

Title: Energy-Efficient 3D Vehicular Crowdsourcing for Disaster Response by Distributed Deep Reinforcement Learning

Abstract:

Fast and efficient access to environmental and life data is key to the successful disaster response. Vehicular crowdsourcing (VC) by a group of unmanned vehicles (UVs) like drones and unmanned ground vehicles to collect these data from Point-of-Interests (PoIs) e.g., possible survivor spots and fire site, provides an efficient way to assist disaster rescue. In this paper, we explicitly consider to navigate a group of UVs in a 3-dimensional (3D) disaster workzone to maximize the amount of collected data, geographical fairness, energy efficiency, while minimizing data dropout due to limited transmission rate. We propose DRL-DisasterVC(3D), a distributed deep reinforcement learning framework, with a repetitive experience replay (RER) to improve learning efficiency, and a clipped target network to increase learning stability. We also use a 3D convolutional neural network (3D CNN) with multi-head-relational attention (MHRA) for spatial modeling, and add auxiliary pixel control (PC) for spatial exploration. We designed a novel disaster response simulator, called “DisasterSim”, and conduct extensive experiments to show that DRL-DisasterVC(3D) outperforms all five baselines in terms of energy efficiency when varying the numbers of UVs, PoIs and SNR threshold.

Biography:

Prof. Chi (Harold) Liu receives a Ph.D. degree in Electronic Engineering from Imperial College, UK in 2010, and a B.Eng. degree in Electronic and Information Engineering from Tsinghua University, China in 2006.

He is currently a Full Professor and Vice Dean at the School of Computer Science and Technology, Beijing Institute of Technology, China. Before moving to academia, he worked for IBM Research - China as a staff researcher and project manager from 2010 to 2013, worked as a postdoctoral researcher at Deutsche Telekom Laboratories, Germany in 2010, and as a Research Staff Member at IBM T. J. Watson Research Center, USA in 2009. His current research interests include the big data analytics, mobile computing, and machine learning. He received the IBM First Plateau Invention Achievement Award in 2012, ACM SigKDD'21 Best Paper Runner-up Award, and IEEE DataCom'16 Best Paper Award. He has published more than 100 prestigious conference and journal papers and owned 26 EU/UK/US/Germany/Spain/China patents. He serves as the Associate Editor for IEEE TRANSACTIONS ON NETWORK SCIENCE AND ENGINEERING, Area Editor for KSII Trans. on Internet and Information Systems, the Symposium Chair for IEEE ICC 2020 on Next Generation Networking, and served as the (Lead) Guest Editor for IEEE Transactions on Emerging Topics in Computing and IEEE Sensors Journal. He was the book editor for 11 books published by Taylor & Francis Group, USA and China Machine Press, China. He also has served as the general chair of IEEE SECON'13 workshop on IoT Networking and Control, IEEE WCNC'12 workshop on IoT Enabling Technologies, and ACM UbiComp'11 Workshop on Networking and Object Memories for IoT. He was a consultant to Asian Development Bank, Bain & Company, and KPMG, USA, and the peer reviewer for Qatar National Research Foundation, National Science Foundation, China, Ministry of Education and Ministry of Science and Technology, China. He is a senior member of IEEE and a Fellow of IET, British Computer Society, and Royal Society of Arts.