

# ARIC 2019 WORKSHOP REPORT

## The 2nd ACM SIGSPATIAL International Workshop on Advances in Resilient and Intelligent Cities Chicago, IL, USA November 5, 2019

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The advancements in sensor technology and ubiquity of connected devices has enabled the generation of large volume of disparate, dynamic and geographically distributed data both by scientific communities and citizens. With astonishing technological innovations and convergence, there have been major changes in peoples daily activities and social interaction. The socio-technological innovations motivate the concept of smart and connected cities. A smart city, however, is subjected to the same challenges as a conventional city, such as environmental damages, hazard impacts, access to services and resources, due to continuous population and economic growth. Therefore, it is imperative to improve our understanding of Resilient and Intelligent Cities in order to leverage technologies and artificial intelligence to tackle the challenges cities face, which range from climate change, public health, traffic congestion, economic growth, to digital divide, social equity, political movements, and cultural conflicts, among others.

Currently, the discussion about making a city intelligent and resilient are occurring on two parallel planes. The challenge is to plan and design intelligent cities under the framework of resilience so that real-time knowledge discovery from both dynamic data streams and static data sets can be accomplished to help practitioners and researchers with their policy decisions. While current developments in data science and artificial intelligence has enabled real-time analytics of online and static data sets, the issue of modeling urban plans to ensure an intelligent city that is also resilient need to be well understood to maximize the benefits of connected technologies, which is the focus of this workshop.

Following our successful ARIC 2018, the 2nd International Workshop on Advances on Resilient and Intelligent Cities (ARIC 2019) was timely. The second workshop brought together researchers and practitioners to address the challenges of integrating large-scale computing, geospatial analytics, and urban sciences in building intelligent and resilient cities. The workshop provided a platform to discuss research areas and issues in modeling urban design by considering sensor technology, edge computing, interactive visualization, modeling and simulation, and advanced data analytics.

ARIC 2019 (<https://aric2019.com/>) was held in conjunction with the 27th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems on Nov. 5, 2017 in Chicago, IL, USA. The workshop received 17 technical submissions, and after a rigorous review process, 10 papers were accepted for full presentation, reaching an acceptance rate of 59%. Each accepted short paper was allocated 20 minutes for presentation, while accepted long papers were assigned 30 minutes. The workshop attracted 40 participants from different background and had 15 participants who registered for the workshop.

The technical program included a keynote from Dr. Rajesh Sankaran from Argonne National Laboratory, who is the R & D lead for the Chicago's Array of Things project in the morning session. Dr. Sankaran's keynote titled *Array of Things: A Fitbit for a City* discussed the computational and technological advantages and limitations of using urban sensors and edge computing to address smart and resilient city requirements. Following the keynote, a vision paper titled *Vision for a Holistic Smart City (HSC)-Integrating Resiliency Framework via Crowdsourced Community Resiliency Information System (CRIS)* was presented by Barnali Dixon and Rebecca Johns from University of South Florida. The paper presented a vision to integrate smart city initiatives in a resiliency framework to increase the integration of socio-technological innovations to meet the demands of smart and resilient cities. Following this presentation, Christa Brelsford (Oak Ridge National Laboratory (ORNL)), Rudy Arthur (Univ. of Exeter), Gautam Thakur (ORNL) and Hywel Williams (Univ. of Exeter) presented the paper titled *Using Digital Trace Data to Identify Regions and Cities*. The paper presented the idea of determining regions and cities by using digital trace data that capture human-dynamics such that a deeper understanding of social networks can be obtained for resilient city initiatives. The third paper in the session titled *Mobility Pattern Analysis for Power Restoration Activities Using Geo-Tagged Tweets* was presented by Bandana Kar (ORN) and Jacob Ethridge (Univ. of Tennessee, Chattanooga). The paper presented an analytical framework to capture mobility patterns using digital trace data to aid with real-time emergency management and response efforts. Following this paper, Ashlynn Daughton, Chrism Watson Ross, Geoffrey Fairchild and Sara Y. Del Valle from Los Alamos National Laboratory presented their paper on *Topic Modeling to Contextualize Event-Based Datasets: The Colombian Peace Process* that discussed the role of digital trace data in understanding and capturing public sentiments during peace process to influence decision-makers. The last paper of the session titled *In-Database Geospatial Analytics using Python* was presented by Avipsa Roy (Arizona State Univ.), Edouard Fouche (Karlsruhe Institute of Technology), Rafael Rodriguez Morales (TU Dresden) and Gregor Moehler (IBM Deutschland Research and Development GmbH). In this paper, the authors presented a new method to perform fast and seamless spatial analysis without in-memory data storage, which can be used for near real-time analytics.

The afternoon session started with the paper titled *ADMSv2: A Modern Architecture for Transportation Data Management and Analysis* by Chrysovalantis Anastasiou, Jianfa Lin, Chaoyang He, Yao-Yi Chiang and Cyrus Shahabi from Univ. of Southern California. This paper presented an end-to-end data-driven system for near real-time and historical analytics of streaming and static transportation big data using machine learning. Following this paper, Alina Klerings (Ruprecht-Karls-Universität Heidelberg), Shimin Tang and Zhiqiang Chen (Univ. of Missouri-Kansas City) presented the paper titled *Structuralizing Disaster-scene Data through Auto-captioning* about an end-to-end deep learning framework with a linked CNN-LSTM architecture for auto-captioning of disaster scene data to help with damage assessment using crowdsourced images. Jerry Mount, Yazeed Alabbad and Ibrahim Demir of The Univ. of Iowa presented the third paper titled *Towards an Integrated and Realtime Wayfinding Framework for Flood Events*. The paper presented a graph-theory based framework to identify flood impacted road networks in real-time to help with navigation. Zonglin Meng, Bo Pen and Qunying Huang from Univ. of Wisconsin-Madison presented the fourth paper titled *Flood Depth Estimation from Web Images*. In the paper, the authors presented a mask R-CNN framework to determine flood depth using crowdsourced images. The last paper of the session titled *Semantics-enabled Spatio-Temporal Modeling of Earth Observation Data: An application to Flood Monitoring* was presented by Kuldeep Kurte (ORNL), Abhishek Potnis and Surya Durbha from Indian Institute of Technology, Bombay. This paper presented a semantic model named Dynamic Flood Ontology (DFO) to extract spatial and temporal information about flood impact areas from remote sensing imagery. A discussion of the participants about future directions concluded the workshop.

We sincerely thank the keynote speaker and the authors for presenting and discussing their papers as they contribute to the purpose of ARIC 2019. We also thank the program committee members for their time and effort in reviewing and evaluating the submitted papers. We hope that the proceedings of ARIC2019 will contribute to the field and stimulate new research. We also hope that the workshop series will continue to provide a leading international forum for researchers, developers and practitioners in the field of computing, urban and geospatial sciences, and data analytics to identify current and future areas of research and promote applications in practice.