

Proceedings of the ASME

**INTERNATIONAL DESIGN ENGINEERING TECHNICAL
CONFERENCES & COMPUTERS AND INFORMATION IN
ENGINEERING CONFERENCE
- 2020 -**

VOLUME 2

**16TH INTERNATIONAL CONFERENCE ON MULTIBODY
SYSTEMS, NONLINEAR DYNAMICS, AND CONTROL
(MSNDC 2020)**

presented at

ASME 2020 INTERNATIONAL DESIGN ENGINEERING TECHNICAL CONFERENCES &
COMPUTERS AND INFORMATION IN ENGINEERING CONFERENCE

AUGUST 17-19, 2020

ONLINE

sponsored by

DESIGN ENGINEERING DIVISION AND COMPUTERS AND INFORMATION IN
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. 978-0-7918-8391-4

© 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

16TH INTERNATIONAL CONFERENCE ON MULTIBODY SYSTEMS, NONLINEAR DYNAMICS, AND CONTROL (MSNDC 2020)

COMPUTATIONAL METHODS IN MULTIBODY SYSTEMS AND NONLINEAR DYNAMICS

DETC2020-22034	V002T02A001
The Adjoint Gradient Method for Time-Optimal Control of a Moon Landing: Ascent, Descent, and Abort <i>Philipp Eichmeir, Karin Nachbagauer, Wolfgang Steiner</i>	
DETC2020-22189	V002T02A002
A Novel Single-Step Unconditionally Stable Numerical Integration Scheme With Tunable Algorithmic Dissipation <i>Huimin Zhang, Runsen Zhang, Andrea Zaroni, Pierangelo Masarati</i>	
DETC2020-22230	V002T02A003
Lyapunov Perron Transformation for Linear Quasi-Periodic Systems <i>Susheelkumar C. Subramanian, Sangram Redkar, Peter Waswa</i>	
DETC2020-22261	V002T02A004
Explicit Time Integration of Multibody Systems Modelled With Three Rotation Parameters <i>Stefan Holzinger, Johannes Gerstmayr</i>	
DETC2020-22336	V002T02A005
DynManto: A Matlab Toolbox for the Simulation and Analysis of Multibody Systems <i>Alexander Held, Ali Moghadasi, Robert Seifried</i>	
DETC2020-22385	V002T02A006
A Two-Stage Extension of the Generalized-[alpha] Method for Constrained Systems in Mechanics <i>Laurent O. Jay, Brice Ch. Merwine, Hiroyuki Sugiyama, Hiroki Yamashita</i>	
DETC2020-22393	V002T02A007
Building Block Based Topology Synthesis Algorithm to Optimize the Natural Frequency Flexure Mechanisms <i>Mathijs E. Fix, Dannis M. Brouwer, Ronald G. K. M. Aarts</i>	
DETC2020-22529	V002T02A008
Deep Learning of (Periodic) Minimal Coordinates for Multibody Simulations <i>Andrea Angeli, Frank Naets, Wim Desmet</i>	

DETC2020-22566..... **V002T02A009**
Mechanical System Modelling Using Physics-Based and Data-Based Subsystems
Siamak Arbatani, Jozsef Kovecses

DETC2020-22572..... **V002T02A010**
A Jupyter Notebook Environment for Multibody Dynamics
Aaron Gaut, Jonathan Cameron, Abhinandan Jain

DETC2020-22597..... **V002T02A011**
Data Driven Model Identification for a Chaotic Pendulum With Variable Interaction Potential
Melih C. Yesilli, Firas A. Khasawneh

CONTACT AND INTERFACE DYNAMICS

DETC2020-22258..... **V002T02A012**
Smooth/Non-Smooth Multibody Co-Simulation of a Particle Damper
Runsen Zhang, Huimin Zhang, Andrea Zannoni, Alessandro Tasora, Pierangelo Masarati

FLEXIBLE MULTIBODY DYNAMICS

DETC2020-22134..... **V002T02A013**
Finite Element Models for Flexible Cosserat Solids
Olivier A. Bauchau, Minghe Shan

DETC2020-22149..... **V002T02A014**
Modal Reduction Procedures for Flexible Multibody System Applications
Matteo Scapolan, Minghe Shan, Olivier A. Bauchau

DETC2020-22242..... **V002T02A015**
A Non-Prismatic Beam Element for the Optimization of Flexure Mechanisms
Koen Dwarshuis, Ronald Aarts, Marcel Ellenbroek, Dannis Brouwer

DETC2020-22255..... **V002T02A016**
Compliant Interface in Component Mode Synthesis
Pierangelo Masarati, Fanny Darbas, Israel Wander

DETC2020-22293..... **V002T02A017**
Consistent and Inertia-Shape-Integral-Free Invariants of the Floating Frame of Reference Formulation
Andreas Zwolfer, Johannes Gerstmayr

DETC2020-22494..... **V002T02A018**
Variational Principles for Non-Material Systems Within an Arbitrary Lagrangian Eulerian Description of Motion
Giuseppe Pennisi, Olivier Bauchau

DETC2020-22514..... **V002T02A019**
Modeling Considerations for Testing Full-Scale Offshore Wind Turbine Nacelles With
Hardware-in-the-Loop
Kirk Heinold, Meghashyam Panyam, Amin Bibo

MODELING, SIMULATION, AND VALIDATION OF VEHICLE DYNAMICS

DETC2020-22051..... **V002T02A020**
Controller Design and Road-Friendly Suspension Optimization: Half Vehicle Model
Vikas Prasad, P. Seshu, Dnyanesh N. Pawaskar

DETC2020-22066..... **V002T02A021**
Numerical Procedure for Non-Hertzian Wheel-Rail Contact Model Integrated in Quasi-
Steady Railway Vehicle Motion Solver
Takayuki Tanaka, Hiroyuki Sugiyama

DETC2020-22195..... **V002T02A022**
Multiscale Off-Road Mobility Simulation With Computational Load Balancing for
Lower-Scale Discrete-Element Models
*Guanchu Chen, Hiroki Yamashita, Yeefeng Ruan, Paramsothy Jayakumar, Hiroyuki
Sugiyama*

DETC2020-22461..... **V002T02A023**
Numerical and Experimental Bifurcation Analysis of Trailers
Hanna Zs. Horvath, Denes Takacs

DETC2020-22764..... **V002T02A024**
Finite Element Model for Prediction of Ground Vehicle Mobility Over Vegetation
Covered Terrains
Tamer Wasfy, Hatem Wasfy, Paramsothy Jayakumar, Srinivas Sanikommu

MOTION PLANNING, DYNAMICS, AND CONTROL

DETC2020-22033..... **V002T02A025**
Modified Model-Free Adaptive Predictive Control Applied to Vibration Reduction of
Mechanical Flexible Systems
Hoang Anh Pham, Dirk Soffker

DETC2020-22251..... **V002T02A026**
A Sliding-Mode Control Algorithm to Enhance In-Hand Motion Capabilities
Rajesh Kumar, Joyjit Mukherjee, Sudipto Mukherjee

DETC2020-22517..... **V002T02A027**
Comparison of Parallel Elastic and Series Elastic Configurations of Vertical Hopping
Spring Mass Model Controlled With Virtual Tuning of Damping
Sinan Sahin Candan, Uluc Saranli, Yigit Yazicioglu

DETC2020-22646..... **V002T02A028**
Recursive Newton-Euler Dynamics and Sensitivity Analysis for Robot Manipulator
With Revolute Joints
Shuvrodeb Barman, Yujiang Xiang

DETC2020-22702..... **V002T02A029**
Swarms of Aquatic Unmanned Surface Vehicles (USV), a Review From Simulation to
Field Implementation
Jamal Ansary, Jacob O'Donnell, Nashiyat Fyza, Brian Trease

NONLINEAR AND COMPUTATIONAL DYNAMICS ASPECTS IN BIOMECHANICS

DETC2020-22147..... **V002T02A030**
Towards Data-Driven Modeling of Pathological Tremors
Jiamin Wang, Sunit K. Gupta, Oumar Barry

DETC2020-22241..... **V002T02A031**
Invariant Manifolds in Human Joint Angle Analysis During Walking Gait
Sandesh G. Bhat, Thomas G. Sugar, Sangram Redkar

DETC2020-22304..... **V002T02A032**
Effects of Flight Controls and Cockpit Layout Design in Rotorcraft-Pilot Couplings: A
Computational Approach
Alessandro Cocco, Andrea Zaroni, Vincenzo Muscarello, Pierangelo Masarati

DETC2020-22407..... **V002T02A033**
Estimation of Reaction Time During Human Balancing on Rolling Balance Board
Based on Mechanical Models
Csenge A. Molnar, Tamas Insperger

DETC2020-22419..... **V002T02A034**
Modelling Stick Balancing by Applying Switching-Type Control
Dalma J. Nagy, Laszlo Bencsik, Tamas Insperger

NONLINEAR DYNAMICS OF SMART STRUCTURES AND SYSTEMS

DETC2020-22470..... **V002T02A035**
Dynamic Morphing of Elastic Plates via Principal Parametric Resonance
Andrea Arena, Walter Lacarbonara

DETC2020-22541..... **V002T02A036**
Nonlinear Dynamic Response of an Isolation System With Negative Stiffness and
Shape Memory-Based Damping
Andrea Salvatore, Biagio Carboni, Walter Lacarbonara

NONLINEAR DYNAMICS OF STRUCTURES

- DETC2020-22018**..... **V002T02A037**
Insight Into the Non Periodic Motion of the Knife Follower With a Polydyne Cam Mechanism
Louay S. Yousuf, Yaakob K. H. Dabool
- DETC2020-22036**..... **V002T02A038**
On Periodic Motions in a Periodically Driven van der Pol-Duffing Oscillator
Yeyin Xu, Albert C. J. Luo
- DETC2020-22176**..... **V002T02A039**
Period-3 Motions in a Parametrically Excited Inverted Pendulum
Albert C. J. Luo, Chuan Guo
- DETC2020-22233**..... **V002T02A040**
On the Dynamics of a Quadratic-Oscillator-Based, Infinite-Equilibrium System
Siyuan Xing, Albert C. J. Luo, Jianzhe Huang
- DETC2020-22392**..... **V002T02A041**
A Heterogeneous Model for Gait Analysis of the Lower-Limb and the Prosthesis Coupled System
Yang Lv, Hongbin Fang, Jian Xu, Qining Wang, Xiaoxu Zhang
- DETC2020-22524**..... **V002T02A042**
Unification of Poincare and Floquet Theory for Time Periodic Systems
Susheelkumar C. Subramanian, Sangram Redkar
- DETC2020-22565**..... **V002T02A043**
Experimental Study of Mullins Effect in Natural Rubber for Different Stretch Conditions
Elli Gkouti, Burak Yenigun, Krystof Jankowski, Aleksander Czekanski
- DETC2020-22712**..... **V002T02A044**
Period-1 to Period-2 Motions in a Discontinuous Oscillator
Siyu Guo, Albert C. J. Luo
- DETC2020-22715**..... **V002T02A045**
Vibration Suppression of a Harmonically Forced Oscillator Using a Passive Nonlinear Vibration Absorber
Bo Yu

OPTIMIZATION, SENSITIVITY ANALYSIS, AND UNCERTAINTY QUANTIFICATION IN DYNAMIC SYSTEMS

- DETC2020-22137**..... **V002T02A046**
Error Quantification in Dynamic Applications of Weakly Nonlinear Transducers
Lautaro Cilenti, Akobuije Chijioke, Nicholas Vlajic, Balakumar Balachandran

TIME-VARYING AND DELAY SYSTEMS

- DETC2020-22188**..... **V002T02A047**
Criticality of Hopf Bifurcation in Precision Motion Stage With PID and Time-Delayed
Feedback Controls
Sunit K. Gupta, Jiamin Wang, Oumar R. Barry
- DETC2020-22362**..... **V002T02A048**
Collocated Position Control of Oscillatory System in Presence of Delay
Bence Szakasz, Gabor Stepan
- DETC2020-22387**..... **V002T02A049**
Bifurcation Analysis of a Lane Keeping Controller With Feedback Delay
Illes Voros, Denes Takacs