

2019 12th International Symposium on Linear Drives for Industry Applications (LDIA 2019)

**Neuchatel, Switzerland
1 – 3 July 2019**



**IEEE Catalog Number: CFP1986V-POD
ISBN: 978-1-5386-5805-5**

**Copyright © 2019 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP1986V-POD
ISBN (Print-On-Demand):	978-1-5386-5805-5
ISBN (Online):	978-1-5386-5804-8

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
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

TABLE OF CONTENTS

RAPID CO-KRIGING BASED MULTI-FIDELITY SURROGATE ASSISTED PERFORMANCE OPTIMIZATION OF A TRANSVERSE FLUX PMLSM	1
<i>Salman Ahmed ; Takafumi Koseki ; Kunihiko Norizuki ; Yasuaki Aoyama</i>	
ELECTRIC DRIVE TRAIN DESIGN FOR WAVE ENERGY CONVERTERS	7
<i>Nick J. Baker ; A. Almoraya ; M. A. H. Raihan ; S. McDonald ; V. Pickert</i>	
DESIGN PRINCIPLE FOR LINEAR ELECTRICAL MACHINES TO MINIMIZE POWER LOSS IN PERIODIC MOTIONS	13
<i>Sebastian Benecke ; Andreas Gerlach ; Roberto Leidhold</i>	
TRENDS IN SUPERCONDUCTING LINEAR ELECTRIC MACHINES	19
<i>M. Bianchetti ; B. J. H. De Bruyn ; D. C. J. Krop ; E. A. Lomonova</i>	
A REVIEW OF INTEGRATED PROPULSION, SUSPENSION AND GUIDANCE PASSIVE GUIDEWAY MAGLEV TECHNOLOGIES	25
<i>Jonathan Z. Bird</i>	
SENSORLESS CONTROL OF A LINEAR GENERATOR FOR ENERGY HARVESTING APPLICATIONS	31
<i>Alexey Bodrov ; Min Zhang ; Roger Shuttleworth ; Matteo F. Iacchetti</i>	
ANALYSIS OF END POLE SIZING EFFECTS IN LINEAR PERMANENT MAGNET SYNCHRONOUS ACTUATORS WITH QUASI-HALBACH ARRAYS	37
<i>Ben Hur B. Boff ; Rodrigo B. Tavares ; Aly F. Flores Filho ; Paulo R. Eckert</i>	
MODIFIED H-LSM FOR URBAN MAGLEVS	43
<i>I. Boldea ; L. N. Tutelea ; X. Xiao ; I. Torac ; W. Xu</i>	
GLOBAL OPTIMIZATION DESIGN OF A LINEAR OSCILLATING MOTOR BASED ON KRIGING SURROGATE MODEL	49
<i>Lixiao Bu ; Jinhua Du</i>	
DESIGN OF DOUBLE SIDED LINEAR MOTOR WITH EASY TO MANUFACTURE HAIRPIN PLATE WINDING	54
<i>Gökhan Çakal ; Ozan Keysan</i>	
DESIGN OF A LINEAR PERMANENT MAGNET TRANSVERSE FLUX MOTOR FOR NEEDLE-FREE JET INJECTION	59
<i>Nick N. L. Do ; Andrew J. Taberner ; Bryan P. Ruddy</i>	
COMPARISON ANALYSIS OF CYLINDRICAL AND RECTANGULAR LINEAR PERMANENT MAGNET TRANSVERSE-FLUX MACHINES FOR WAVE ENERGY APPLICATIONS	65
<i>Oleksandr Dobzhanskyi</i>	
A PROPOSAL FOR PRECISION POSITIONING CONTROL OF LINEAR INDUCTION MOTOR USING NONLINEAR FRICTION COMPENSATION AND HIGH-ORDER DISTURBANCE OBSERVER	70
<i>S. Egashira ; T. Nakagawa</i>	
SENSORLESS DIRECT THRUST CONTROL OF A LINEAR INDUCTION MOTOR BASED ON MRAS	76
<i>Mahmoud F. Elmorshedy ; Wei Xu ; Yi Liu ; Said M. Allam ; Mosaad M. Ali ; Minghai Dong</i>	
INFLUENCE OF EDDY CURRENT LOSSES IN THE OPTIMIZATION OF LINEAR CORELESS BLDC MOTORS WITH PCB WINDINGS	82
<i>Guillaume François ; François Baudart ; Bruno Dehez</i>	
MODELING OF INTEGRATED EDDY CURRENT DAMPING RINGS FOR A TUBULAR ELECTROMAGNETIC SUSPENSION SYSTEM	88
<i>L. A. J. Friedrich ; B. L. J. Gysen ; E. A. Lomonova</i>	
DESIGN OF A HIGH-TEMPERATURE LINEAR ELECTROMAGNETIC ACTUATOR	92
<i>Jacek F. Gieras</i>	
A ROTOR POSTURE MEASUREMENT SYSTEM BY ANALYZING SENSED MAGNETIC FIELD FROM ARRAYED HALL SENSORS	97
<i>Akio Gofuku ; Naoto Yokomitsu ; Tomoaki Yano ; Nagayoshi Kasashima</i>	
NON-CONTACT CONVEYANCE EXPERIMENTS FOR A STEEL PLATE UNDER LEVITATION AND GUIDANCE CONTROL WITHOUT USING GAP SENSORS AND SIDESLIP SENSORS	102
<i>Nao Harigaya ; Ikuto Oikawa ; Toshiko Nakagawa</i>	
A MAGNETIC LEAD SCREW WITH VARIABLE STIFFNESS MECHANISM	108
<i>Akira Heya ; Yoshihiro Nakata ; Katsuhiro Hirata ; Hiroshi Ishiguro</i>	

BANDWIDTH IMPROVEMENTS OF LINEAR DIRECT DRIVES WITH A 100 KHZ PWM-FREQUENCY	112
<i>Julia Höllthaler ; Rainer Hagl ; Ralph Kennel</i>	
INVESTIGATION OF MAGNETIC PERFORMANCE ON THE CYLINDER-SHAPED PM TYPE LINEAR HALBACH ARRAY ASSEMBLED BY 45 DEGREE ROTATING ARRANGEMENT	118
<i>Toshiki Itasaka ; Yuki Ishiguro ; Kota Shinozaki ; Jun Watanabe ; Daichi Wakamatsu ; Atsushi Ito ; Haruhiko Suzuki</i>	
INCLINATION CONTROL OF THE CARRIER IN THE MAGNETICALLY LEVITATED CONVEYANCE SYSTEM USING THE LINEAR STEPPER MOTOR	122
<i>Kota Ito ; Junichiro Yoshida ; Ibuki Watano ; Shunsuke Ohashi</i>	
DYNAMIC ANALYSIS OF A TUBULAR GENERATOR FOR AUTOMOTIVE SUSPENSION APPLICATIONS	127
<i>M. Kleijer ; L. A. J. Friedrich ; B. L. J. Gysen ; E. A. Lomonova</i>	
TECHNICAL EFFORTS FOR ENERGY-SAVING OPERATION OF LINEAR METROS IN JAPAN	132
<i>Takafumi Koseki ; Shota Miyoshi ; Takeshi Mizuma ; Shoichiro Watanabe ; Eisuke Isobe ; Jun Kawashita</i>	
EXPERIMENTAL STUDY OF THERMAL BEHAVIOR OF TUBULAR LINEAR MACHINES	137
<i>Habibou Lawali Ali ; Yacine Amara ; Jorge Peixinho ; Georges Barakat ; Nicolas Ziegler</i>	
A LIB4 PIEZOELECTRIC ULTRASONIC LINEAR MICROMOTOR USING A FULL SYMMETRY STATOR	143
<i>Chaodong Li ; Lexian Li</i>	
INVESTIGATION OF LINEAR GENERATOR FOR HIGH SPEED MAGLEV TRAIN BY 2D FINITE ELEMENT MODEL	147
<i>Longxiang Li ; Qinfen Lu</i>	
A NEW CONCEPT STRUCTURE OF THE PROPULSION SYSTEM FOR A MEDIUM SPEED MAGLEV SYSTEM - SIMULATION AND ANALYSIS	153
<i>Ying Lin ; Xiaohua Wang ; Feng Qin ; Yu Jin ; Diqiang Lu ; Fei Ni</i>	
A HIGH FORCE DENSITY LINEAR ACTUATOR FOR ACTIVE SUSPENSION	157
<i>Zhengmeng Liu ; Jiabin Wang</i>	
THE INFLUENCE OF THE SECONDARY THICKNESS ON THE AIR-GAP MAGNETIC FELID AND LOSSES OF THE LINEAR INDUCTION MOTOR	163
<i>Gang Lyu ; Tong Zhou ; Dihui Zeng</i>	
IMPROVED MODELLING OF A MONOMORPH PIEZOELECTRIC ACTUATOR FOR LINEAR SELF-SENSING APPLICATIONS	167
<i>Louis Masson ; Yves Perriard</i>	
MULTI-OBJECTIVE OPTIMISATION METHODOLOGY FOR SELF-SENSING PIEZOELECTRIC MONOMORPH BENDERS	173
<i>Louis Masson ; Yves Perriard</i>	
DESIGN AND COMPARISON OF PERMANENT MAGNET SELF-BEARING LINEAR-ROTARY ACTUATORS	179
<i>Spasoje Miric ; Dominik Bortis ; Johann Walter Kolar</i>	
MULTIFUNCTIONAL Z ACTUATOR WITH AN ADJUSTABLE BUILT-IN GRAVITY COMPENSATOR FOR HIGH PRECISION SYSTEMS	185
<i>Manish Mittal ; Valerio Tamellini ; Alessandro Fasolo ; Gorka Galdos ; Sylwia Szczukiewicz</i>	
THREE-DIMENSIONAL CONTROL OF AN IRON BALL BY FLUX-PATH CONTROL MECHANISMS LOCATED AROUND MAGNETIC SOURCE	191
<i>Takeshi Mizuno ; Naoki Ishibashi ; Yuji Ishino ; Daisuke Yamaguchi ; Masaya Takasaki</i>	
A STUDY OF TRANSLATOR LENGTH IN A TUBULAR LINEAR ELECTRICAL MACHINE DESIGNED FOR USE IN A LINEAR COMBUSTION JOULE ENGINE	196
<i>Ramin M. Korbekandi ; Nick J. Baker ; Dawei Wu</i>	
DESIGN AND SIMULATION OF A DOUBLE-MOVER TUBULAR LINEAR INDUCTION MOTOR FOR HIGH THRUST FORCE	202
<i>Valentina Consolo ; Antonino Musolino ; Rocco Rizzo ; Luca Sani ; Claudia Simonelli</i>	
EXPERIMENTAL CONFIRMATION OF SPEED AND AIR GAP CONTROL WITH ONLY LINEAR INDUCTION MOTOR FOR LEVITATION	208
<i>Shota Nakatani ; Kenta Sannomiya ; Daichi Okamori ; Toshimitsu Morizane ; Noriyuki Kimura ; Hideki Omori</i>	
CONTROL OF THE LATERAL VIBRATION BY USING WEIGHT REDUCED DAMPER COIL ON SUPERCONDUCTING MAGNETICALLY LEVITATION BOGIE	213
<i>Shunsuke Ohashi ; Riki Nakakida ; Tomohiro Takeuchi</i>	
NONCONTACT MC TYPE ROTARY MOTOR USING LORENTZ FORCE AND WIRELESS POWER SUPPLY	218
<i>Koichi Oka ; Yuto Oguri ; Yusuke Kajisawa ; Akinori Harada</i>	

DEVELOPMENT OF A LINEAR MOTOR FOR URBAN MAGNETICALLY LEVITATED VEHICLES USING AN INNOVATIVE WORKBENCH TOPOLOGY	222
<i>Roberto André Henrique De Oliveira ; João Murta Pina ; Richard Magdalena Stephan ; Antônio Carlos Ferreira</i>	
BEARING-LESS FOUR-COIL OSCILLATORY LINEAR MOTOR	228
<i>Florian Poltschak</i>	
WINDING LAYOUT FOR ACTIVE BEARING FORCE REDUCTION IN TUBULAR LINEAR MOTORS	233
<i>Florian Poltschak ; Richard Thalhammer</i>	
PERFORMANCE MEASUREMENT OF AN ELECTROMAGNETIC FREE PISTON COMPRESSOR WITHOUT PERMANENT MAGNETS	239
<i>David Rafetseder ; Wolfgang Amrhein</i>	
LINEAR GENERATOR DESIGN FOR A FREE-PISTON ENGINE WITH HIGH FORCE DENSITY	245
<i>Henning Schillingmann ; Quirin Maurus ; Markus Henke</i>	
DESIGN AND ANALYSIS OF SURFACE PERMANENT MAGNET VERNIER LINEAR MOTOR BASED ON AIR GAP MAGNETIC FLUX DENSITY DISTRIBUTION	251
<i>Hyoseok Shi ; Noboru Niguchi ; Katsuhiro Hirata</i>	
ANALYSIS OF AN ELECTROMAGNETIC RAILGUN WITH TAPERED RAILS AND CONCAVE ARMATURE USING 3-D FEM	256
<i>S. R. Naga Praneeth ; Dipta Chaudhuri ; Bhim Singh ; Shouri Chatterjee ; G. Bhuvanewari</i>	
EXAMINATION OF A FREE-PISTON ENGINE LINEAR GENERATOR SYSTEM WITH OPPOSITE-SIDE COMBUSTION	260
<i>Tatsuki Suzuki ; Kaname Naganuma ; Masami Nirei ; Yuichiro Yamanaka ; Takumi Goto ; Mitsuhide Sato ; Yinggang Bu ; Tsutomu Mizuno</i>	
SLIDE PERFORMANCE OF MAGNETIC FIELD DISTRIBUTION BY USING CYLINDER-SHAPED PM TYPE LINEAR HALBACH ARRAY WITH SYNCHRONIZED ROTATION MECHANISM	266
<i>Haruhiko Suzuki ; Toshiki Itasaka ; Yuki Ishiguro ; Kota Shinozaki ; Jun Watanabe ; Daichi Wakamatsu ; Atsushi Ito</i>	
BASIC CHARACTERISTICS OF THE YOKE EQUIPPED ROTORS IN THE MAGNETIC BEARING USING HTS PINNING EFFECT	270
<i>S. Takimura ; S. Hiraoka ; T. Arai ; S. Ohashi</i>	
DESIGN ANALYSIS OF A SHAPE MEMORY ALLOY BIAS-SPRING LINEAR ACTUATOR	274
<i>Sean Thomas ; Morgan Almanza ; Yves Perriard</i>	
APPLICATION AND VALIDATION OF A LINEAR ELECTROMAGNETIC ACTUATOR WITHIN A HAPTIC PIANO KEY	279
<i>Sébastien Timmermans ; Quentin Desclée ; Guillaume Paillot ; Paul Fisette ; Bruno Dehez</i>	
VERIFICATION OF EFFECTIVENESS OF AN MRF SEMI-ACTIVE DAMPER USING A DOUBLE-CAGE STRUCTURE ELEVATOR SIMULATOR	285
<i>T. Torii ; K. Kawase ; T. Nakagawa</i>	
LINEAR ACTUATOR UTILIZING MAGNETIC SHAPE MEMORY MATERIAL	291
<i>Arda Tüysüz ; Sebastian Breisch ; Tim Molter</i>	
DESIGN OF A PERMANENT MAGNET-BIASED RELUCTANCE VALVE ACTUATOR WITH INTEGRATED EDDY CURRENT DAMPING	295
<i>J. R. M. Van Dam ; D. C. J. Krop ; B. L. J. Gysen ; E. A. Lomonova</i>	
TUNNEL-VISION ON ECONOMIC LINEAR PROPULSION?	301
<i>André Veltman ; Paul Van Der Hulst ; Marco Jonker ; Henk Polinder</i>	
A LOW-SPEED MAGLEV SPEED INCREASING PLAN BY ADOPTING 3000V DC POWER SUPPLY	307
<i>Xiaohua Wang ; Ying Lin ; Fei Ni ; Diqiang Lu</i>	
THE MULTI-OBJECTIVE OPTIMIZATION OF IRONLESS PERMANENT MAGNET LINEAR SYNCHRONOUS MACHINE WITH UNEQUAL HALBACH ARRAY	313
<i>Huihuang Wang ; Yumei Du ; Liming Shi ; Ruihuang Zhang ; Qiongquan Ge</i>	
TRACTION CONTROL OF MULTI-SECTION LONG PRIMARY IRONLESS LINEAR SYNCHRONOUS MOTOR FOR MAGLEV VEHICLE	317
<i>Ke Wang ; Zhuoyuan Deng ; Liming Shi ; Qiongquan Ge ; Yaohua Li</i>	
MULTIPHYSICS ANALYSIS OF TUBULAR LINEAR PERMANENT MAGNET SYNCHRONOUS MOTOR OPERATING IMMERSSED IN CRUDE OIL	321
<i>Yi Chen Wu ; Mateus Cirolini ; Thamy Cristina Hayashi ; Aline Zienniczak ; Eduardo Andre Perondi ; Paulo Roberto Eckert</i>	

WAVE FORCE SIMULATION OF DIRECT DRIVE WAVE ENERGY CONVERSION SYSTEM BASED ON SRM	327
<i>Kun Yang ; Jinhua Du ; Quanwei Liu</i>	
PROPOSAL OF A NOVEL TRANSFER DEVICE USING A LINEAR MOTOR IN PARALLEL SYNCHRONOUS OPERATION	331
<i>Kengo Yoshida ; Kenji Suzuki ; Hideo Dohmeki</i>	
COMPARISON OF TOROIDAL-WINDING LINEAR PM VERNIER MACHINES WITH TYPICAL LINEAR SYNCHRONOUS MACHINES IN ASPECT OF THRUST FORCE CHARACTERISTICS	337
<i>He Zhang ; Baoquan Kou ; Yi Shao ; Ronghai Qu</i>	
Author Index	