

# **2020 21st IEEE International Conference on Mobile Data Management (MDM 2020)**

**Versailles, France  
30 June – 3 July 2020**



IEEE Catalog Number: CFP20299-POD  
ISBN: 978-1-7281-4664-5

**Copyright © 2020 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:	CFP20299-POD
ISBN (Print-On-Demand):	978-1-7281-4664-5
ISBN (Online):	978-1-7281-4663-8
ISSN:	1551-6245

**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](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# **2020 21st IEEE International Conference on Mobile Data Management (MDM)**

# **MDM 2020**

## **Table of Contents**

Message from the General Chairs .....	xiv
Message from the Program Chairs .....	xv
Message from the Industry Track Chairs .....	xvii
Message from the Demonstration Track Chairs .....	xviii
Message from the Workshops Chairs .....	xix
Message from the Ph.D. Workshop Chairs .....	xx
Message from the MBDW'20 Workshop Chairs .....	xi
Message from the Mobisocial'20 Workshop Chairs .....	xxii
Message from the 3SCity-E2C'20 Workshop Chairs .....	xxiii
Sponsors and Supporters .....	xxiv
Organizing Committee .....	xxv
Program Committee .....	xxvii
Workshop Committees .....	xxix
External Reviewers .....	xxx
Keynotes .....	xxxii

## **Panel**

COVID-19 Mobile Contact Tracing Apps (MCTA): A Digital Vaccine or a Privacy Demolition? .....	1
<i>Demetrios Zeinalipour-Yazti (University of Cyprus) and Christophe Claramunt (Naval Academy Research Institute, French Naval Academy)</i>	

## **Advanced Seminar**

Managing Uncertainty in Evolving Geo-Spatial Data .....	5
<i>Andreas Züfle (George Mason University), Goce Trajcevski (Iowa State University), Dieter Pfoser (George Mason University), and Joon-Seok Kim (George Mason University)</i>	

## Research Track

### Research Session 1: Fingerprint Positioning

A New Similarity Measure for Low-Sampling Cellular Fingerprint Trajectories .....	9
<i>Paolo Gallo (University of Udine, Italy), Donatella Gubiani (University of Nova Gorica, Slovenia), Angelo Montanari (University of Udine, Italy), and Nicola Saccamanno (University of Udine, Italy)</i>	
IFLoc: Indoor Height Estimation by Telco Data .....	19
<i>Jinhua Lv (Tongji University), Yige Zhang (Tongji University), Weixiong Rao (Tongji University), Jiehua Chen (Huawei Inc), Xiaofeng Hu (Huawei Inc), and Qinglin Chen (Huawei Inc)</i>	

### Research Session 2: Privacy and Trust

Money Cannot Buy Everything: Trading Mobile Data with Controllable Privacy Loss .....	29
<i>Shuyuan Zheng (Kyoto University), Yang Cao (Kyoto University), and Masatoshi Yoshikawa (Kyoto University)</i>	
VPN+ Towards Detection and Remediation of Information Leakage on Smartphones .....	39
<i>Ed Novak (Franklin and Marshall College), Phyto Thuta Aung (Franklin and Marshall College), and Thu Do (Franklin and Marshall College)</i>	
Distributed Incentive-Based Secured Traffic Monitoring in VANETs .....	49
<i>Ayan Roy (Missouri University of Science and Technology, USA) and Sanjay Madria (Missouri University of Science and Technology, USA)</i>	

### Research Session 3: Path Planning

Trade-off Aware Sequenced Routing Queries (or OSR Queries when POIs are Not Free) .....	59
<i>Francesco Lettich (University of Alberta), Mario Nascimento (University of Alberta), and Samiul Anwar (University of Alberta)</i>	
Semantically Diverse Path Search .....	69
<i>Xu Teng (Iowa State University, USA), Goce Trajcevski (Iowa State University, USA), Joon-Seok Kim (George Mason University, USA), and Andreas Züfle (George Mason University, USA)</i>	
STAD: Spatio-Temporal Adjustment of Traffic-Oblivious Travel-Time Estimation .....	79
<i>Sofiane Abbar (Qatar Computing Research Institute, HBKU), Rade Stanojevic (Qatar Computing Research Institute, HBKU), and Mohamed Mokbel (Qatar Computing Research Institute, HBKU)</i>	

### Research Session 4: Mobile Data Analytics

Crash Prediction and Risk Assessment with Individual Mobility Networks .....	89
<i>Riccardo Guidotti (University pf Pisa) and Mirco Nanni (ISTI-CNR, Pisa)</i>	

Online Clustering of Trajectories in Road Networks .....	99
<i>Ticiana Linhares Coelho da Silva (Insight Data Science Lab, Brazil), Francesco Lettich (University of Alberta, Canada), José Antônio Fernandes de Macêdo (Insight Data Science Lab, Brazil), Karine Zeitouni (Université Paris-Saclay, France), and Marco A. Casanova (PUC-RIO, Brazil)</i>	
Learning Semantic Relationships of Geographical Areas Based on Trajectories .....	109
<i>Saim Mehmood (York University, Canada) and Manos Papagelis (York University, Canada)</i>	

## **Research Session 5: Short Papers**

GradeSense: Gradation Aware Storage for Robust Activity Recognition in a Multimodal Smarthouse .....	119
<i>Madhumita Mallick (Indian Institute of Technology Kharagpur, India), Niloy Ganguly (Indian Institute of Technology Kharagpur, India), and Suparna Bhattacharya (Hewlett Packard Enterprise, India)</i>	
Context-Aware Data Association for Multi-Inhabitant Sensor-Based Activity Recognition .....	125
<i>Luca Arrotta (University of Milan), Claudio Bettini (University of Milan), Gabriele Civitarese (University of Milan), and Riccardo Presotto (University of Milan)</i>	
Semantic Trajectory Modelling in Indoor and Outdoor Spaces .....	131
<i>Hassan Noureddine (Naval Academy Research Institute, France), Cyril Ray (Naval Academy Research Institute, France), and Christophe Claramunt (Naval Academy Research Institute, France)</i>	

## **Research Session 6: Machine Learning on Mobile Devices**

Notable Site Recognition Using Deep Learning on Mobile and Crowd-Sourced Imagery .....	137
<i>Jimin Tan (New York University, USA), Anastasios Noulas (New York University, USA), Diego Saez (Wikimedia Foundation, Spain), and Rossano Schifanella (University of Turin, Italy / ISI Foundation, Italy)</i>	
Probabilistic Value Selection for Space Efficient Model .....	148
<i>Gunarto Sindoro Njoo (Singapore Management University), Baihua Zheng (Singapore Management University), Kuo-Wei Hsu (Taiwan), and Wen-Chih Peng (National Chiao Tung University)</i>	

## **Research Session 7: Location-Based Social Networks**

Location-Based Social Network Data Generation Based on Patterns of Life .....	158
<i>Joon-Seok Kim (George Mason University), Hyunjee Jin (George Mason University), Hamdi Kavak (George Mason University), Ovi Chris Rouly (Tulane University), Andrew Crooks (George Mason University), Dieter Pfoser (George Mason University), Carola Wenk (Tulane University), and Andreas Züfle (George Mason University)</i>	

Dynamic Macro Scale Traffic Flow Optimisation Using Crowd-Sourced Urban Movement Data ....	168
<i>Laurens Arp (Leiden University), Dyon van Vreumingen (Leiden University), Daniela Gaweihns (Leiden University), and Mitra Baratchi (Leiden University)</i>	

## Industry Track

### Industrial Session 1

Noise Patterns in GPS Trajectories .....	178
<i>Abdeltawab Hendawi (University of Rhode Island, USA), James Shen (University of Washington Tacoma, USA), Sree Sindhu Sabbineni (University of Washington Tacoma, USA), Yaxiao Song (Microsoft Corporation, USA), Peiwei Cao (Microsoft Corporation, USA), Zhihong Zhang (Microsoft Corporation, USA), John Krumm (Microsoft Research, USA), and Mohamed Ali (University of Washington Tacoma, USA)</i>	
STIMULATE: A System for Real-Time Information Acquisition and Learning for Disaster Management .....	186
<i>M. Yasin Kabir (Missouri University of Science and Technology, USA), Sergey Gruzdev (Missouri University of Science and Technology, USA), and Sanjay Madria (Missouri University of Science and Technology, USA)</i>	

### Industrial Session 2

A Solution for Annotating Sensor Data Streams - An Industrial Use Case in Building Management System .....	194
<i>Dumindu Madithiyagasthenna (Swinburne University of Technology, Australia), Prem Prakash Jayaraman (Swinburne University of Technology, Australia), Ahsan Morshed (Central Queensland University, Australia), Abdur Rahim Mohammad Forkan (Swinburne University of Technology, Australia), Dimitrios Georgakopoulos (Swinburne University of Technology, Australia), Yong-Bin Kang (Swinburne University of Technology, Australia), and Mirek Piechowski (Piechowski Energy, Australia)</i>	
AutoConjunction: Adaptive Model-Based Feature Conjunction for CTR Prediction .....	202
<i>Chih-Yao Chang (Huawei Noah's Ark Lab), Xing Tang (Huawei Technologies co. ltd), Bo-Wen Yuan (National Taiwan University), Jui-Yang Hsia (National Taiwan University), Zhirong Liu (Huawei Noah's Ark Lab), Zhenhua Dong (Huawei Noah's Ark Lab), Xiuqiang He (Huawei Noah's Ark Lab), and Chih-Jen Lin (National Taiwan University)</i>	
RESGCN: RESidual Graph Convolutional Network Based Free Dock Prediction in Bike Sharing System .....	210
<i>Tianxiang Qin (Shanghai University, China), Tong Liu (Shanghai University, China), Hexiang Wu (Shanghai University, China), Weiqin Tong (Shanghai University, China), and Shimin Zhao (Shanghai Shentong Metro Co., Ltd., China)</i>	

The Anyplace 4.0 IoT Localization Architecture .....	218
<i>Paschalis Mpeis (University of Cyprus), Thierry Roussel (Alstom SA), Manish Kumar (Infosys Ltd), Constantinos Costa (University of Pittsburgh), Christos Laoudias (University of Cyprus), Denis Capot-Ray (Alstom SA), and Demetrios Zeinalipour-Yazti (University of Cyprus)</i>	

## Demo Track

A Demonstration of Summit: A Scalable Data Management Framework for Massive Trajectory ....	226
<i>Louai Alarabi (Umm Al-Qura University, Mecca, KSA) and Mohamed F Mokbel (University of Minnesota - Twin Cities, Minneapolis, USA)</i>	
NLMO: Towards a Natural Language Tool for Querying Moving Objects .....	228
<i>Xieyang Wang (Nanjing University of Aeronautics and Astronautics, China), Jianqiu Xu (Nanjing University of Aeronautics and Astronautics, China), and Yaxin Wang (Lanzhou University, China)</i>	
CAPRIO v2.0: A Context-Aware Unified Indoor-Outdoor Path Recommendation System .....	230
<i>Constantinos Costa (University of Pittsburgh), Panos K. Chrysanthis (University of Pittsburgh), Xiaoyu Ge (University of Pittsburgh), Evan McEllhenney (University of Pittsburgh), Evan Kebler (University of Pittsburgh), Panos K. Chrysanthis (University of Pittsburgh; University of Cyprus), and Demetrios Zeinalipour-Yazti (University of Cyprus)</i>	
Tools for Processing Digital Trajectories of Tourists .....	232
<i>Cécile Cayéré (La Rochelle Université), Cyril Faucher (La Rochelle Université), Christian Sallaberry (Université de Pau et des Pays de l'Adour), Marie-Noëlle Bessagnet (Université de Pau et des Pays de l'Adour), and Philippe Roose (Université de Pau et des Pays de l'Adour)</i>	
SMART-Env .....	234
<i>Sabrina Friedl (LMU Munich), Sebastian Schmoll (LMU Munich), Felix Borutta (LMU Munich), and Matthias Schubert (LMU Munich)</i>	
A Road Segment Attribute Completion System .....	236
<i>Razvan-Gabriel Cirstea (Aalborg University, Denmark), Hilmar Gústafsson (Aalborg University, Denmark), Rasmus Riis Grønbæk Pedersen (Aalborg University, Denmark), Rolf Hakon Verder Sehested (Aalborg University, Denmark), Tamas Imre Winkler (Aalborg University, Denmark), and Bin Yang (Aalborg University, Denmark)</i>	
Distributed Mobility Data Management in MobilityDB .....	238
<i>Mohamed Bakli (Université Libre de Bruxelles, Brussels, Belgium), Mahmoud Sakr (Université Libre de Bruxelles, Brussels, Belgium), and Esteban Zimányi (Université Libre de Bruxelles, Brussels, Belgium)</i>	
Managing Moving Objects with Imprecise Location .....	240
<i>Abdullah Islam (University of Rhode Island), Abdeltawab Hendawi (University of Rhode Island), and Mohamed Ali (University of Washington)</i>	

A Correlated Time Series Forecast System .....	242
<i>Nicolaj Casanova Abildgaard (Aalborg University, Denmark), Casper Weiss Bang (Aalborg University, Denmark), Jonas Hansen (Aalborg University, Denmark), Tobias Lambek Jacobsen (Aalborg University, Denmark), Thomas Højriis Knudsen (Aalborg University, Denmark), Nichlas Ørts Lisby (Aalborg University, Denmark), Chenjuan Guo (Aalborg University, Denmark), and Bin Yang (Aalborg University, Denmark)</i>	

## PhD Workshop

Big Mobility Data Analytics: Algorithms and Techniques for Efficient Trajectory Clustering.....	244
<i>Panagiotis Tampakakis (University of Piraeus)</i>	
Big Data Series Analytics in the Context of Environmental Crowd Sensing .....	246
<i>Hafsa El Hafyani (UVSQ - Université Paris-Saclay)</i>	
A Big Data Platform for Spatio-Temporal Social Event Discovery .....	248
<i>Aamir Shoeb Alam Khan (Dalhousie University), Imad Afyouni (University of Sharjah), and Zaher Al Aghbari (University of Sharjah)</i>	
Modelling, Managing and Processing of Mobility Data in Urban Environment .....	250
<i>Hassan Noureddine (Naval Academy Research Institute, France)</i>	

## MBDW'20 Workshop

Exploratory Trajectory Analysis for Massive Historical AIS Datasets .....	252
<i>Anita Graser (University of Salzburg, Austria; AIT Austrian Institute of Technology, Austria), Melitta Dragaschnig (AIT Austrian Institute of Technology, Austria), Peter Widhalm (AIT Austrian Institute of Technology, Austria), Hannes Koller (AIT Austrian Institute of Technology, Austria), and Norbert Brändle (AIT Austrian Institute of Technology, Austria)</i>	
Machine Learning Based System for Vessel Turnaround Time Prediction .....	258
<i>Dejan Stepec (XLAB Research), Tomaz Martincic (XLAB Research), Fabrice Klein (Port of Bordeaux), Daniel Vladusic (XLAB Research), and Joao Pita Costa (XLAB Research)</i>	
Detection of Abnormal Vessel Behaviours from AIS Data Using GeoTrackNet: From the Laboratory to the Ocean .....	264
<i>Duong Nguyen (IMT Atlantique, France), Matthieu Simonin (University of Rennes, Inria, CNRS, IRISA, France), Guillaume Hajduch (CLS: Collecte Localisation Satellites, France), Rodolphe Vadaine (CLS: Collecte Localisation Satellites, France), Cedric Tedeschi (University of Rennes, Inria, CNRS, IRISA, France), and Ronan Fablet (IMT Atlantique, France)</i>	
Discrete Kalman Filter and Linear Regression Comparison for Vessel Coordinate Prediction .....	269
<i>Christiaan Neil Burger (Stellenbosch University), Trienko Lups Grobler (Stellenbosch University), and Waldo Kleynhans (University of Pretoria, IMIS Global)</i>	

Sea Area Monitoring and Analysis of Fishing Vessels Activity: The i4sea Big Data Platform .....	275
<i>Panagiotis Tampakis (University of Piraeus), Eva Chondrodima (University of Piraeus), Aggelos Pikrakis (University of Piraeus), Yannis Theodoridis (University of Piraeus), Kostis Pristouris (ATHENA Research Center), Harry Nakos (ATHENA Research Center), Eleni Petra (ATHENA Research Center), Theodore Dalamagas (ATHENA Research Center), Andreas Kandiros (Cosmos Business Systems), Georgios Markakis (Cosmos Business Systems), Irida Maina (Hellenic Centre for Marine Research), and Stefanos Kavadas (Hellenic Centre for Marine Research)</i>	
Optimizing Vessel Trajectory Compression .....	281
<i>Giannis Fikioris (NCSR Demokritos, Athens, Greece), Kostas Patroumpas (Athena Research Center, Athens, Greece), and Alexander Artikis (NCSR Demokritos, Athens, Greece and University of Piraeus, Greece)</i>	
EU-MRV: An Analysis of 2018's Ro-Pax CO <sub>2</sub> Data .....	287
<i>Gianandrea Mannarini (CMCC), Lorenzo Carelli (CMCC), and Amal Salhi (CMCC)</i>	
Experimental Comparison of Complex Event Processing Systems in the Maritime Domain .....	293
<i>Alexandros Troupiotis-Kapeliaris (National Centre for Scientific Research "Demokritos", Greece), Konstantinos Chatzikokolakis (MarineTraffic, Greece), Dimitris Zissis (University of the Aegean, Greece), and Elias Alevizos (National and Kapodistrian University of Athens, Greece)</i>	
Artificial Intelligence Technologies for Maritime Surveillance Applications .....	299
<i>Valerio Fontana (RHEA Group), José Manuel Delgado Blasco (RHEA Group), Andrea Cavallini (RHEA Group), Nicola Lorusso (RHEA Group), Alessandro Scream (RHEA Group), and Antonio Romeo (RHEA Group)</i>	

## Mobisocial'20 Workshop

Are Satellite Images Effective for Estimating Land Prices on Deep Neural Network Models? .....	304
<i>Shinya Yamada (Osaka University), Shohei Yamasaki (Osaka University), Tomoya Okuno (Osaka University), Kei Harada (Osaka University), Yuya Sasaki (Osaka University), and Makoto Onizuka (Osaka University)</i>	
An Efficient Method for Recommending Branch Locations to Reduce the Transportation Distance between Stations and Urban Events .....	310
<i>Sheng-Ting Chien (National Cheng Kung University Tainan, Taiwan (R.O.C)), Fandel Lin (Engineering National Cheng Kung University Tainan, Taiwan (R.O.C)), Chiunghui Tsai (National Cheng Kung University Tainan, Taiwan (R.O.C)), and Hsun-Ping Hsieh (National Cheng Kung University Tainan, Taiwan (R.O.C))</i>	
DACNN: Dynamic Weighted Attention with Multi-channel Convolutional Neural Network for Emotion Recognition .....	316
<i>Cheng-Ta Yang (National Taiwan University of Science and Technology) and Yi-Ling Chen (National Taiwan University of Science and Technology)</i>	

Personalized Tourism Route Recommendation Based on User's Active Interests*	322
<i>Zhizhou Duan (Northwest University), Yuan Gao (Northwest University), Jun Feng (Northwest University), Xiaoxi Zhang (Northwest University), and Jie Wang (Northwest University)</i>	
Live Stream Highlight Detection Using Chat Messages	328
<i>Chieh-Ming Liaw (National Taiwan University of Science and Technology, Taiwan, R.O.C.) and Bi-Ru Dai (National Taiwan University of Science and Technology, Taiwan, R.O.C.)</i>	
Detecting Social Anxiety with Online Social Network Data	333
<i>Ming-Yi Chang (National Tsing Hua University) and Chih-Ying Tseng (National Tsing Hua University)</i>	
Ontology-Based Dynamic Semantic Annotation for Social Image Retrieval	337
<i>Yi-Hui Chen (Chang Gung University, Taiwan), Eric Jui-Lin Lu (National Chung Hsing University, Taiwan), and Sheng-Chia Lin (National Chung Hsing University)</i>	
Counting People by Using Convolutional Neural Network and a PIR Array	342
<i>Peng-Rong Tsou (NCHU), Cheng-En Wu (NCHU), Yen-Ru Chen (NCHU), Yun-Ting Ho (NCHU), Jun-Kai Chang (NCHU), and Hsiao-Ping Tsai (NCHU)</i>	

## 3SCity-E2C'20 Workshop

A Cost Model for Data Discovery in Large-Scale IoT Networks of Smart Cities	348
<i>Torbjørn Kirkevik Soltvedt (Norwegian University of Science and Technology (NTNU)), Amir Sinaeepourfard (Norwegian University of Science and Technology (NTNU)), and Dirk Ahlers (Norwegian University of Science and Technology (NTNU))</i>	
Towards a Simulation Framework for Edge-to-Cloud Orchestration in C-ITS	354
<i>Phu H. Nguyen (SINTEF), Åsmund Hugo (SINTEF), Karl Svantorp (Aventi Group AS), and Bjørn Magne Elnes (Aventi Group AS)</i>	
A Smart Fog-to-Cloud System in Airport: Challenges and Lessons Learnt	359
<i>Antonio Salis (Engineering Sardegna) and Jens Jensen (UK Research and Innovation/STFC RAL)</i>	
A Novel Edge-to-Cloud-as-a-Service (E2CaaS) Model for Building Software Services in Smart Cities	365
<i>Jaro Robberechts (Ghent University, Belgium), Amir Sinaeepourfard (Norwegian University of Science and Technology (NTNU), Norway), Tom Goethals (Ghent University, Belgium), and Bruno Volckaert (Ghent University, Belgium)</i>	
Bridging MQTT and Kafka to Support C-ITS: A Feasibility Study	371
<i>Åsmund Hugo (SINTEF Digital), Brice Morin (SINTEF Digital), and Karl Svantorp (Aventi Technology)</i>	
Smart Surveillance for Smart City	N/A
<i>Atanu Mandal (Jadavpur University, India) and Sudip Kumar Naskar (Jadavpur University, India)</i>	

<b>Author Index</b>	383
---------------------	-----