

**Proceedings of ASME 2021
International Design Engineering
Technical Conferences and
Computers and Information in
Engineering Conference**

(IDETC-CIE2021)

Volume 8A

**45TH MECHANISMS AND ROBOTICS
CONFERENCE (MR)**

**August 17-19, 2021
Virtual, Online**

Conference Sponsors
Design Engineering Division

Computers and Information
in Engineering Division

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/journalguidelines/rights-and-permissions>

ISBN: 978-0-7918-8544-4

CONTENTS

Proceedings of ASME 2021 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference IDETC-CIE2021 Volume 8A

45TH MECHANISMS AND ROBOTICS CONFERENCE (MR)

Compliant Mechanisms (A. Midha Symposium)

DETC2021-67371	V08AT08A001
Design of a New Piezoelectrically Actuated Compliant Microgripper With High Area Usage Efficiency <i>Zekui Lyu and Qingsong Xu</i>	
DETC2021-67642	V08AT08A002
Local Redesign for Additive Manufacturability of Compliant Mechanisms Using Topology Optimization <i>Stijn Koppen, Emma Hoes, Matthijs Langelaar, and Mary I. Frecker</i>	
DETC2021-67948	V08AT08A003
Design of a Triple Crossed Flexure Pivot With Minimized Parasitic Shift <i>E. Thalmann and S. Henein</i>	
DETC2021-68104	V08AT08A004
Conceptual Design of a Compliant Hip Orthosis for Trendelenburg Gait <i>P. Vugts, J. Rommers, Bram T. Sterke, and J. L. Herder</i>	
DETC2021-68169	V08AT08A005
Design and Analysis of Flexible Continuum Robot Based on Origami and Mortise-Tenon Structure (FCRBOM) <i>Yue Yu, Lifang Qiu, Decheng Wang, and Jing Zou</i>	
DETC2021-68255	V08AT08A006
Modelling the Axis Drift of Short Wire Flexures and Increasing Their Support Stiffness Using Polymers <i>Boris Daan, Jelle Rommers, and Just L. Herder</i>	
DETC2021-68366	V08AT08A007
Design and Analysis of a Contact-Aided Variable Stiffness Flexure Hinge (CVSFH) <i>Shenyuan Dai, Lifang Qiu, Qichao Chen, and Yanlin Li</i>	
DETC2021-68415	V08AT08A008
Variable Stiffness Design and Analysis of Flexure Hinge Based on ID-LEJ <i>Yanlin Li, Lifang Qiu, Kang Zhou, and Chongxiang Li</i>	
DETC2021-68421	V08AT08A009
A Compliant Micromechanism for Biaxially Stretching Biological Cells <i>Neeraj Singh Fartyal, Himanshu Marwah, and Sreenath Balakrishnan</i>	
DETC2021-68439	V08AT08A010
Effect of Matching Buckling Loads on Post-Buckling Behavior in Compliant Mechanisms <i>A. Numić, T. W. A. Blad, and F. van Keulen</i>	
DETC2021-69028	V08AT08A011
Nonlinear Analysis of a Class of Inversion-Based Compliant Cross-Spring Pivots <i>Shiyao Li, Guangbo Hao, Yingyue Chen, Jiaxiang Zhu, and Giovanni Berselli</i>	
DETC2021-69032	V08AT08A012
A Mirror-Symmetrical XY Compliant Parallel Manipulator With Improved Performances Without Increasing the Footprint <i>Jiaxiang Zhu, Guangbo Hao, Shiyao Li, Shuwen Yu, and Xianwen Kong</i>	

DETC2021-69340	V08AT08A013
A Flexure-Based Displacement Reducer Capable of Achieving Very Large Reduction Ratio	
<i>Houqi Wu and Guimin Chen</i>	
DETC2021-69688	V08AT08A014
Design and Actuation of a Skeleton for a Robotic Fish	
<i>Dina Joy K. Abulon, Jiaji Li, and J. Michael McCarthy</i>	
DETC2021-69726	V08AT08A015
Design of a Monolithic Constant-Force Compliant Mechanism for Extended Range of Motion and Minimal Force Variation	
<i>Ching-Wei Lo, Yuan Chang, Mien-Li Wang, Cian-Ru Lin, and Jyh-Jone Lee</i>	
DETC2021-69826	V08AT08A016
Programmable Stiffness and Applications of 3D Printed TPU Grid Lattices	
<i>Yifan Yuan and Cynthia Sung</i>	
DETC2021-69887	V08AT08A017
A Family of Novel Compliant Linear-Motion Mechanisms Based on Compliant Rolling-Contact Element Pivot	
<i>Tonglong Huo, Jingjun Yu, Hongzhe Zhao, and Xian Wei</i>	
DETC2021-69958	V08AT08A018
Constant Force Compliant Mechanisms Without Preloading	
<i>Premkumar Pujali and Hong Zhou</i>	
DETC2021-70068	V08AT08A019
A Novel Micro-Positioning Stage With Large-Stroke and Adjustable Stiffness	
<i>Zhijun Yang, Bingyu Cai, Ruiqi Li, Hao Peng, and Youdun Bai</i>	
DETC2021-70226	V08AT08A020
A Reconfigurable Variable-Stiffness Parallel Beam for Compliant Robotic Mechanisms Towards Safe Human Interaction	
<i>Jiaming Fu and Dongming Gan</i>	
DETC2021-70686	V08AT08A021
Methods for Shape Fitting in Morphing Compliant Mechanisms	
<i>Alden Yellowhorse, Jelle Rommers, Ali Amoozandeh, and Just L. Herder</i>	
DETC2021-71332	V08AT08A022
The Mixed-Body Model: A Method for Predicting Large Deflections in Stepped Cantilever Beams	
<i>Brandon S. Sargent, Collin R. Ynchausti, Todd G. Nelson, and Larry L. Howell</i>	
DETC2021-71756	V08AT08A023
Mechanical Characterization of Metal Additively Manufactured Contact Aided Cellular Compliant Mechanisms	
<i>Jivtesh B. Khurana and Mary Frecker</i>	
Mechanisms Synthesis and Analysis	
DETC2021-66762	V08AT08A024
Gravity Balancing Reliability and Sensitivity Analysis of Robotic Manipulators With Uncertainties	
<i>Vu Linh Nguyen, Chin-Hsing Kuo, and Po Ting Lin</i>	
DETC2021-67479	V08AT08A025
An Application of Graph Theory for the Detection of Degenerate Structures in Planetary Gear Trains	
<i>Essam L. Esmail and Anahed H. Juber</i>	
DETC2021-68528	V08AT08A026
Conceptual Configuration Synthesis of Line-Foldable Deployable Space Truss Structures Utilizing Graph Theory and Entropy	
<i>Shoufei Wang and Yong Zhao</i>	

DETC2021-68550	V08AT08A027
Potential Energy as Design Criterion in Planar Multistable Mechanisms <i>Edward J. Dold and Philip A. Voglewede</i>	
DETC2021-69202	V08AT08A028
A Pareto Front Mechanism Optimization for Controlling an Aircraft Using a Bio-Inspired Rotating Empennage <i>David H. Myszka, James J. Joo, and Andrew P. Murray</i>	
DETC2021-69279	V08AT08A029
Synthesis of Defect-Free Peaucellier Mechanism and Potential Implications for Energy Harvesting <i>Ali Almandeel, Abdulaziz Aladwani, and Hessein Ali</i>	
DETC2021-69971	V08AT08A030
Analysis and Synthesis of Conical Coil Springs <i>Harshkumar Patel and Hong Zhou</i>	
DETC2021-70026	V08AT08A031
Kinematic Design of Deployable Structures With Low Actuation Requirements Based on Pop-Up Folding <i>Eduardo E. Montano and Edwin A. Peraza Hernandez</i>	
DETC2021-70160	V08AT08A032
On the Structural Constraint and Motion of 3-PRS Parallel Kinematic Machines <i>Hassen Nigatu, Yun Ho Choi, and Doik Kim</i>	
DETC2021-70378	V08AT08A033
Design and Kinematic Analysis of a Novel 2-DoF Closed-Loop Mechanism for the Actuation of Machining Robots <i>Angelica Ginnante, François Leborne, Stéphane Caro, Enrico Simetti, and Giuseppe Casalino</i>	
DETC2021-70723	V08AT08A034
A Comprehensive Numerical Study on the Number of Identifiable Kinematic Parameters of Parallel Mechanisms <i>Lingyu Kong, Genliang Chen, Guanyu Huang, Sumian Song, Anhuan Xie, and Dan Zhang</i>	
DETC2021-71314	V08AT08A035
The Redesign of a Recumbent Tricycle Using a Crank Rocker Mechanism to Increase Power Throughput in FES Cycling <i>Anthony L. Bazler, David H. Myszka, and Andrew P. Murray</i>	
DETC2021-71616	V08AT08A036
Type Synthesis of Long Symmetric Planar Shape-Morphing Mechanism Arrays <i>Craig Lusk</i>	
DETC2021-71629	V08AT08A037
Informed Latent Space Exploration for Image-Based Path Synthesis of Linkages <i>Shrinath Deshpande, Zhijie Lyu, and Anurag Purwar</i>	
DETC2021-71778	V08AT08A038
Design of a Planar Cable-Driven Parallel Crane Without Parasitic Tilt <i>Lionel Etienne, Philippe Cardou, Marceau Métillon, and Stéphane Caro</i>	
Medical and Rehabilitation Robotics	
DETC2021-67673	V08AT08A039
Multi-Keel Passive Prosthetic Foot Design Optimization Using the Lower Leg Trajectory Error Framework <i>Victor Prost, Heidi V. Peterson, and Amos G. Winter, V</i>	
DETC2021-67808	V08AT08A040
Fourier Analysis Guided Cable Actuator Design for Coordinated Walking Assistance <i>Chong Liu, Rand Hidayah, and Sunil Agrawal</i>	

DETC2021-68538	V08AT08A041
Kinematic Synthesis of Gait Correction for a Rehabilitation Machine <i>Zvonimir Pusnik, Carl A. Nelson, Judith M. Burnfield, and Thad W. Buster</i>	
DETC2021-69087	V08AT08A042
Autonomous Robotic Subcutaneous Injection Under Near-Infrared Image Guidance <i>Dingliang Huang, Bin Hu, Yinna Chen, Yu Chen, Liangchen Sui, Zhaoyang Wang, Yijun Jiang, Zhongyuan Ren, Yuxuan Wang, Xu Cao, and Peng Qi</i>	
DETC2021-69203	V08AT08A043
Myoelectric Control of Robotic Leg Prostheses and Exoskeletons: A Review <i>Ali Nasr, Brokoslaw Laschowski, and John McPhee</i>	
DETC2021-69353	V08AT08A044
Application of a Customized Optical Force Sensor to a Cable-Driven Leg Exoskeleton <i>Jiaxu Huang, Rand Hidayah, Sunil Agrawal, Jorge A. Diez, and Nicolas García-Aracil</i>	
DETC2021-70009	V08AT08A045
Gait Prediction and Mechanism Design for 1-DOF Lower Limb Rehabilitation Devices Based on Machine Learning <i>Wanbing Song, Yating Zhang, Zhaojie Ge, and Ping Zhao</i>	
DETC2021-71549	V08AT08A046
Development and Characterization of a Modular Soft Actuator Enabled Elbow Exoskeleton for Assistive Movements <i>Veysel Erel, Inderjeet Singh, Alexandra R. Lindsay, W. Y. Shi, and Muthu B. J. Wijesundara</i>	

Mobile Robotics

DETC2021-66902	V08AT08A047
A Novel Approach With Bayesian Networks to Multi-Robot Task Allocation in Dynamic Environments <i>Ching-Wei Chuang and Harry H. Cheng</i>	
DETC2021-69800	V08AT08A048
Comparison of Neural Network-Based Pose Estimation Approaches for Mobile Manipulation <i>Arindam B. Chowdhury, Juncheng Li, and David J. Cappelleri</i>	