------|
| IMECE2019-10135 | V02BT02A001 |
| Intrusion Detection of Cyber-Physical Attacks in Manufacturing Systems: A Review <i>Mingtao Wu, Young B. Moon</i> | |
| IMECE2019-10158 | V02BT02A002 |
| Configuration and Business Protocol of International Load Sharing of Manufacturing and its Challenges Under I4.0 and IIoT <i>Samir Mekid, Usman Akbar</i> | |
| IMECE2019-10366 | V02BT02A003 |
| A Secure Cyber-Manufacturing System Augmented by the Blockchain <i>Jinwoo Song, Young B. Moon</i> | |
| IMECE2019-10442 | V02BT02A004 |
| Physical Data Auditing for Attack Detection in Cyber-Manufacturing Systems: Blockchain for Machine Learning Process <i>Jinwoo Song, Diksha Shukla, Mingtao Wu, Vir V. Phoha, Young B. Moon</i> | |
| IMECE2019-10583 | V02BT02A005 |
| Digital Twin: Concept of Hybrid Programming for Industrial Robots -- Use Case <i>Vladimir Kuts, Martins Sarkans, Tauno Otto, Toivo Tahemaa, Yevhen Bondarenko</i> | |
| IMECE2019-10732 | V02BT02A006 |
| Integration of Digital Equipment Based on General Information Model and Model Mapping to MTConnect <i>Zhaokun Zhang, Zhufeng Shao, Liping Wang, Yong Luo</i> | |
| IMECE2019-10889 | V02BT02A007 |
| Digital Tools to Capture Manufacturing Tacit Knowledge to Support Next Generation Automation Systems <i>David A. Guerra-Zubiaga, Kathy S. Schwaig, Sabih Nasir, Alex Bondar</i> | |
| IMECE2019-11023 | V02BT02A008 |
| Digital Twin in a Manufacturing Integrated System: Siemens TIA and PLM Case Study <i>David A. Guerra-Zubiaga, Alex Bondar, Gilberto Escobedo, Arthur Schumacher</i> | |
| IMECE2019-11160 | V02BT02A009 |
| Real-Time Assembly Recognition Based on the Similarity Between Spatial Increment and Part Model <i>Jiazhen Pang, Yuan Li, Jie Zhang, Jianfeng Yu</i> | |

IMECE2019-11337..... **V02BT02A010**
An Application of a Digital Twin to Robotic System Design for an Unstructured Environment
Matthew Q. Marshall, Cameron Redovian

IMECE2019-11345..... **V02BT02A011**
Physics-Based Simulation of Agile Robotic Systems
Pavel Piliptchak, Murat Aksu, Frederick M. Proctor, John L. Michaloski

IMECE2019-12050..... **V02BT02A012**
An Initial Framework for Implementation of Industry 4.0 in the High Technological Manufacturing Sector in Southern California
Sagil James, Anupam Shetty

IMECE2019-12309..... **V02BT02A013**
How to Establish Digital Thread Using 3D Factory
Holey Ajay, Alandikar Shashank

GENERAL MANUFACTURING

IMECE2019-10383..... **V02BT02A014**
A Lightweight Framework of R-LATs for Large-Scale Application
Kang Jia, Ruihua He, Gang Fu, Wenjun Su, Zhigang Liu

IMECE2019-10692..... **V02BT02A015**
Investigating the Purge Flow Rate in a Reactor Scale Simulation of an Atomic Layer Deposition Process
Emeka Charles Nwanna, Rigardt Alfred Maarten Coetzee, Tien-Chien Jen

IMECE2019-10919..... **V02BT02A016**
Eccentricity of Rotor Prediction of Aero-Engine Rotor Based on Image Identification and Machine Learning
Zihao Zhang, Junkang Guo, Yanhui Sun, Jun Hong

INNOVATIVE PRODUCT AND PROCESS DESIGN

IMECE2019-10452..... **V02BT02A017**
A Methodology for Modelling Tugger Train Systems Using Modelica
Joao Veiga, Joao Sousa, Jose Machado, Joao Silva, Toni Machado, Pedro Silva

IMECE2019-10621..... **V02BT02A018**
Joining Techniques for Novel Metal Polymer Hybrid Heat Exchangers
Gowtham Kuntumalla, Yuquan Meng, Manjunath Rajagopal, Ricardo Toro, Hanyang Zhao, Ho Chan Chang, Sreenath Sundar, Srinivasa Salapaka, Nenad Miljkovic, Chenhui Shao, Placid Ferreira, Sanjiv Sinha

| | |
|--|--------------------|
| IMECE2019-10985 | V02BT02A019 |
| Artificial Intelligence Based Architecture to Support Dementia Patients <i>Fernando Luis-Ferreira, Joao Sarraipa, Jorge Calado, Joana Andrade, Daniel Rodrigues, Ricardo Jardim Goncalves</i> | |
| IMECE2019-11266 | V02BT02A020 |
| Integration of Vibration Absorbers in Milling Chucks <i>Mihir Joshi, Matthias Weigold, Michael Schoell</i> | |
| IMECE2019-11362 | V02BT02A021 |
| A Digital Twin for Intra-Logistics Process Planning for the Automotive Sector Supported by Big Data Analytics <i>Guilherme Guerreiro, Paulo Figueiras, Ruben Costa, Maria Marques, Diogo Graca, Gisela Garcia, Ricardo Jardim-Goncalves</i> | |
| IMECE2019-11393 | V02BT02A022 |
| Computational Model for Knowledge Transfer Skills in Industry 4.0 in an Enhanced and Effective Way <i>Andreia Artifice, Fernando Luis-Ferreira, Joao Sarraipa, Ricardo Jardim-Goncalves</i> | |
| IMECE2019-11415 | V02BT02A023 |
| Discovery of Public Transportation Patterns Through the Use of Big Data Technologies for Urban Mobility <i>Hugo Antunes, Paulo Figueiras, Ruben Costa, Joel Teixeira, Ricardo Jardim-Goncalves</i> | |
| IMECE2019-11527 | V02BT02A024 |
| A Methodology for Virtual Factory Applications Definition, Development and Validation <i>Elsa Marcelino-Jesus, Joao Sarraipa, Francisco Fraile, Raul Poler</i> | |
| IMECE2019-11554 | V02BT02A025 |
| Stress and Mesh Stiffness Evaluation of Bimaterial Spur Gears <i>Fatih Karpat, Tufan Gurkan Yilmaz, Oguz Dogan, Onur Can Kalay</i> | |
| IMECE2019-11582 | V02BT02A026 |
| Definition of Basic Functional Geometries: A Survey to Support Automatic Metrology <i>Andre Pinto Vale, Joao Silva, Carlos A. P. Costa, Michael Machado</i> | |
| IMECE2019-11600 | V02BT02A027 |
| The Evolution of Tridimensional Metrology: The Era of Computer Aided Metrology <i>Michael Machado, Joao Silva, Joao Sousa, Andre Filipe Pinto Vale</i> | |
| IMECE2019-11659 | V02BT02A028 |
| Innovative Information Model to Improve Quality and Collaboration on Stone Industry <i>Adriana Cunha, Joao Silva</i> | |
| IMECE2019-11711 | V02BT02A029 |
| Innovative Product/Service for Personalized Health Management <i>Maria Marques, Fabio Lopes, Ruben Costa, Carlos Agostinho, Pedro Oliveira, Ricardo Jardim-Goncalves</i> | |

IMECE2019-11785..... **V02BT02A030**
Development of a Cleaning Robot for Trench Drains
Adithya Kaushik, Janet Dong, Ce Gao, Hazem Elzarka

IMECE2019-11807..... **V02BT02A031**
Temperature Change of Spindle Using Non-Contact Controllable Excitation and Response Measurement
Wenjun Su, Shaoke Wan, Jun Hong

LASER-BASED ADVANCED MANUFACTURING AND MATERIALS PROCESSING

IMECE2019-10563..... **V02BT02A032**
Advanced Packaging Solution for High Density FCCSP Molding Warpage
Shuai-Lin Liu, Ward Ye, Yu-Po Wang, Long-Yuan Wang, Fred Lin

IMECE2019-11002..... **V02BT02A033**
Experimental Study on Geometric Precision of Microholes Drilling by Picosecond Laser
Zhanfei Zhang, Wenhui Wang, Ruisong Jiang, Chengcheng Jin, Xiaoxiang Zhu, Xiaofen Liu

IMECE2019-11810..... **V02BT02A034**
Effects of Laser Ablation Parameters to Pattern High Purity Magnesium Surfaces
Yahya E. Yayoglu, Nathan D. Gallant, Ryan Toomey, Nathan B. Crane

IMECE2019-12122..... **V02BT02A035**
Effect of External Magnetic Field on the Microstructure of 316L Stainless Steel Fabricated by Directed Energy Deposition
Jin Wang, Yachao Wang, Jing Shi, Yutai Su

IMECE2019-12238..... **V02BT02A036**
Study of Metallurgical and Mechanical Behavior of Laser Butt-Welded Dissimilar Joint of Inconel and Stainless Steel
Sanjib Jaypuria, Santosh Kumar Gupta, Sulthan Suresh-Fazeela, Dilip Kumar Pratihari, Debalay Chakrabarti, M. N. Jha

MEASUREMENT SCIENCE, SENSORS, NON-DESTRUCTIVE EVALUATION (NDE), AND PROCESS CONTROL FOR ADVANCED MANUFACTURING

IMECE2019-10323..... **V02BT02A037**
In-Situ Fatigue Prediction of Direct Laser Deposition Parts Based on Thermal Profile
Seyyed Hadi Seifi, Wenmeng Tian, Aref Yadollahi, Haley Doude, Linkan Bian

IMECE2019-10571..... **V02BT02A038**
Remaining Useful Life Prediction Based on Spindle Load and Cutting Process Parameters in Machining
Ankur Krishna, Bilal Muhammed

IMECE2019-10822..... **V02BT02A039**
Influence Study of Gas Pressure on the Volume Measurement of Engine Combustion Chamber by Using Helmholtz Resonance
Kun Chen, Sun Jin, Shun Liu, Ang Tian, Wei Mo

IMECE2019-10981..... **V02BT02A040**
Rapid Qualification of Additive Manufactured Parts Using OpenMETA
Michael R. Myers

IMECE2019-10986..... **V02BT02A041**
Univariate and Multivariate Gauge Repeatability and Reproducibility Analysis on the High Frequency Dynamic Mechanical Analysis (DMA) Measurement System
Roja Esmaeeli, Haniph Aliniagerdroudbari, Seyed Reza Hashemi, Hammad Al-Shammari, Muapper Alhadri, Siamak Farhad

IMECE2019-10993..... **V02BT02A042**
An Initial Study Towards In-Situ Ultrasonic Monitoring and Measurement of Part Properties During Photopolymer Based Additive Manufacturing
Tong Su, Menghan Jiang, Qing-Ming Wang, Xiayun Zhao

IMECE2019-11184..... **V02BT02A043**
An Optimized 3D Probe Using Sensitivity and Compliance Analysis
Weikang Zheng, Zhigang Liu, Junkang Guo

IMECE2019-11791..... **V02BT02A044**
Application of Extended Kalman Filter to Dynamic Tracking Problem in R-LATs
Wenjun Su, Kang Jia, Jun Hong, Zhigang Liu

NANOMANUFACTURING: NOVEL PROCESSES, APPLICATIONS, AND PROCESS-PROPERTY RELATIONSHIPS

IMECE2019-10693..... **V02BT02A045**
A First Principle Study on the Adhesion and Stability of Al₂O₃ (0001)/Pt (111) Film Interface
Lesego M. Mohlala, Rigardt A. M. Coetzee, Tien-Chien Jen, Peter A. Olubambi

IMECE2019-11456..... **V02BT02A046**
Fiber Creation and Deposition on Arbitrary Surfaces With Gas-Modified Electrospinning
Emily A. Kooistra-Manning, Lane G. Huston, Jack L. Skinner, Jessica M. Andriolo

ROBOTICS AND AUTOMATION IN ADVANCED MANUFACTURING

IMECE2019-10388..... **V02BT02A047**
Influence of the Form of Pulse of Excitation on the Speed and Power Parameters of the Linear Pulse Electromechanical Converter of the Induction Type
Vladimir F. Bolyukh, Igor I. Katkov

IMECE2019-10851..... **V02BT02A048**
Effect of the Die Hole Structure and Distribution on the Strength of Ring Die in
Pelletizing Equipment
Junhong Li, Yu Sun, Kai Wu, Yu Wang

IMECE2019-11577..... **V02BT02A049**
Development of Vision-Based Control System for Mobile 3D Printer
Pengji Duan, Yutong Liu, Junjun Ding, Mingshao Zhang

VARIATION SIMULATION AND DESIGN FOR ASSEMBLY

IMECE2019-10020..... **V02BT02A050**
Robust Design of Aero-Engine Assembly Using Taguchi Method Based on Jacobian-
Torsor Model
Siyi Ding, Xiaohu Zheng, Jinsong Bao, Jie Zhang

IMECE2019-10231..... **V02BT02A051**
Boolean Algebra-Based Dimensional Error Accumulation in Solid and Fluid Domain
for Turbines
Jun Ni, Yu Sun, Kai Wu

IMECE2019-10285..... **V02BT02A052**
Non-Rigid Variation Simulation for Ready-to-Assemble Furniture
Kristina Warmefjord, Rikard Soderberg, Lars Lindkvist, Andreas Dagman

IMECE2019-10294..... **V02BT02A053**
Low-Order Representation of Manufacturing Variations Based on B-Spline Morphing
Jose Urbano, Dieter Bestle, Ulf Gerstberger, Peter Flassig

IMECE2019-10306..... **V02BT02A054**
Anisotropy Oriented Tolerance Analysis of Composite Assembly With T-Maps Method
Hua Wang, Chen Yan, Junyang Yu

IMECE2019-10539..... **V02BT02A055**
Deck Lid Surround Fit Correlation Study Between Dimensional Variation Simulation
and Physical Vehicle
Han Zhongwu, Hu Min, Ma Zhenhai, Niu Xiaoxu, Cao Ni

IMECE2019-10566..... **V02BT02A056**
Enabler Study for Plan View Outline Styling of Front End Based on Variation
Simulation
Jin Siyuan, Hu Min, Chen Yabin

IMECE2019-10635..... **V02BT02A057**
Simulation of Body Force Impact on the Assembly Process of Aircraft Parts
*Sergey Lupuleac, Aleksandr Smirnov, Maria Churilova, Julia Shinder, Nadezhda Zaitseva,
Elodie Bonhomme*

| | |
|--|--------------------|
| IMECE2019-10711 | V02BT02A058 |
| Definition and Evaluation of Induced Geometry for Design | |
| <i>Bryan Fischer, Edward Morse</i> | |
| IMECE2019-10843 | V02BT02A059 |
| Mutual Information-Based Sensing Optimization for In-Process Quality Inspection of Multi-Station Assembly Processes | |
| <i>Yinhua Liu, Xiaolei Hu, Xiaowei Yue</i> | |
| IMECE2019-10871 | V02BT02A060 |
| Equilibrium Equations of Incremental Forces and its Application in Assembly Variation Analysis of Compliant Structures | |
| <i>Zhihua Niu, Zhimin Li, Sun Jin, Xinxin Li</i> | |
| IMECE2019-11060 | V02BT02A061 |
| Variation Analysis for Composite Parts With Considering Local Delamination Defects | |
| <i>Jinyu Liu, Zhimin Li, Tao Liu, Xinxin Li</i> | |
| IMECE2019-11225 | V02BT02A062 |
| A Knowledge-Based Engineering Workbench for Automated Tolerance Specification | |
| <i>Christopher Sauer, Bjoern Heling, Simon Schmutzler, Benjamin Schleich</i> | |
| IMECE2019-11251 | V02BT02A063 |
| Barriers for Virtual Assessment of Structural Robustness | |
| <i>Tim Brix Nerenst, Martin Ebro, Morten Nielsen, Tobias Eifler, Kim Lau Nielsen</i> | |
| IMECE2019-11328 | V02BT02A064 |
| Consideration and Impact Assessment of Measurement Uncertainty in the Context of Tolerance Analysis | |
| <i>Bjorn Heling, Andreas Michael Muller, Benjamin Schleich, Tino Hausotte, Sandro Wartzack</i> | |