

# ARIC 2020 WORKSHOP REPORT

## The 3rd ACM SIGSPATIAL International Workshop on Advances in Resilient and Intelligent Cities Seattle, WA, USA November 3, 2020

Bandana Kar<sup>1</sup>, Xinyue Ye<sup>2</sup>, Shima Mohebbi<sup>3</sup>, Guangtao Fu<sup>4</sup>

<sup>1</sup>Oak Ridge National Lab, TN, USA

<sup>2</sup>Texas A & M University, TX, USA

<sup>3</sup>George Mason University, VA, USA

<sup>4</sup>University of Exeter, Exeter, England

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 interactions. These innovations have contributed to the establishment of smart and connected cities. A smart city is forward-looking, progressive, and has the potential to provide high-quality life. A resilient city can preserve its activities and bounce back to its previous stage or to a new normal in the face of an emergency while meeting the daily activities and needs of its citizens. It is imperative to improve our understanding of Resilient and Intelligent Cities in order to leverage these new technologies to tackle the challenges ranging from climate change, public health, traffic congestion, economic growth, to digital divide, social equity, political movements, and cultural conflicts, among others.

A smart city 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. The COVID-19 pandemic has highlighted this difference between smart and resilient cities more so than any other hazard events. While the availability of real-time data and analytics, cloud computing and artificial intelligence (AI) has enabled the development of dashboards and platforms to help with decision-making during this pandemic, these platforms and dashboards fail to address the resilience of the impacted communities as evidenced by the economic stress and increase in COVID-19 spread across the United States and other countries around the world. The challenge is to plan and design intelligent cities under the framework of resilience so that the knowledge discovery from static and dynamic data streams could be used for policy, research and future expansion of cities.

The 3rd International Workshop on Advances on Resilient and Intelligent Cities (ARIC 2020) was timely. Following the success of ARIC 2019 workshop, the 2020 ARIC workshop brought together researchers and practitioners from different disciplines to address the challenges of integrating large-scale computing, geospatial analytics, public health research, infrastructure resilience and urban sciences in building intelligent and resilient cities that can withstand the impacts of future pandemics and extreme events. The workshop featured two keynotes, nine research papers and a panel session discussing the current trend in smart and resilient city research, future directions, and the role of geo-design, sensor technologies, edge computing, modeling and simulation to increase the resilience of cities.

The morning session of the workshop started with a Keynote titled *Smart Cities and Internet of Things* that was delivered by Dr.Sokwoo Rhee. Dr.Rhee is the Associate Director for Cyber-Physical Systems (CPS)

Innovation at the National Institute of Standards and Technology (NIST), U.S. Department of Commerce. He is leading smart city and Internet of Things (IoT) innovation programs at NIST, including the Global City Teams Challenge (GCTC) and the Smart Cities and Communities Framework (SCCF) program. This keynote (i) provided an overview of the structure of smart cities, global trends, and technical issues and challenges, and (ii) discussed how NIST is working with private sector stakeholders and other U.S. federal agencies to aid cities and communities across the world to share ideas and develop comprehensive solutions to address their issues.

Following the keynote, five papers were presented. The first paper titled *Constructing a Digital City on a Web-3D Platform* was presented by Toshikazu Seto, Yoshihide Sekimoto, Kosuke Asahi and Takahiro Endo (Japan). This paper discussed a platform to display 20 data types and create a digital twin of a city. This presentation was followed by the paper titled *Reducing and Linking Spatio-Temporal Datasets with kD-STR* that was presented by Liam Steadman, Nathan Griffiths, Stephen Jarvis, Mark Bell, Shaun Helman and Caroline Wallbank (United Kingdom) that discussed the kD-STR algorithm to link spatial and temporal datasets that are essential for the modeling of smart and resilient cities. The third paper titled *Exploiting Points of Interest for Predictive Policing* was presented by Luis Gustavo Coutinho Do Rego, Ticiana Linhares Coelho da Silva, Regis Pires Magalhes, Jose Antonio Fernandes de Macedo and Wellington Clay Porcino Silva (Brazil). This paper discussed a big data analytics approach to analyze and forecast spatio-temporal patterns of criminal activities to aid with policing. The fourth paper titled *Data-Driven Mobility Models for COVID-19 Simulation* was presented by John Pesavento, Andy Chen, Rayan Yu, Joon-Seok Kim, Hamdi Kavak, Taylor Anderson and Andreas Zfle (USA). This paper presented an Agent-based model using point of interest data along with topic modeling to simulate the spread of COVID-19. The last paper in this session titled *Characterizing the Spread of COVID-19 from Human Mobility Patterns and Socio Demographic Indicators* was presented by Avipsa Roy and Bandana Kar (USA). This paper presented a machine learning approach to model COVID-19 spread in Los Angeles City using socio-economic indicators and mobility data during March through July of 2020.

The afternoon session of the workshop featured a keynote titled *Public Private Partnerships: Value Capture in Urban Development* by Dr. Wilfred Pinfold. Dr. Pinfold is the Chief Executive Officer of urban.systems Inc, a company that builds vibrant communities using technology to facilitate civic engagement, deliver services and share resources. Dr. Pinfold discussed the need to improve public services and efficient resource-usage, and the role of public-private partnerships in benefiting communities and building their resilience.

Following the keynote, four papers were presented. The first paper titled *Green Infrastructures and Their Impact on Resilience - Spatial Interactions in Centralized Sewer Systems* was presented by Mayra Rodriguez, Guangtao Fu and David Butler (UK). This paper discussed the spatial interactions between green infrastructure placement and improvements in sewer networks to reduce flooding impacts. The second paper titled *Seismic Resilience Assessments of Water Pipelines - A Case Study for the City of Los Angeles Water System Pipeline Network* was presented by Yajie Lee, Jianping Hu, Alek Harounian, Zhenghui Hu and Ronald Eguchi (USA). This paper presented a stochastic method to assess the risk of water infrastructure networks to seismic events using the case study of the City of Los Angeles. The third paper titled *Designing Community-Based Intelligent Systems for Water Infrastructure Resilience* was presented by Nalini Venkatasubramanian, Craig Davis and Ronald Eguchi (USA). The paper discussed the use of IoT devices and machine learning based analytics to assess the resilience across the water infrastructure networks. The last paper in this session was *AI-supported Citizen Science to Monitor High-Tide Flooding in Newport Beach, California*. This paper authored by Behzad Golparvar and Ruo-Qian Wang (USA) presented an AI based approach to extract flood depth information from crowdsourced imagery using computer vision and photogrammetric techniques.

The last session of the workshop was a panel titled *Smart and Resilient Cities: Where To Go Next?*. The panelists David Cauffman (Department of Homeland Security), Dr. Ian McRae (Sherwood Design Engineers), Scott Tousley (Splunk), Dr. William Mobley (Texas A & M University) and Dr. Ronita Bardhan (University of Cambridge) discussed the issue of geo-design and its role in making cities resilient, current standards and policies that enable integration of smart city initiatives and resilience framework, and future directions to help stakeholders achieve their goal to make their city smart and resilient.

