

2019 International Symposium on Multi-Robot and Multi-Agent Systems (MRS 2019)

**New Brunswick, New Jersey, USA
22 – 23 August 2019**



**IEEE Catalog Number: CFP19K19-POD
ISBN: 978-1-7281-2877-1**

**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:	CFP19K19-POD
ISBN (Print-On-Demand):	978-1-7281-2877-1
ISBN (Online):	978-1-7281-2876-4

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

ROS-CBT: COMMUNICATION BENCHMARKING TOOL FOR THE ROBOT OPERATING SYSTEM: EXTENDED ABSTRACT	1
<i>Kizito Masaba ; Alberto Quattrini Li</i>	
EXPERIMENTAL VALIDATION OF STABLE COORDINATION FOR MULTI-ROBOT SYSTEMS WITH LIMITED FIELDS OF VIEW USING A PORTABLE MULTI-ROBOT TESTBED- EXTENDED ABSTRACT	4
<i>Pratik Mukherjee ; Matteo Santilli ; Andrea Gasparri ; Ryan K. Williams</i>	
A HARDWARE AND SOFTWARE TESTBED FOR UNDERACTUATED SELF-ASSEMBLING ROBOTS: EXTENDED ABSTRACT	7
<i>Alexandra Nilles ; Justin Wasserman ; Austin Born ; Chris Horn ; John Born ; Steven M. Lavallo</i>	
EFFECTIVE HEURISTICS FOR MULTI-ROBOT PATH PLANNING IN WAREHOUSE ENVIRONMENTS	10
<i>Shuai D. Han ; Jingjin Yu</i>	
LLDM: LOCALLY LINEAR DISTANCE MAPS FOR ROBOT MOTION PLANNING: EXTENDED ABSTRACT	13
<i>Josiah Putman ; Lisa Oh ; Luyang Zhao ; Evan Honnold ; Galen Brown ; Weifu Wang ; Devin Balkcom</i>	
ON MINIMUM TIME MULTI-ROBOT PLANNING WITH GUARANTEES ON THE TOTAL COLLECTED REWARD	16
<i>Armin Sadeghi ; Ahmad Bilal Asghar ; Stephen L. Smith</i>	
DECENTRALIZED MULTIPLE MOBILE DEPOTS ROUTE PLANNING FOR REPLENISHING PERSISTENT SURVEILLANCE ROBOTS	23
<i>Yifan Ding ; Wenhao Luo ; Katia Sycara</i>	
COLLISION-AWARE TASK ASSIGNMENT FOR MULTI-ROBOT SYSTEMS	30
<i>Fang Wu ; Vivek Shankar Varadharajan ; Giovanni Beltrame</i>	
ANYTIME MULTI-ARM TASK AND MOTION PLANNING FOR PICK-AND-PLACE OF INDIVIDUAL OBJECTS VIA HANDOFFS	37
<i>Rahul Shome ; Kostas E. Bekris</i>	
COOPERATIVE CONTROL OF AN AUTONOMOUS FLOATING MODULAR STRUCTURE WITHOUT COMMUNICATION: EXTENDED ABSTRACT	44
<i>Wei Wang ; Luis Mateos ; Zijian Wang ; Kuan Wei Huang ; Mac Schwager ; Carlo Ratti ; Daniela Rus</i>	
TOWARDS A SCALABLE, SELF-RECONFIGURABLE ROBOT WITH COMPLIANT MODULES	47
<i>Steven Ceron ; Logan Horowitz ; Nialah Wilson ; Claire Chen ; Daniel Kim ; Kirstin Petersen</i>	
A SOFT-BODIED MODULAR RECONFIGURABLE ROBOTIC SYSTEM COMPOSED OF INTERCONNECTED KILOBOTS	50
<i>Federico Pratisoli ; Andrea Giovanni Reina ; Yuri Kaszubowski Lopes ; Lorenzo Sabattini ; Roderich Groß</i>	
A BIO-INSPIRED TRANSPORTATION NETWORK FOR SCALABLE SWARM FORAGING: EXTENDED ABSTRACT	53
<i>Qi Lu ; Melanie E. Moses</i>	
MONITORING ACCESS TO USER DEFINED AREAS WITH MULTI-AGENT TEAM IN URBAN ENVIRONMENTS	56
<i>Manas Gupta ; Ming C Lin ; Dinesh Manocha ; Huan Xu ; Michael Otte</i>	
MOBILE RADIATION SOURCE INTERCEPTION BY AERIAL ROBOT SWARMS	63
<i>Indrajeet Yadav ; Herbert G. Tanner</i>	
A FLEXIBLE NAVIGATION SUPPORT SYSTEM FOR A TEAM OF UNDERWATER ROBOTS	70
<i>Anwar Quraishi ; Alexander Bahr ; Felix Schill ; Alcherio Martinoli</i>	
TRAJECTORY PLANNING FOR THE SHAPESHIFTING OF AUTONOMOUS SURFACE VESSELS	76
<i>Banti Gheneti ; Shinkyu Park ; Ryan Kelly ; Drew Meyers ; Pietro Leoni ; Carlo Ratti ; Daniela Rus</i>	
DECENTRALIZED DYNAMIC TASK ALLOCATION IN SWARM ROBOTIC SYSTEMS FOR DISASTER RESPONSE: EXTENDED ABSTRACT	83
<i>Payam Ghassemi ; David Depauw ; Souma Chowdhury</i>	
MULTIROBOT SIMULTANEOUS PATH PLANNING AND TASK ASSIGNMENT ON GRAPHS WITH STOCHASTIC COSTS	86
<i>Fan Yang ; Nilanjan Chakraborty</i>	
SELF-REACTIVE PLANNING OF MULTI-ROBOTS WITH DYNAMIC TASK ASSIGNMENTS	89
<i>Qin Yang ; Zhiwei Luo ; Wenzhan Song ; Ramviyas Parasuraman</i>	

MULTI-AGENT PURSUIT-EVASION UNDER UNCERTAINTIES WITH REDUNDANT ROBOT ASSIGNMENTS: EXTENDED ABSTRACT	92
<i>Leiming Zhang ; Amanda Prorok ; Subhrajit Bhattacharya</i>	
SCHEDULING SPARE DRONES FOR PERSISTENT TASK PERFORMANCE WITH SEVERAL REPLACEMENT STATIONS - EXTENDED ABSTRACT	95
<i>Erez Hartuv ; Noa Agmon ; Sarit Kraus</i>	
ROBOTS THAT SYNC AND SWARM: A PROOF OF CONCEPT IN ROS 2	98
<i>Agata Barcis ; Michal Barcis ; Christian Bettstetter</i>	
A MINIMALISTIC APPROACH TO SEGREGATION IN ROBOT SWARMS	105
<i>Peter Mitrano ; Jordan Burklund ; Michael Giancola ; Carlo Pinciroli</i>	
DISTRIBUTED ALGORITHM FOR SELECTING LEADERS FOR SUPERVISORY ROBOTIC SWARM CONTROL	112
<i>Michal A. Lewkowicz ; Rohil Agarwal ; Nilanjan Chakraborty</i>	
THE ROBOTIC SWARM CONTAMINATION PROBLEM	119
<i>Sapir Avrahami ; Noa Agmon</i>	
COMMUNICATION THROUGH MOTION: LEGIBILITY OF MULTI-ROBOT SYSTEMS	126
<i>Beatrice Capelli ; Cristian Secchi ; Lorenzo Sabattini</i>	
COMPUTATIONAL AND STRUCTURAL ADVANTAGES OF PAIRWISE FLOCKING	133
<i>Geoff Nagy ; Alex Thornton ; Hangjian Ling ; Guillam McIvor ; Nicholas T. Ouellette ; Richard Vaughan</i>	
NON-UNIFORM POLICIES FOR MULTI-ROBOT ASYMMETRIC PERIMETER PATROL IN ADVERSARIAL DOMAINS - EXTENDED ABSTRACT	136
<i>Yaniv Oshart ; Noa Agmon ; Sarit Kraus</i>	
DECENTRALISED SELF-ORGANISING MAPS FOR THE ONLINE ORIENTEERING PROBLEM WITH NEIGHBOURHOODS	139
<i>Graeme Best ; Geoffrey A. Hollinger</i>	
TOWARDS AN ONLINE APPROACH FOR KNOWLEDGE COMMUNICATION PLANNING: EXTENDED ABSTRACT	142
<i>Nikolaos Tsiogkas ; David M. Lane</i>	
MEMORY-BASED MULTIAGENT ONE-SHOT LEARNING: EXTENDED ABSTRACT	145
<i>Shauharda Khadka ; Connor Yates ; Kagan Tumer</i>	
VORONOI-BASED COVERAGE CONTROL WITH CONNECTIVITY MAINTENANCE FOR ROBOTIC SENSOR NETWORKS	148
<i>Wenhao Luo ; Katia Sycara</i>	
DECENTRALIZED MINIMUM-ENERGY COVERAGE CONTROL FOR TIME-VARYING DENSITY FUNCTIONS	155
<i>María Santos ; Siddharth Mayya ; Gennaro Notomista ; Magnus Egerstedt</i>	
B-UAVC: BUFFERED UNCERTAINTY-AWARE VORONOI CELLS FOR PROBABILISTIC MULTI-ROBOT COLLISION AVOIDANCE	162
<i>Hai Zhu ; Javier Alonso-Mora</i>	
DISTRIBUTED COLLISION AVOIDANCE OF MULTIPLE ROBOTS WITH PROBABILISTIC BUFFERED VORONOI CELLS	169
<i>Mingyu Wang ; Mac Schwager</i>	
DECENTRALIZED NONLINEAR MODEL PREDICTIVE CONTROL FOR 3D FORMATION OF MULTIROTOR MICRO AERIAL VEHICLES WITH RELATIVE SENSING AND ESTIMATION	176
<i>I. Kagan Erunsal ; Alcherio Martinoli ; Rodrigo Ventura</i>	
MULTI-ROBOT CONTROL USING COVERAGE OVER TIME-VARYING DOMAINS: EXTENDED ABSTRACT	179
<i>Xiaotian Xu ; Yancy Diaz-Mercado</i>	
OPTIMAL POLICIES FOR ROUTING MULTI SENSOR-EFFECTOR COMBINED AUTONOMOUS DEVICES	182
<i>Yura Oh ; Warren B. Powell</i>	
OPTIMIZED MOTION STRATEGY FOR ACTIVE TARGET LOCALIZATION OF MOBILE ROBOTS WITH TIME-VARYING CONNECTIVITY: EXTENDED ABSTRACT	185
<i>Liang Zhang ; Zexu Zhang ; Roland Siegwart ; Jen Jen Chung</i>	
INFORMATIVE PATH PLANNING WITH LOCAL PENALIZATION FOR DECENTRALIZED AND ASYNCHRONOUS SWARM ROBOTIC SEARCH	188
<i>Payam Ghassemi ; Souma Chowdhury</i>	
DECENTRALIZED MULTI-FLOOR EXPLORATION BY A SWARM OF MINIATURE ROBOTS TEAMING WITH WALL-CLIMBING UNITS	195
<i>Jabez L. Kit ; Audelia G. Dharmawan ; David Mateo ; Shaohui Foong ; Gim Song Soh ; Roland Bouffanais ; Kristin L. Wood</i>	

MAP MERGING OF ORIENTED TOPOLOGICAL SEMANTIC MAPS	202
<i>Jose Luis Susa Rincon ; Stefano Carpin</i>	
DIRICHLET-MULTINOMIAL COUNTERFACTUAL REWARDS FOR HETEROGENEOUS MULTIAGENT SYSTEMS	209
<i>Gaurav Dixit ; Nicholas Zerbel ; Kagan Tumer</i>	
AN APPROXIMATION ALGORITHM FOR DISTRIBUTED RESILIENT SUBMODULAR MAXIMIZATION: EXTENDED ABSTRACT	216
<i>Lifeng Zhou ; Pratap Tokekar</i>	
DATA-EFFICIENT DECENTRALIZED PLACE RECOGNITION WITH 3D CONSTELLATIONS OF OBJECTS: EXTENDED ABSTRACT	219
<i>Benjamin Ramtoula ; Ricardo De Azambuja ; Giovanni Beltrame</i>	
FITNESS CRITICS FOR MULTIAGENT LEARNING: EXTENDED ABSTRACT	222
<i>Golden Rockefeller ; Patrick Mannion ; Kagan Tumer</i>	
TRAFFIC MANAGEMENT STRATEGIES FOR MULTI-ROBOTIC RIGID PAYLOAD TRANSPORT SYSTEMS: EXTENDED ABSTRACT	225
<i>Yahnit Sirineni ; Pulkit Verma ; Kamalakar Karlapalem</i>	
TRANSPORTATION OF DEFORMABLE PAYLOAD THROUGH STATIC AND DYNAMIC OBSTACLES USING LOOSELY COUPLED NONHOLONOMIC ROBOTS	228
<i>Subhasis Chand ; Pulkit Verma ; Rahul Tallamraju ; Kamalakar Karlapalem</i>	
PASSIVITY-BASED DECENTRALIZED CONTROL OF MULTI-ROBOT SYSTEMS WITH DELAYS USING CONTROL BARRIER FUNCTIONS	231
<i>Gennaro Notomista ; Xiaoyi Cai ; Junya Yamauchi ; Magnus Egerstedt</i>	
A REINFORCEMENT LEARNING APPROACH TO MULTI-ROBOT PLANAR CONSTRUCTION	238
<i>Caroline Strickland ; David Churchill ; Andrew Vardy</i>	
DECENTRALIZED GATHERING OF STOCHASTIC, OBLIVIOUS AGENTS ON A GRID: A CASE STUDY WITH 3D M-BLOCKS	245
<i>Anil Özdemir ; John W. Romanishin ; Roderich Groß ; Daniela Rus</i>	
COMPARATIVE ANALYSIS OF SENSORS IN RIGID AND DEFORMABLE MODULAR ROBOTS FOR SHAPE ESTIMATION	252
<i>Steven Ceron ; Nialah Wilson ; Logan Horowitz ; Kirstin Petersen</i>	
Author Index	