# **IEEE INFOCOM 2022 – IEEE Conference on Computer Communications**

**Virtual Conference** 2-5 May 2022

Pages 1-719



IEEE Catalog Number: CFP22INF-POD **ISBN:** 

978-1-6654-5823-8

# Copyright © 2022 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:	CFP22INF-POD
ISBN (Print-On-Demand):	978-1-6654-5823-8
ISBN (Online):	978-1-6654-5822-1
ISSN:	0743-166X

#### 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



# Program

Keynote: Opening, Awards, and Keynote Break-1-May3: Virtual Lunch Break

A-1: Security 1

## Fast and Secure Key Generation with Channel Obfuscation in Slowly Varying Environments

Guyue Li and Haiyu Yang (Southeast University, China); Junqing Zhang (University of Liverpool, United Kingdom (Great Britain)); Hu Aiqun (Southeast University, China); Hongbo Liu (University of Electronic Science and Technology of China, China) pp. 1-10

#### MILLIEAR: Millimeter-wave Acoustic Eavesdropping with Unconstrained Vocabulary

Pengfei Hu and Yifan Ma (Shandong University, China); Panneer Selvam Santhalingam and Parth Pathak (George Mason University, USA); Xiuzhen Cheng (Shandong University, China) pp. 11-20

## The Hanging ROA: A Secure and Scalable Encoding Scheme for Route Origin Authorization

Yanbiao Li (Computer Network Information Center, Chinese Academy of Sciences, China); Hui Zou and Yuxuan Chen (University of Chinese Academy of Sciences & Computer Network Information Center, Chinese Academy of Sciences, China); Yinbo Xu and Zhuoran Ma (University of Chinese Academy of Sciences & Computer Network Information Center, China); Di Ma (Internet Domain Name System National Engineering Research Center, China); Ying Hu (Computer Network Information Center, Chinese Academy of Science, China); Gaogang Xie (CNIC Chinese Academy of Sciences & University of Chinese Academy of Sciences, China) pp. 21-30

#### Thwarting Unauthorized Voice Eavesdropping via Touch Sensing in Mobile Systems

Wenbin Huang (Hunan University, China); Wenjuan Tang (HNU, China); Kuan Zhang (University of Nebraska-Lincoln, USA); Haojin Zhu (Shanghai Jiao Tong University, China); Yaoxue Zhang (Tsinghua University, China) pp. 31-40

# B-1: Collaborative Learning

#### ComAI: Enabling Lightweight, Collaborative Intelligence by Retrofitting Vision DNNs

Kasthuri Jayarajah (University of Maryland Baltimore County, USA); Dhanuja Wanniarachchige (Singapore Management University, Singapore); Tarek Abdelzaher (University of Illinois, Urbana Champaign, USA); Archan Misra (Singapore Management University, Singapore) pp. 41-50

#### Dual-track Protocol Reverse Analysis Based on Share Learning

Weiyao Zhang, Xuying Meng and Yujun Zhang (Institute of Computing Technology, Chinese Academy of Sciences, China) pp. 51-60

## FedFPM: A Unified Federated Analytics Framework for Collaborative Frequent Pattern Mining

Zibo Wang and Yifei Zhu (Shanghai Jiao Tong University, China); Dan Wang (The Hong Kong Polytechnic University, Hong Kong); Zhu Han (University of Houston, USA)

pp. 61-70

## Layer-aware Collaborative Microservice Deployment toward Maximal Edge Throughput

Lin Gu, Zirui Chen and Honghao Xu (Huazhong University of Science and Technology, China); Deze Zeng (China University of Geosciences, China); Bo Li (Hong Kong University of Science and Technology, Hong Kong); Hai Jin (Huazhong University of Science and Technology, China) pp. 71-79

# C-1: Human Sensing

### Amaging: Acoustic Hand Imaging for Self-adaptive Gesture Recognition

Penghao Wang, Ruobing Jiang and Chao Liu (Ocean University of China, China) pp. 80-89

## mmECG: Monitoring Human Cardiac Cycle in Driving Environments Leveraging Millimeter Wave

Xiangyu Xu (Southeast University, China); Jiadi Yu (Shanghai Jiao Tong University, China); Chenguang Ma (Ant Financial Services Group, China); Yanzhi Ren and Hongbo Liu (University of Electronic Science and Technology of China, China); Yanmin Zhu, Yi-Chao Chen and Feilong Tang (Shanghai Jiao Tong University, China) pp. 90-99

## Mudra: A Multi-Modal Smartwatch Interactive System with Hand Gesture Recognition and User Identification

Kaiwen Guo, Hao Zhou, Ye Tian and Wangqiu Zhou (University of Science and Technology of China, China); Yusheng Ji (National Institute of Informatics, Japan); Xiang-Yang Li (University of Science and Technology of China, China) pp. 100-109

### Sound of Motion: Real-time Wrist Tracking with A Smart Watch-Phone Pair

Tianyue Zheng and Cai Chao (Nanyang Technological University, Singapore); Zhe Chen (School of Computer Science and Engineering, Nangyang Technological University, Singapore); Jun Luo (Nanyang Technological University, Singapore) pp. 110-119

# D-1: MIMO

## D\(^2\)BF---Data-Driven Beamforming in MU-MIMO with Channel Estimation Uncertainty

Shaoran Li, Nan Jiang, Yongce Chen, Thomas Hou, Wenjing Lou and Weijun Xie (Virginia Tech, USA) pp. 120-129

## M3: A Sub-Millisecond Scheduler for Multi-Cell MIMO Networks under C-RAN Architecture

Yongce Chen, Thomas Hou, Wenjing Lou and Jeffrey Reed (Virginia Tech, USA); Sastry Kompella (Naval Research Laboratory, USA) pp. 130-139

### MUSTER: Subverting User Selection in MU-MIMO Networks

Tao Hou (University of South Florida, USA); Shengping Bi and Tao Wang (New Mexico State University, USA); Zhuo Lu and Yao Liu (University of South Florida, USA); Satyajayant Misra (New Mexico State University, USA); Yalin E Sagduyu (Virginia Tech, USA) pp. 140-149

# Semi-Online Precoding with Information Parsing for Cooperative MIMO Wireless Networks

Juncheng Wang and Ben Liang (University of Toronto, Canada); Min Dong (Ontario Tech University, Canada); Gary Boudreau (Ericsson, Canada); Hatem Abou-Zeid (University of Calgary, Canada) pp. 150-159

# E-1: Packets and Flows

#### FlowShark: Sampling for High Flow Visibility in SDNs

Sogand Sadrhaghighi (University of Calgary, Canada); Mahdi Dolati (University of Tehran, Iran); Majid Ghaderi (University of Calgary, Canada); Ahmad Khonsari (University of Tehran, Iran) pp. 160-169

### Joint Resource Management and Flow Scheduling for SFC Deployment in Hybrid Edge-and-Cloud Network

Yingling Mao, Xiaojun Shang and Yuanyuan Yang (Stony Brook University, USA) pp. 170-179

#### NFlow and MVT Abstractions for NFV Scaling

Ziyan Wu and Yang Zhang (University of Minnesota, USA); Wendi Feng (Beijing Information Science and Technology University, China); Zhi-Li Zhang (University of Minnesota, USA) pp. 180-189

#### The Information Velocity of Packet-Erasure Links

Elad Domanovitz (Tel Aviv University, Israel); Tal Philosof (Samsung, Israel); Anatoly Khina (Tel Aviv University, Israel) pp. 190-199

# F-1: Robustness

#### Distributed Bandits with Heterogeneous Agents

Lin Yang (University of Massachusetts, Amherst, USA); Yu-Zhen Janice Chen (University of Massachusetts at Amherst, USA); Mohammad Hajiesmaili (University of Massachusetts Amherst, USA); John Chi Shing Lui (Chinese University of Hong Kong, Hong Kong); Don Towsley (University of Massachusetts at Amherst, USA) pp. 200-209

# *Experimental Design Networks: A Paradigm for Serving Heterogeneous Learners under Networking Constraints*

Yuezhou Liu, Yuanyuan Li, Lili Su, Edmund Yeh and Stratis Ioannidis (Northeastern University, USA) pp. 210-219

## MC-Sketch: Enabling Heterogeneous Network Monitoring Resolutions with Multi-Class Sketch

Kate Ching-Ju Lin (National Chiao Tung University, Taiwan); Wei-Lun Lai (National Yang-Ming Chiao Tung University, Taiwan) pp. 220-229

# Stream Iterative Distributed Coded Computing for Learning Applications in Heterogeneous Systems

Homa Esfahanizadeh (Massachusetts Institute of Technology, USA); Alejandro Cohen (Technion, Israel); Muriel Médard (MIT, USA) pp. 230-239

# G-1: Mobile Networks and Beyond

# ChARM: NextG Spectrum Sharing Through Data-Driven Real-Time O-RAN Dynamic Control

Luca Baldesi, Francesco Restuccia and Tommaso Melodia (Northeastern University, USA)

pp. 240-249

## MARISA: A Self-configuring Metasurfaces Absorption and Reflection Solution Towards 6G

Antonio Albanese (NEC Laboratories Europe GmbH & Universidad Carlos III de Madrid, Germany); Francesco Devoti and Vincenzo Sciancalepore (NEC Laboratories Europe GmbH, Germany); Marco Di Renzo (CNRS & Paris-Saclay University, France); Xavier Costa-Perez (ICREA and i2cat & NEC Laboratories Europe, Spain) pp. 250-259

## OnionCode: Enabling Multi-priority Coding in LED-based Optical Camera Communications

Haonan Wu, Yi-Chao Chen, Guangtao Xue and Yuehu Jiang (Shanghai Jiao Tong University, China); Ming Wang (University of Illinois at Urbana-Champaign, USA); Shiyou Qian and Jiadi Yu (Shanghai Jiao Tong University, China); Pai-Yen Chen (University of Illinois at Chicago, USA) pp. 260-269

# OrchestRAN: Network Automation through Orchestrated Intelligence in the Open RAN

Salvatore D'Oro, Leonardo Bonati, Michele Polese and Tommaso Melodia (Northeastern University, USA)

# Break-2-May3: Virtual Coffee Break A-2: Security 2

#### Backdoor Defense with Machine Unlearning

Yang Liu (Xidian University, China); MingYuan Fan (University of FuZhou, China); Cen Chen (East China Normal University, China); Ximeng Liu (Fuzhou University, China); Zhuo Ma (Xidian University, China); Wang Li (Ant Group, China); Jianfeng Ma (Xidian University, China) pp. 280-289

# Revisiting Frequency Analysis against Encrypted Deduplication via Statistical Distribution

Jingwei Li, Guoli Wei, Jiacheng Liang and Yanjing Ren (University of Electronic Science and Technology of China, China); Patrick Pak-Ching Lee (The Chinese University of Hong Kong, Hong Kong); Xiaosong Zhang (University of Electronic Science and Technology of China, China) pp. 290-299

# Switching Gaussian Mixture Variational RNN for Anomaly Detection of Diverse CDN Websites

Liang Dai (Institute of Information Engineering, Chinese Academy of Sciences, China); Chen Wenchao (National Laboratory of Radar Signal Processing, Xidian University, China); Yanwei Liu (Institute of Information Engineering, Chinese Academy of Sciences, China); Antonios Argyriou (University of Thessaly, Greece); Chang Liu (University of Chinese Academy of Science, China); Tao Lin (Communication University of China, China); Wang Penghui (National Laboratory of Radar Signal Processing, Xidian University, China); Zhen Xu (Institute of Information Engineering, Chinese Academy of Sciences, China); Bo Chen (National Laboratory of Radar Signal Processing, Xidian University, China) pp. 300-309

#### Towards an Efficient Defense against Deep Learning based Website Fingerprinting

Zhen Ling, Gui Xiao, Wenjia Wu, Xiaodan Gu and Ming Yang (Southeast University, China); Xinwen Fu (University of Massachusetts Lowell, USA) pp. 310-319

# **B-2: Distributed ML**

# Addressing Network Bottlenecks with Divide-and-Shuffle Synchronization for Distributed DNN Training

Weiyan Wang (Hong Kong University of Science and Technology, Hong Kong); Cengguang Zhang (Hong Kong University of Science and Technology, China); Liu Yang (Hong Kong University of Science and Technology, Hong Kong); Kai Chen (Hong Kong University of Science and Technology, China); Kun Tan (Huawei, China) pp. 320-329

#### Distributed Inference with Deep Learning Models across Heterogeneous Edge Devices

Chenghao Hu and Baochun Li (University of Toronto, Canada) pp. 330-339

#### Efficient Pipeline Planning for Expedited Distributed DNN Training

Ziyue Luo and Xiaodong Yi (The University of Hong Kong, Hong Kong); Long Guoping (Institute of Computing Technology, Chinese Academy of Sciences, China); Shiqing Fan (Alibaba Group, China); Chuan Wu (The University of Hong Kong, Hong Kong); Jun Yang and Wei Lin (Alibaba Group, China) pp. 340-349

## *Mercury: A Simple Transport Layer Scheduler to Accelerate Distributed DNN Training* Qingyang Duan, Zeqin Wang and Yuedong Xu (Fudan University, China); Shaoteng Liu (Huawei Corp., China); Jun Wu (Fudan University, China) pp. 350-359

# C-2: IoT

- **DBAC: Directory-Based Access Control for Geographically Distributed IoT Systems** Luoyao Hao, Vibhas V Naik and Henning Schulzrinne (Columbia University, USA) pp. 360-369
- **IoTMosaic: Inferring User Activities from IoT Network Traffic in Smart Homes** Yinxin Wan, Kuai Xu, Feng Wang and Guoliang Xue (Arizona State University, USA) pp. 370-379

Physical-Level Parallel Inclusive Communication for Heterogeneous IoT Devices Sihan Yu (Clemson University, USA); Xiaonan Zhang (Florida State University, USA); Pei Huang (Meta, USA); Linke Guo (Clemson University, USA) pp. 380-389

**RF-Protractor: Non-Contacting Angle Tracking via COTS RFID in Industrial IoT** 

#### Environment

Tingjun Liu, Chuyu Wang, Lei Xie and Jingyi Ning (Nanjing University, China); Tie Qiu (Tianjin University, China); Fu Xiao (Nanjing University of Posts and Telecommunications, China); Sanglu Lu (Nanjing University, China) pp. 390-399

## D-2: WiFi

#### Physical-World Attack towards WiFi-Based Behavior Recognition

Jianwei Liu and Yinghui He (Zhejiang University, China); Chaowei Xiao (University of Michigan, ann arbor, USA); Jinsong Han (Zhejiang University & School of Cyber Science and Technology, China); Le Cheng and Kui Ren (Zhejiang University, China) pp. 400-409

#### Push the Limit of WiFi-based User Authentication towards Undefined Gestures

Hao Kong (Shanghai Jiao Tong University, China); Li Lu (Zhejiang University, China); Jiadi Yu, Yanmin Zhu, Feilong Tang, Yi-Chao Chen and Linghe Kong (Shanghai Jiao Tong University, China); Feng Lyu (Central South University, China) pp. 410-419

#### Target-oriented Semi-supervised Domain Adaptation for WiFi-based HAR

Zhipeng Zhou (University of Science and Technology of China, China); Feng Wang (University of Mississippi, USA); Jihong Yu (Beijing Institute of Technology, China); Ju Ren (Tsinghua University, China); Zhi Wang (Xi'an Jiaotong University, China); Wei Gong (University of Science and Technology of China, China) pp. 420-429

### *WiRa: Enabling Cross-Technology Communication from WiFi to LoRa with IEEE* 802.11ax

Dan Xia, Xiaolong Zheng, Fu Yu, Liang Liu and Huadong Ma (Beijing University of Posts and Telecommunications, China) pp. 430-439

# E-2: Performance

## Mag-E4E: Trade Efficiency for Energy in Magnetic MIMO Wireless Power Transfer System

Xiang Cui, Hao Zhou, Jialin Deng and Wangqiu Zhou (University of Science and Technology of China, China); Xing Guo (Anhui University, China); Yu Gu (Hefei University of Technology, China) pp. 440-449

#### Minimal Total Deviation in TCAM Load Balancing

Yaniv Sadeh (Tel Aviv University, Israel); Ori Rottenstreich (Technion - Israel Institute of Technology, Israel); Haim Kaplan (Tel-Aviv University, Israel) pp. 450-459

# Performance and Scaling of Parallel Systems with Blocking Start and/or Departure Barriers

Brenton Walker (Leibniz Universität Hannover, Germany); Stefan Bora (Universität Hannover, Germany); Markus Fidler (Leibniz Universität Hannover, Germany) pp. 460-469

#### Short-Term Memory Sampling for Spread Measurement in High-Speed Networks

Yang Du, He Huang and Yu-e Sun (Soochow University, China); Shigang Chen (University of Florida, USA); Guoju Gao, Xiaoyu Wang and Shenghui Xu (Soochow University, China)

рр. 470-479

# F-2: Routing

# E2E Fidelity Aware Routing and Purification for Throughput Maximization in Quantum Networks

Yangming Zhao and Gongming Zhao (University of Science and Technology of China, China); Chunming Qiao (University at Buffalo, USA) pp. 480-489

#### **Opportunistic Routing in Quantum Networks**

Ali Farahbakhsh and Chen Feng (University of British Columbia, Canada) pp. 490-499

#### **Optimal Routing for Stream Learning Systems**

Xinzhe Fu (Massachusetts Institute of Technology, USA); Eytan Modiano (MIT, USA) pp. 500-509

#### Multi-Entanglement Routing Design over Quantum Networks

Yiming Zeng, Jiarui Zhang, Ji Liu, Zhenhua Liu and Yuanyuan Yang (Stony Brook University, USA) pp. 510-519

# G-2: LoRa

# CurveALOHA: Non-linear Chirps Enabled High Throughput Random Channel Access for LoRa

Chenning Li, Zhichao Cao and Li Xiao (Michigan State University, USA) pp. 520-529

### Don't Miss Weak Packets: Boosting LoRa Reception with Antenna Diversities

Ningning Hou, Xianjin Xia and Yuanqing Zheng (The Hong Kong Polytechnic University, Hong Kong) pp. 530-539

# LoRadar: An Efficient LoRa Channel Occupancy Acquirer based on Cross-channel Scanning

Fu Yu, Xiaolong Zheng, Liang Liu and Huadong Ma (Beijing University of Posts and Telecommunications, China) pp. 540-549

## PolarScheduler: Dynamic Transmission Control for Floating LoRa Networks

Ruinan Li, Xiaolong Zheng, Yuting Wang, Liang Liu and Huadong Ma (Beijing University of Posts and Telecommunications, China) pp. 550-559

Break-3-May3: Virtual Coffee Break

Demo-1: Demo Session 1

Demo-2: Demo Session 2

Demo-3: Demo Session 3

A-3: Privacy

## Otus: A Gaze Model-based Privacy Control Framework for Eye Tracking Applications

Miao Hu and Zhenxiao Luo (Sun Yat-Sen University, China); Yipeng Zhou (Macquarie University, Australia); Xuezheng Liu and Di Wu (Sun Yat-Sen University, China) pp. 560-569

## Privacy-Preserving Online Task Assignment in Spatial Crowdsourcing: A Graphbased Approach

Hengzhi Wang, En Wang and Yongjian Yang (Jilin University, China); Jie Wu (Temple University, USA); Falko Dressler (TU Berlin, Germany) pp. 570-579

#### Protect Privacy from Gradient Leakage Attack in Federated Learning

Junxiao Wang, Song Guo and Xin Xie (Hong Kong Polytechnic University, Hong Kong); Heng Qi (Dalian University of Technology, China) pp. 580-589

#### When Deep Learning Meets Steganography: Protecting Inference Privacy in the Dark

Qin Liu (Hunan University & Temple University, China); Jiamin Yang and Hongbo Jiang (Hunan University, China); Jie Wu (Temple University, USA); Tao Peng (Guangzhou University, China); Tian Wang (Beijing Normal University & UIC, China); Guojun Wang (Guangzhou University, China) pp. 590-599

# B-3: Cloud

### Cutting Tail Latency in Commodity Datacenters with Cloudburst

Gaoxiong Zeng (Huawei Technologies, China); Li Chen (Huawei, China); Bairen Yi (Bytedance, China); Kai Chen (Hong Kong University of Science and Technology, China)

рр. 600-609

#### EdgeMatrix: A Resources Redefined Edge-Cloud System for Prioritized Services

Yuanming Ren, Shihao Shen, Yanli Ju and Xiaofei Wang (Tianjin University, China); Wenyu Wang (Shanghai Zhuichu Networking Technologies Co., Ltd., China); Victor C.M. Leung (Shenzhen University, China & The University of British Columbia, Canada) pp. 610-619

#### TRUST: Real-Time Request Updating with Elastic Resource Provisioning in Clouds

Jingzhou Wang, Gongming Zhao, Hongli Xu and Yangming Zhao (University of Science and Technology of China, China); Xuwei Yang (Huawei Technologies, China); He Huang (Soochow University, China) pp. 620-629

## VITA: Virtual Network Topology-aware Southbound Message Delivery in Clouds

Luyao Luo, Gongming Zhao and Hongli Xu (University of Science and Technology of China, China); Liguang Xie and Ying Xiong (Futurewei Technologies, USA) pp. 630-639

# C-3: Learning and Prediction

# Boosting Internet Card Cellular Business via User Portraits: A Case of Churn Prediction

Fan Wu and Ju Ren (Tsinghua University, China); Feng Lyu (Central South University, China); Peng Yang (Huazhong University of Science and Technology, China); Yongmin Zhang and Deyu Zhang (Central South University, China); Yaoxue Zhang (Tsinghua University, China) pp. 640-649

## *Lumos: towards Better Video Streaming QoE through Accurate Throughput Prediction*

Gerui Lv, Qinghua Wu, Weiran Wang and Zhenyu Li (Institute of Computing Technology, Chinese Academy of Sciences, China); Gaogang Xie (CNIC Chinese Academy of Sciences & University of Chinese Academy of Sciences, China) pp. 650-659

#### Poisoning Attacks on Deep Learning based Wireless Traffic Prediction

Tianhang Zheng and Baochun Li (University of Toronto, Canada) pp. 660-669

## PreGAN: Preemptive Migration Prediction Network for Proactive Fault-Tolerant Edge Computing

Shreshth Tuli and Giuliano Casale (Imperial College London, United Kingdom (Great Britain)); Nicholas Jennings (Imperial College, United Kingdom (Great Britain)) pp. 670-679

# D-3: RFID Applications

#### Encoding based Range Detection in Commodity RFID Systems

Xi Yu and Jia Liu (Nanjing University, China); Shigeng Zhang (Central South University, China); Xingyu Chen, Xu Zhang and Lijun Chen (Nanjing University, China) pp. 680-689

#### RC6D: An RFID and CV Fusion System for Real-time 6D Object Pose Estimation

Bojun Zhang (TianJin University, China); Mengning Li (Shanghai Jiao Tong University); Xin Xie (Hong Kong Polytechnic University, Hong Kong); Luoyi Fu (Shanghai Jiao Tong University, China); Xinyu Tong and Xiulong Liu (Tianjin University, China) pp. 690-699

#### **RCID:** Fingerprinting Passive RFID Tags via Wideband Backscatter

Jiawei Li, Ang Li, Dianqi Han and Yan Zhang (Arizona State University, USA); Tao Li (Indiana University-Purdue University Indianapolis, USA); Yanchao Zhang (Arizona State University, USA) pp. 700-709

### **Revisiting RFID Missing Tag Identification**

Kanghuai Liu (SYSU, China); Lin Chen (Sun Yat-sen University, China); Junyi Huang and Shiyuan Liu (SYSU, China); Jihong Yu (Beijing Institute of Technology, China) pp. 710-719

# E-3: Policy and Rules

#### CoToRu: Automatic Generation of Network Intrusion Detection Rules from Code

Heng Chuan Tan (Advanced Digital Sciences Center, Singapore); Carmen Cheh and Binbin Chen (Singapore University of Technology and Design, Singapore) pp. 720-729

#### Learning Buffer Management Policies for Shared Memory Switches

Mowei Wang, Sijiang Huang and Yong Cui (Tsinghua University, China); Wendong Wang (Beijing University of Posts and Telecommunications, China); Zhenhua Liu (Huawei Technologies, China) pp. 730-739

## Learning Optimal Antenna Tilt Control Policies: A Contextual Linear Bandit Approach

Filippo Vannella (KTH Royal Institute of Technology & Ericsson Research, Sweden); Alexandre Proutiere (KTH, Sweden); Yassir Jedra (KTH Royal Institute of Technology, Sweden); Jaeseong Jeong (Ericsson Research, Sweden) pp. 740-749

### Policy-Induced Unsupervised Feature Selection: A Networking Case Study

Jalil Taghia, Farnaz Moradi, Hannes Larsson and Xiaoyu Lan (Ericsson Research, Sweden); Masoumeh Ebrahimi (KTH Royal Institute of Techology & University of Turku, Sweden); Andreas Johnsson (Ericsson Research, Sweden) pp. 750-759

# F-3: Scheduling 1

AutoByte: Automatic Configuration for Optimal Communication Scheduling in DNN

#### Training

Yiqing Ma (HKUST, China); Hao Wang (HKUST, Hong Kong); Yiming Zhang (NUDT & NiceX Lab, China); Kai Chen (Hong Kong University of Science and Technology, China) pp. 760-769

## Joint Near-Optimal Age-based Data Transmission and Energy Replenishment Scheduling at Wireless-Powered Network Edge

Quan Chen (Guangdong University of Technology, China); Zhipeng Cai (Georgia State University, USA); Cheng Liang lun and Feng Wang (Guangdong University of Technology, China); Hong Gao (University of Harbin Institute Technology, China) pp. 770-779

## Kalmia: A Heterogeneous QoS-aware Scheduling Framework for DNN Tasks on Edge Servers

Ziyan Fu and Ju Ren (Tsinghua University, China); Deyu Zhang (Central South University, China); Yuezhi Zhou and Yaoxue Zhang (Tsinghua University, China) pp. 780-789

### Subset Selection for Hybrid Task Scheduling with General Cost Constraints

Yu Sun, Chi Lin, Jiankang Ren, Pengfei Wang, Lei Wang, Guowei WU and Qiang Zhang (Dalian University of Technology, China) pp. 790-799

# G-3: 5G and mmW Networks

### A Comparative Measurement Study of Commercial 5G mmWave Deployments

Arvind Narayanan (University of Minnesota, USA); Muhammad Iqbal Rochman (University of Chicago, USA); Ahmad Hassan (University of Minnesota, USA); Bariq S. Firmansyah (Institut Teknologi Bandung, Indonesia); Vanlin Sathya (University of Chicago, USA); Monisha Ghosh (University of Notre Dame, USA); Feng Qian (University of Minnesota, Twin Cities, USA); Zhi-Li Zhang (University of Minnesota, USA)

pp. 800-809

### AI in 5G: The Case of Online Distributed Transfer Learning over Edge Networks

Yulan Yuan (Beijing University of Posts and Telecommunications, China); Lei Jiao (University of Oregon, USA); Konglin Zhu (Beijing University of Posts and Telecommunications, China); Xiaojun Lin (Purdue University, USA); Lin Zhang (Beijing University of Posts and Telecommunications, China)

#### pp. 810-819

## *mmPhone: Acoustic Eavesdropping on Loudspeakers via mmWave-characterized Piezoelectric Effect*

Chao Wang, Feng Lin, Tiantian Liu, Ziwei Liu, Yijie Shen, Zhongjie Ba and Li Lu (Zhejiang University, China); Wenyao Xu (SUNY Buffalo & Wireless Health Institute, USA); Kui Ren (Zhejiang University, China) pp. 820-829

#### **Optimizing Coverage with Intelligent Surfaces for Indoor mmWave Networks**

Jingyuan Zhang and Douglas Blough (Georgia Institute of Technology, USA) pp. 830-839

## Break-1-May4: Virtual Coffee Break

# E-4: Pricing

#### DiFi: A Go-as-You-Pay Wi-Fi Access System

Lianjie Shi, Runxin Tian, Xin Wang and Richard T. B. Ma (National University of Singapore, Singapore) pp. 840-849

#### Online Data Valuation and Pricing for Machine Learning Tasks in Mobile Health

Anran Xu, Zhenzhe Zheng, Fan Wu and Guihai Chen (Shanghai Jiao Tong University, China)

pp. 850-859

#### **Online Pricing with Limited Supply and Time-Sensitive Valuations**

Shaoang Li, Lan Zhang and Xiang-Yang Li (University of Science and Technology of China, China) pp. 860-869

### *Optimal Pricing Under Vertical and Horizontal Interaction Structures for IoT Networks*

Ningning Ding (The Chinese University of Hong Kong, Hong Kong); Lin Gao (Harbin Institute of Technology (Shenzhen), China); Jianwei Huang (The Chinese University of Hong Kong, Shenzhen, China); Xin Li (Huawei Technologies, China); Xin Chen (Shanghai Research Center, Huawei Technologies, China) pp. 870-879

# F-4: Scheduling 2

# EdgeTuner: Fast Scheduling Algorithm Tuning for Dynamic Edge-Cloud Workloads and Resources

Rui Han, Shilin Wen, Chi Harold Liu, Ye Yuan and Guoren Wang (Beijing Institute of Technology, China); Lydia Y. Chen (IBM Zurich Research Laboratory, Switzerland) pp. 880-889

### *Optimizing Task Placement and Online Scheduling for Distributed GNN Training Acceleration*

Ziyue Luo, Yixin Bao and Chuan Wu (The University of Hong Kong, Hong Kong) pp. 890-899

#### Payment Channel Networks: Single-Hop Scheduling for Throughput Maximization

Nikolaos Papadis and Leandros Tassiulas (Yale University, USA) pp. 900-909

### Shield: Safety Ensured High-efficient Scheduling for Magnetic MIMO Wireless Power Transfer System

Wangqiu Zhou, Hao Zhou, Xiaoyu Wang, Kaiwen Guo, Haisheng Tan and Xiang-Yang Li (University of Science and Technology of China, China) pp. 910-919

# G-4: Algorithms 1

## *Copa+: Analysis and Improvement of thedelay-based congestion control algorithm Copa*

Wanchun Jiang, Haoyang Li, Zheyuan Liu, Jia Wu and Jiawei Huang (Central South University, China); Danfeng Shan (Xi'an Jiaotong University, China); Jianxin Wang (Central South University, China) pp. 920-929

#### Learning for Robust Combinatorial Optimization: Algorithm and Application

Zhihui Shao (UC Riverside, USA); Jianyi Yang (University of California, Riverside, USA); Cong Shen (University of Virginia, USA); Shaolei Ren (University of California, Riverside, USA) pp. 930-939

#### Polynomial-Time Algorithm for the Regional SRLG-disjoint Paths Problem

Balázs Vass (Budapest University of Technology and Economics, Hungary); Erika R. Bérczi-Kovács and Ábel Barabás (Eötvös University, Budapest, Hungary); Zsombor László Hajdú and János Tapolcai (Budapest University of Technology and Economics, Hungary)

pp. 940-949

## Provably Efficient Algorithms for Traffic-sensitive SFC Placement and Flow Routing

Yingling Mao, Xiaojun Shang and Yuanyuan Yang (Stony Brook University, USA) pp. 950-959

## Panel: Panel

## Break-2-May4: Virtual Lunch Break

# Award: A Reflection with INFOCOM Achievement Award Winner

## D-5: Mobile Applications 1

#### DeepEar: Sound Localization with Binaural Microphones

Qiang Yang and Yuanqing Zheng (The Hong Kong Polytechnic University, Hong Kong)

pp. 960-969

## Impact of Later-Stages COVID-19 Response Measures on Spatiotemporal Mobile Service Usage

André Felipe Zanella, Orlando E. Martínez-Durive and Sachit Mishra (IMDEA Networks Institute, Spain); Zbigniew Smoreda (Orange Labs & France Telecom Group, France); Marco Fiore (IMDEA Networks Institute, Spain) pp. 970-979

### SAH: Fine-grained RFID Localization with Antenna Calibration

Xu Zhang, Jia Liu, Xingyu Chen, Wenjie Li and Lijun Chen (Nanjing University, China) pp. 980-988

### Separating Voices from Multiple Sound Sources using 2D Microphone Array

Xinran Lu, Lei Xie and Fang Wang (Nanjing University, China); Tao Gu (Macquarie University, Australia); Chuyu Wang, Wei Wang and Sanglu Lu (Nanjing University, China) pp. 989-998

# E-5: AoI

## **A Theory of Second-Order Wireless Network Optimization and Its Application on Aol** Daojing Guo, Khaled Nakhleh and I-Hong Hou (Texas A&M University, USA); Sastry Kompella and Clement Kam (Naval Research Laboratory, USA)

## Age-Based Scheduling for Monitoring and Control Applications in Mobile Edge Computing Systems

Xingqiu He, Sheng Wang, Xiong Wang, Shizhong Xu and Jing Ren (University of Electronic Science and Technology of China, China) pp. 1009-1018

#### Aol-centric Task Scheduling for Autonomous Driving Systems

Chengyuan Xu, Qian Xu and Jianping Wang (City University of Hong Kong, Hong Kong); Kui Wu (University of Victoria, Canada); Kejie Lu (University of Puerto Rico at Mayaguez, Puerto Rico); Chunming Qiao (University at Buffalo, USA) pp. 1019-1028

### AoI-minimal UAV Crowdsensing by Model-based Graph Convolutional Reinforcement Learning

Zipeng Dai, Chi Harold Liu, Yuxiao Ye, Rui Han, Ye Yuan and Guoren Wang (Beijing Institute of Technology, China); Jian Tang (Syracuse University, USA) pp. 1029-1038

# F-5: Caching

# Caching-based Multicast Message Authentication in Time-critical Industrial Control Systems

Utku Tefek (Advanced Digital Sciences Center, Singapore & University of Illinois Urbana-Champaign, USA); Ertem Esiner (Advanced Digital Sciences Center, Singapore); Daisuke Mashima (Advanced Digital Sciences Center & National University of Singapore, Singapore); Binbin Chen (Singapore University of Technology and Design, Singapore); Yih-Chun Hu (University of Illinois at Urbana-Champaign, USA) pp. 1039-1048

#### Distributed Cooperative Caching in Unreliable Edge Environments

Yu Liu, Yingling Mao, Xiaojun Shang, Zhenhua Liu and Yuanyuan Yang (Stony Brook University, USA) pp. 1049-1058

#### Online File Caching in Latency-Sensitive Systems with Delayed Hits and Bypassing

Chi Zhang, Haisheng Tan and Guopeng Li (University of Science and Technology of China, China); Zhenhua Han (Microsoft Research Asia, China); Shaofeng H.-C. Jiang (Peking University, China); Xiang-Yang Li (University of Science and Technology of China, China) pp. 1059-1068

#### Retention-aware Container Caching for Serverless Edge Computing

Li Pan (Huazhong University of Science and Technology, China); Lin Wang (VU Amsterdam & TU Darmstadt, The Netherlands); Shutong Chen and Fangming Liu (Huazhong University of Science and Technology, China) pp. 1069-1078

# G-5: Algorithms 2

## A Unified Model for Bi-objective Online Stochastic Bipartite Matching with Twosided Limited Patience

Gaofei Xiao and Jiaqi Zheng (Nanjing University, China); Haipeng Dai (Nanjing University & State Key Laboratory for Novel Software Technology, China) pp. 1079-1088

#### Lazy Self-Adjusting Bounded-Degree Networks for the Matching Model

Evgeniy Feder (ITMO University, Russia); Ichha Rathod and Punit Shyamsukha (Indian Institute of Technology Delhi, India); Robert Sama (University of Vienna, Austria); Vitaly Aksenov (ITMO University, Russia); Iosif Salem and Stefan Schmid (University of Vienna, Austria)

pp. 1089-1098

## Maximizing h-hop Independently Submodular Functions Under Connectivity Constraint

Wenzheng Xu and Dezhong Peng (Sichuan University, China); Weifa Liang and Xiaohua Jia (City University of Hong Kong, Hong Kong); Zichuan Xu (Dalian University of Technology, China); Pan Zhou (School of CSE, Huazhong University of Science and Technology, China); Weigang Wu and Xiang Chen (Sun Yat-sen University, China) pp. 1099-1108

# *Optimal Shielding to Guarantee Region-Based Connectivity under Geographical Failures*

Binglin Tao, Mingyu Xiao, Bakhadyr Khoussainov and Junqiang Peng (University of Electronic Science and Technology of China, China) pp. 1109-1118

# Break-3-May4: Virtual Coffee Break A-6: Mobile Security

# Big Brother is Listening: An Evaluation Framework on Ultrasonic Microphone Jammers

Yike Chen, Ming Gao, Yimin Li, Lingfeng Zhang, Li Lu and Feng Lin (Zhejiang University, China); Jinsong Han (Zhejiang University & School of Cyber Science and Technology, China); Kui Ren (Zhejiang University, China) pp. 1119-1128

# InertiEAR: Automatic and Device-independent IMU-based Eavesdropping on Smartphones

Ming Gao, Yajie Liu, Yike Chen, Yimin Li, Zhongjie Ba and Xian Xu (Zhejiang University, China); Jinsong Han (Zhejiang University & School of Cyber Science and Technology, China) pp. 1129-1138

# JADE: Data-Driven Automated Jammer Detection Framework for Operational Mobile Networks

Caner Kilinc (University of Edinburgh, Sweden); Mahesh K Marina (The University of Edinburgh, United Kingdom (Great Britain)); Muhammad Usama (Information Technology University (ITU), Punjab, Lahore, Pakistan); Salih Ergüt (Oredata, Turkey & Rumeli University, Turkey); Jon Crowcroft (University of Cambridge, United Kingdom (Great Britain)); Tugrul Gundogdu and Ilhan Akinci (Turkcell, Turkey) pp. 1139-1148

### MDoC: Compromising WRSNs through Denial of Charge by Mobile Charger

Chi Lin, Pengfei Wang, Qiang Zhang, Hao Wang, Lei Wang and Guowei WU (Dalian University of Technology, China) pp. 1149-1158

# B-6: Edge Computing

### MoDEMS: Optimizing Edge Computing Migrations For User Mobility

Taejin Kim (Carnegie Mellon University, USA); Sandesh Dhawaskar Sathyanarayana (Energy Sciences Network, Lawrence Berkeley National Laboratory & University of Colorado Boulder, USA); Siqi Chen (University of Colorado Boulder, USA); Youngbin Im (Ulsan National Institute of Science and Technology, Korea (South)); Xiaoxi Zhang (Sun Yat-sen University, China); Sangtae Ha (University of Colorado Boulder, USA); Carlee Joe-Wong (Carnegie Mellon University, USA)

## Optimal Admission Control Mechanism Design for Time-Sensitive Services in Edge Computing

Shutong Chen (Huazhong University of Science and Technology, China); Lin Wang (VU Amsterdam & TU Darmstadt, The Netherlands); Fangming Liu (Huazhong University of Science and Technology, China) pp. 1169-1178

## Towards Online Privacy-preserving Computation Offloading in Mobile Edge Computing

Xiaoyi Pang (Wuhan University, China); Zhibo Wang (Zhejiang University, China); Jingxin Li and Ruiting Zhou (Wuhan University, China); Ju Ren (Tsinghua University, China); Zhetao Li (Xiangtan University, China) pp. 1179-1188

## Two Time-Scale Joint Service Caching and Task Offloading for UAV-assisted Mobile Edge Computing

Ruiting Zhou and Xiaoyi Wu (Wuhan University, China); Haisheng Tan (University of Science and Technology of China, China); Renli Zhang (Wuhan University, China) pp. 1189-1198

# C-6: Learning at the Edge

# Decentralized Task Offloading in Edge Computing: A Multi-User Multi-Armed Bandit Approach

Xiong Wang (Huazhong University of Science and Technology, China); Jiancheng Ye (Huawei, Hong Kong); John C.S. Lui (The Chinese University of Hong Kong, Hong Kong)

pp. 1199-1208

### Deep Learning on Mobile Devices Through Neural Processing Units and Edge Computing

Tianxiang Tan and Guohong Cao (The Pennsylvania State University, USA) pp. 1209-1218

### Learning-based Multi-Drone Network Edge Orchestration for Video Analytics

Chengyi Qu, Rounak Singh, Alicia Esquivel Morel and Prasad Calyam (University of Missouri-Columbia, USA) pp. 1219-1228

#### Online Model Updating with Analog Aggregation in Wireless Edge Learning

Juncheng Wang (University of Toronto, Canada); Min Dong (Ontario Tech University, Canada); Ben Liang (University of Toronto, Canada); Gary Boudreau (Ericsson, Canada); Hatem Abou-Zeid (University of Calgary, Canada) pp. 1229-1238

# D-6: Mobile Applications 2

## **An RFID and Computer Vision Fusion System for Book Inventory using Mobile Robot** Jiuwu Zhang and Xiulong Liu (Tianjin University, China); Tao Gu (Macquarie University, Australia); Bojun Zhang (TianJin University, China); Dongdong Liu, Zijuan Liu and Keqiu Li (Tianjin University, China) pp. 1239-1248

### GASLA: Enhancing the Applicability of Sign Language Translation

Jiao Li, Yang Liu, Weitao Xu and Zhenjiang Li (City University of Hong Kong, Hong Kong) pp. 1249-1258

# Tackling Multipath and Biased Training Data for IMU-Assisted BLE Proximity Detection

Tianlang He and Jiajie Tan (The Hong Kong University of Science and Technology, China); Steve Zhuo (HKUST, Hong Kong); Maximilian Printz and S.-H. Gary Chan (The Hong Kong University of Science and Technology, China) pp. 1259-1268

#### VR Viewport Pose Model for Quantifying and Exploiting Frame Correlations

Ying Chen and Hojung Kwon (Duke University, USA); Hazer Inaltekin (Macquarie University, Australia); Maria Gorlatova (Duke University, USA) pp. 1269-1278

# E-6: QoE

### Adaptive Bitrate with User-level QoE Preference for Video Streaming

Xutong Zuo (Tsinghua University, China); Jiayu Yang (Beijing University of Posts and Telecommunications, China); Mowei Wang and Yong Cui (Tsinghua University, China) pp. 1279-1288

#### Enabling QoE Support for Interactive Applications over Mobile Edge with High User

#### Mobility

Xiaojun Shang (Stony Brook University, USA); Yaodong Huang (Shenzhen University, China); Yingling Mao, Zhenhua Liu and Yuanyuan Yang (Stony Brook University, USA) pp. 1289-1298

#### On Uploading Behavior and Optimizations of a Mobile Live Streaming Service

Jinyang Li, Zhenyu Li and Qinghua Wu (Institute of Computing Technology, Chinese Academy of Sciences, China); Gareth Tyson (Queen Mary, University of London, United Kingdom (Great Britain)) pp. 1299-1308

#### VSiM: Improving QoE Fairness for Video Streaming in Mobile Environments

Yali Yuan (University of Goettingen, Germany); Weijun Wang (Nanjing University & University of Goettingen, China); Yuhan Wang (Göttingen University, Germany); Sripriya Adhatarao (Uni Goettingen, Germany); Bangbang Ren (National University of Defense Technology, China); Kai Zheng (Huawei Technologies, China); Xiaoming Fu (University of Goettingen, Germany) pp. 1309-1318

# F-6: Low Latency

# Dino: A Block Transmission Protocol with Low Bandwidth Consumption and Propagation Latency

Zhenxing Hu and Zhen Xiao (Peking University, China) pp. 1319-1328

# Enabling Low-latency-capable Satellite-Ground Topology for Emerging LEO Satellite Networks

Yaoying Zhang, Qian Wu, Zeqi Lai and Hewu Li (Tsinghua University, China) pp. 1329-1338

## SPACERTC: Unleashing the Low-latency Potential of Mega-constellations for Real-Time Communications

Zeqi Lai, Weisen Liu, Qian Wu and Hewu Li (Tsinghua University, China); Jingxi Xu (Tencent, China); Jianping Wu (Tsinghua University, China) pp. 1339-1348

## Torp: Full-Coverage and Low-Overhead Profiling of Host-Side Latency

Xiang Chen (Zhejiang University, Peking University, and Fuzhou University, China); Hongyan Liu (Zhejiang University, China); Junyi Guo (Peking University, China); Xinyue Jiang (Zhejiang University, China); Qun Huang (Peking University, China); Dong Zhang (Fuzhou University, China); Chunming Wu and Haifeng Zhou (Zhejiang University, China) pp. 1349-1358

# G-6: Algorithms 3

## Ao\(^2\)I: Minimizing Age of Outdated Information to Improve Freshness in Data Collection

Qingyu Liu, Chengzhang Li, Thomas Hou, Wenjing Lou and Jeffrey Reed (Virginia Tech, USA); Sastry Kompella (Naval Research Laboratory, USA) pp. 1359-1368

# CausalRD: A Causal View of Rumor Detection via Eliminating Popularity and Conformity Biases

Weifeng Zhang, Ting Zhong and Ce Li (University of Electronic Science and Technology of China, China); Kunpeng Zhang (University of Maryland, USA); Fan Zhou (University of Electronic Science and Technology of China, China) pp. 1369-1378

### Learning from Delayed Semi-Bandit Feedback under Strong Fairness Guarantees

Juaren Steiger (Queen's University, Canada); Bin Li (The Pennsylvania State University, USA); Ning Lu (Queen's University, Canada) pp. 1379-1388

## Optimizing Sampling for Data Freshness: Unreliable Transmissions with Random Two-way Delay

Jiayu Pan and Ahmed M Bedewy (The Ohio State University, USA); Yin Sun (Auburn University, USA); Ness B. Shroff (The Ohio State University, USA) pp. 1389-1398 Break-4-May4: Virtual Dinner Break

- Poster-1: Poster Session 1
- Poster-2: Poster Session 2
- Poster-3: Poster Session 3
- Poster-4: Poster Session 4
- Poster-5: Poster Session 5

## A-7: Attacks

#### Connectivity Maintenance in Uncertain Networks under Adversarial Attack

Jianzhi Tang, Luoyi Fu and Jiaxin Ding (Shanghai Jiao Tong University, China); Xinbing Wang (Shanghai Jiaotong University, China); Guihai Chen (Shanghai Jiao Tong University, China) pp. 1399-1408

# *FeCo: Boosting Intrusion Detection Capability in IoT Networks via Contrastive Learning*

Ning Wang (Virginia Tech, USA); Yimin Chen (University of Massachusetts Lowell, USA); Yang Hu (Virgina Tech, USA); Wenjing Lou and Thomas Hou (Virginia Tech, USA) pp. 1409-1418

# PhoneyTalker: An Out-of-the-Box Toolkit for Adversarial Example Attack on Speaker

#### Recognition

Meng Chen, Li Lu, Zhongjie Ba and Kui Ren (Zhejiang University, China) pp. 1419-1428

# *TrojanFlow: A Neural Backdoor Attack to Deep Learning-based Network Traffic Classifiers*

Rui Ning, ChunSheng Xin and Hongyi Wu (Old Dominion University, USA) pp. 1429-1438

# B-7: Federated Learning 1

## A Profit-Maximizing Model Marketplace with Differentially Private Federated Learning

Peng Sun (The Chinese University of Hong Kong, Shenzhen, China); Xu Chen (Sun Yat-sen University, China); Guocheng Liao (Sun Yat-Sen University, China); Jianwei

Huang (The Chinese University of Hong Kong, Shenzhen, China) pp. 1439-1448

# *Communication-Efficient Device Scheduling for Federated Learning Using Stochastic Optimization*

Jake Perazzone (US Army Research Lab, USA); Shiqiang Wang (IBM T. J. Watson Research Center, USA); Mingyue Ji (University of Utah, USA); Kevin S Chan (US Army Research Laboratory, USA) pp. 1449-1458

#### **Optimal Rate Adaption in Federated Learning with Compressed Communications**

Laizhong Cui and Xiaoxin Su (Shenzhen University, China); Yipeng Zhou (Macquarie University, Australia); Jiangchuan Liu (Simon Fraser University, Canada) pp. 1459-1468

### Towards Optimal Multi-modal Federated Learning on Non-IID Data with Hierarchical Gradient Blending

Sijia Chen and Baochun Li (University of Toronto, Canada) pp. 1469-1478

# C-7: Crowdsensing

### A Comparative Approach to Resurrecting the Market of MOD Vehicular Crowdsensing

Chaocan Xiang (Chongqing University, China); Yaoyu Li (ChongQing University, China); Yanlin Zhou (Chongqing University, China); Suining He (The University of Connecticut, USA); Yuben Qu (Nanjing University of Aeronautics and Astronautics, China); Zhenhua Li (Tsinghua University, China); Liangyi Gong (Computer Network Information Center, Chinese Academy of Sciences, China); Chao Chen (Chongqing University, China) pp. 1479-1488

#### Real-Time Execution of Trigger-Action Connection for Home Internet-of-Things

Kai Dong, Yakun Zhang, Yuchen Zhao, Daoming Li, Zhen Ling and Wenjia Wu (Southeast University, China); Xiaorui Zhu (Nanjing Xiaozhuang University, China) pp. 1489-1498

#### Spatiotemporal Fracture Data Inference in Sparse Urban CrowdSensing

En Wang, Mijia Zhang and Yuanbo Xu (Jilin University, China); Haoyi Xiong (Baidu, USA); Yongjian Yang (Jilin University, China) pp. 1499-1508

#### Worker Selection Towards Data Completion for Online Sparse Crowdsensing

Wenbin Liu, En Wang and Yongjian Yang (Jilin University, China); Jie Wu (Temple University, USA) pp. 1509-1518

# D-7: Network Functions and Tasking

### An Efficient Two-Layer Task Offloading Scheme for MEC Networks with Multiple Services Providers

Ju Ren and Jiani Liu (Tsinghua University, China); Yongmin Zhang and Zhaohui Li (Central South University, China); Zhibo Wang (Zhejiang University, China); Feng Lyu (Central South University, China); Yaoxue Zhang (Tsinghua University, China) pp. 1519-1528

#### **Dyssect: Dynamic Scaling of Stateful Network Functions**

Fabricio Carvalho (Federal University of Mato Grosso do Sul, Brazil); Ronaldo A. Ferreira (UFMS, Brazil); Italo Cunha (Universidade Federal de Minas Gerais, Brazil); Marcos A. M. Vieira (Federal University of Minas Gerais, Brazil); Murali K Ramanathan (Uber Technologies Inc, USA) pp. 1529-1538

# Network Synthesis under Delay Constraints: The Power of Network Calculus Differentiability

Fabien Geyer (Airbus, Germany); Steffen Bondorf (Ruhr University Bochum, Germany) pp. 1539-1548

#### User Experience Oriented Task Computation for UAV-Assisted MEC System

Lutian Shen (Yunnan University, China) pp. 1549-1558

# E-7: Optimization

## Energy-Efficient Trajectory Optimization for Aerial Video Surveillance under QoS Constraints

Cheng Zhan (Southwest University, China); Han Hu (Beijing Institute of Technology, China); Shiwen Mao (Auburn University, USA); Jing Wang (Renmin University of China, China) pp. 1559-1568

### GADGET: Online Resource Optimization for Scheduling Ring-All-Reduce Learning

Jobs

Menglu Yu and Ye Tian (Iowa State University, USA); Bo Ji (Virginia Tech, USA); Chuan Wu (The University of Hong Kong, Hong Kong); Hridesh Rajan (Iowa State University, USA); Jia Liu (The Ohio State University, USA) pp. 1569-1578

### Midpoint Optimization for Segment Routing

Alexander Brundiers (Osnabrück University, Germany); Timmy Schüller (Deutsche Telekom Technik GmbH & Osnabrück University, Germany); Nils Aschenbruck (Osnabrück University, Germany) pp. 1579-1588

## On Designing Secure Cross-user Redundancy Elimination for WAN Optimization

Yuan Zhang, Ziwei Zhang, Minze Xu, Chen Tian and Sheng Zhong (Nanjing University, China) pp. 1589-1598

# F-7: Vehicular Systems

# ANTIGONE: Accurate Navigation Path Caching in Dynamic Road Networks leveraging Route APIs

Xiaojing Yu and Xiang-Yang Li (University of Science and Technology of China, China); Jing Zhao (Illinois Institute of Technology, USA); Guobin Shen (Joveai Inc, USA); Nikolaos M. Freris and Lan Zhang (University of Science and Technology of China, China)

рр. 1599-1608

## Cutting Through the Noise to Infer Autonomous System Topology

Kirtus G Leyba and Joshua J. Daymude (Arizona State University, USA); Jean-Gabriel Young (University of Vermont, USA); Mark Newman (University of Michigan, USA); Jennifer Rexford (Princeton University, USA); Stephanie Forrest (Arizona State University, USA) pp. 1609-1618

## Joint Order Dispatch and Charging for Electric Self-Driving Taxi Systems

Guiyun Fan, Haiming Jin and Yiran Zhao (Shanghai Jiao Tong University, China); Yiwen Song (Carnegie Mellon University, USA); Xiaoying Gan and Jiaxin Ding (Shanghai Jiao Tong University, China); Lu Su (Purdue University, USA); Xinbing Wang (Shanghai Jiaotong University, China) pp. 1619-1628

#### Vehicle-to-Nothing? Securing C-V2X Against Protocol-Aware DoS Attacks

Geoff Twardokus and Hanif Rahbari (Rochester Institute of Technology, USA) pp. 1629-1638

# G-7: Data and Datacenters

#### Constrained In-network Computing with Low Congestion in Datacenter Networks

Raz Segal, Chen Avin and Gabriel Scalosub (Ben-Gurion University of the Negev, Israel)

pp. 1639-1648

# Fast and Heavy Disjoint Weighted Matchings for Demand-Aware Datacenter Topologies

Kathrin Hanauer, Monika Henzinger, Stefan Schmid and Jonathan Trummer (University of Vienna, Austria) pp. 1649-1658

# Jingwei: An Efficient and Adaptable Data Migration Strategy for Deduplicated Storage Systems

Geyao Cheng, Deke Guo, Lailong Luo, Junxu Xia and Yuchen Sun (National University of Defense Technology, China) pp. 1659-1668

### **Optimal Data Placement for Stripe Merging in Locally Repairable Codes**

Si Wu and Qingpeng Du (University of Science and Technology of China, China); Patrick Pak-Ching Lee (The Chinese University of Hong Kong, Hong Kong); Yongkun Li and Yinlong Xu (University of Science and Technology of China, China) pp. 1669-1678

# Break-1-May5: Virtual Coffee Break

# A-8: Attacks and Security

## 6Forest: An Ensemble Learning-based Approach to Target Generation for Internetwide IPv6 Scanning

Tao Yang, Bingnan Hou, Tongqing Zhou and Zhiping Cai (National University of Defense Technology, China) pp. 1679-1688

## Auter: Automatically Tuning Multi-layer Network Buffers in Long-Distance Shadowsocks Networks

Xu He (George Mason University, USA); Jiahao Cao (Tsinghua University, China); Shu Wang and Kun Sun (George Mason University, USA); Lisong Xu (University of Nebraska-Lincoln, USA); Qi Li (Tsinghua University, China) pp. 1689-1698

#### FUME: Fuzzing Message Queuing Telemetry Transport Brokers

Bryan Pearson (University of Central Florida, USA); Yue Zhang (Jinan University, China); Cliff Zou (University of Central Florida, USA); Xinwen Fu (University of Massachusetts Lowell, USA) pp. 1699-1708

#### Large-scale Evaluation of Malicious Tor Hidden Service Directory Discovery

Chunmian Wang, Zhen Ling, Wenjia Wu, Qi Chen and Ming Yang (Southeast University, China); Xinwen Fu (University of Massachusetts Lowell, USA) pp. 1709-1718

# B-8: Federated Learning 2

## FLASH: Federated Learning for Automated Selection of High-band mmWave Sectors

Batool Salehihikouei, Jerry Z Gu, Debashri Roy and Kaushik Chowdhury (Northeastern University, USA) pp. 1719-1728

## Joint Superposition Coding and Training for Federated Learning over Multi-Width Neural Networks

Hankyul Baek, Won Joon Yun and Yunseok Kwak (Korea University, Korea (South)); Soyi Jung (Hallym University, Korea (South)); Mingyue Ji (University of Utah, USA); Mehdi Bennis (Centre of Wireless Communications, University of Oulu, Finland); Jihong Park (Deakin University, Australia); Joongheon Kim (Korea University, Korea (South))

## рр. 1729-1738

## Tackling System and Statistical Heterogeneity for Federated Learning with Adaptive Client Sampling

Bing Luo (Shenzhen Institute of Artificial Intelligence and Robotics for Society & The Chinese University of Hong Kong, Shenzhen, China); Wenli Xiao (The Chinese University of Hong Kong, Shenzhen, China); Shiqiang Wang (IBM T. J. Watson Research Center, USA); Jianwei Huang (The Chinese University of Hong Kong, Shenzhen, China); Leandros Tassiulas (Yale University, USA) pp. 1739-1748

# *The Right to be Forgotten in Federated Learning: An Efficient Realization with Rapid Retraining*

Yi Liu (City University of Hong Kong, China); Lei Xu (Nanjing University of Science and Technology, China); Xingliang Yuan (Monash University, Australia); Cong Wang (City University of Hong Kong, Hong Kong); Bo Li (Hong Kong University of Science and Technology, Hong Kong) pp. 1749-1758

## C-8: Mobile Sensing

#### Can We Obtain Fine-grained Heartbeat Waveform via Contact-free RF-sensing?

Shujie Zhang and Tianyue Zheng (Nanyang Technological University, Singapore); Zhe Chen (School of Computer Science and Engineering, Nangyang Technological University, Singapore); Jun Luo (Nanyang Technological University, Singapore) pp. 1759-1768

# DroneSense: Leveraging Drones for Sustainable Urban-scale Sensing of Open Parking Spaces

Dong Zhao (Beijing University of Posts and Telecommunications, China); Mingzhe Cao (BeiUniversity of Posts and Telecommunications, China); Lige Ding, Qiaoyue Han, Yunhao Xing and Huadong Ma (Beijing University of Posts and Telecommunications, China) pp. 1769-1778

#### **RF-Wise: Pushing the Limit of RFID-based Sensing**

Cui Zhao (Xi'an Jiaotong University, China); Zhenjiang Li (City University of Hong Kong, Hong Kong); Han Ding (Xi'an Jiaotong University, China); Ge Wang (Xi'an Jiaotong University, China); Wei Xi and Jizhong Zhao (Xi'an Jiaotong University, China) pp. 1779-1788

#### TeethPass: Dental Occlusion-based User Authentication via In-ear Acoustic Sensing

Yadong Xie and Fan Li (Beijing Institute of Technology, China); Yue Wu (Tsinghua University, China); Huijie Chen (Beijing University of Technology, China); Zhiyuan Zhao (Beijing Institute of Technology, China); Yu Wang (Temple University, USA) pp. 1789-1798

# D-8: Online Learning

# Online Learning-Based Rate Selection for Wireless Interactive Panoramic Scene Delivery

Harsh Gupta (University of Illinois at Urbana-Champaign, USA); Jiangong Chen and Bin Li (The Pennsylvania State University, USA); R. Srikant (University of Illinois at Urbana-Champaign, USA) pp. 1799-1808

# Schedule or Wait: Age-Minimization for IoT Big Data Processing in MEC via Online Learning

Zichuan Xu and Wenhao Ren (Dalian University of Technology, China); Weifa Liang (City University of Hong Kong, Hong Kong); Wenzheng Xu (Sichuan University, China); Qiufen Xia (Dalian University of Technology, China); Pan Zhou (School of CSE, Huazhong University of Science and Technology, China); Mingchu Li (School of Software, Dalian University of Technology, China) pp. 1809-1818

## Sending Timely Status Updates through Channel with Random Delay via Online Learning

Haoyue Tang, Yuchao Chen, Jintao Wang and Jingzhou Sun (Tsinghua University, China); Jian Song (Tsinghua University & Beijing National Research Center for Information Science and Technology & Key Lab of DTV System of Guangdong & Shenzhen, Research Institute of Tsinghua University in Shenzhen, China) pp. 1819-1827

### Socially-Optimal Mechanism Design for Incentivized Online Learning

Zhiyuan Wang (Beihang University, China); Lin Gao (Harbin Institute of Technology (Shenzhen), China); Jianwei Huang (The Chinese University of Hong Kong, Shenzhen, China) pp. 1828-1837

## E-8: Resource Management

#### Energy Saving in Heterogeneous Wireless Rechargeable Sensor Networks

Riheng Jia, Jinhao Wu, Jianfeng Lu, Minglu Li, Feilong Lin and Zhonglong Zheng (Zhejiang Normal University, China) pp. 1838-1847

#### Escala: Timely Elastic Scaling of Control Channels in Network Measurement

Hongyan Liu (Zhejiang University, China); Xiang Chen (Zhejiang University, Peking

University, and Fuzhou University, China); Qun Huang (Peking University, China); Dezhang Kong (Zhejiang University, China); Sun Jinbo (Institute of Computing Technology, Chinese Academy of Sciences, China); Dong Zhang (Fuzhou University, China); Haifeng Zhou and Chunming Wu (Zhejiang University, China) pp. 1848-1857

#### LSAB: Enhancing Spatio-Temporal Efficiency of AoA Tracking Systems

Qingrui Pan, Zhenlin An and Qiongzheng Lin (The Hong Kong Polytechnic University, Hong Kong); Lei Yang (The Hong Kong Polytechnic University, China) pp. 1858-1867

# StepConf: SLO-Aware Dynamic Resource Configuration for Serverless Function Workflows

Zhaojie Wen, Yishuo Wang and Fangming Liu (Huazhong University of Science and Technology, China) pp. 1868-1877

# F-8: Video Analytics

## ArmSpy: Video-assisted PIN Inference Leveraging Keystroke-induced Arm Posture Changes

Yuefeng Chen, YiCong Du, Chunlong Xu, Yanghai Yu and Hongbo Liu (University of Electronic Science and Technology of China, China); Huan Dai (Suzhou University of Science and Technology, China); Yanzhi Ren (University of Electronic Science and Technology of China, China); Jiadi Yu (Shanghai Jiao Tong University, China) pp. 1878-1887

# DNN-Driven Compressive Offloading for Edge-Assisted Semantic Video Segmentation

Xuedou Xiao, Juecheng Zhang and Wei Wang (Huazhong University of Science and Technology, China); Jianhua He (Essex University, United Kingdom (Great Britain)); Qian Zhang (Hong Kong University of Science and Technology, Hong Kong) pp. 1888-1897

# *FlexPatch: Fast and Accurate Object Detection for On-device High-Resolution Live Video Analytics*

Kichang Yang, Juheon Yi and Kyungjin Lee (Seoul National University, Korea (South)); Youngki Lee (Seoul National University, Singapore) pp. 1898-1907

#### *Learning for Crowdsourcing: Online Dispatch for Video Analytics with Guarantee*

Yu Chen, Sheng Zhang, Yibo Jin and Zhuzhong Qian (Nanjing University, China); Mingjun Xiao (University of Science and Technology of China, China); Ning Chen and Zhi Ma (Nanjing University, China) pp. 1908-1917

# G-8: Networks Protocols 1

### Add/Drop Flexibility and System Complexity Tradeoff in ROADM Designs

Lexin Pan (Shanghai Jiao Tong University, China); Tong Ye (Shanghai JiaoTong University, China) pp. 1918-1927

#### Detecting and Resolving PFC Deadlocks with ITSY Entirely in the Data Plane

Xinyu Crystal Wu and T. S. Eugene Ng (Rice University, USA) pp. 1928-1937

# Mousika: Enable General In-Network Intelligence in Programmable Switches by Knowledge Distillation

Guorui Xie (Tsinghua University, China); Qing Li (Peng Cheng Laboratory, China); Yutao Dong and Guanglin Duan (Tsinghua University, China); Yong Jiang (Graduate School at Shenzhen, Tsinghua University, China); Jingpu Duan (Southern University of Science and Technology, China) pp. 1938-1947

### Persistent Items Tracking in Large Data Streams Based on Adaptive Sampling

Lin Chen (Sun Yat-sen University, China); Raphael C.-W. Phan (Monash University, Malaysia); Zhili Chen (East China Normal University, China); Dan Huang (University of Central Florida, USA) pp. 1948-1957

# Break-2-May5: Virtual Lunch Break

# A-9: Blockchain

### Blockchain Based Non-repudiable IoT Data Trading: Simpler, Faster, and Cheaper

Fei Chen, Jiahao Wang and Changkun Jiang (Shenzhen University, China); Tao Xiang (Chongqing University, China); Yuanyuan Yang (Stony Brook University, USA) pp. 1958-1967

#### BrokerChain: A Cross-Shard Blockchain Protocol for Account/Balance-based State

#### Sharding

Huawei Huang, Xiaowen Peng, Jianzhou Zhan, Shenyang Zhang and Yue Lin (Sun Yat-Sen University, China); Zibin Zheng (School of Data and Computer Science, Sun Yat-sen University, China); Song Guo (The Hong Kong Polytechnic University, Hong Kong) pp. 1968-1977

#### S-Store:: A Scalable Data Store towards Permissioned Blockchain Sharding

Xiaodong Qi (East China Normal University, China) pp. 1978-1987

#### **Optimal Oblivious Routing for Structured Networks**

Sucha Supittayapornpong (Vidyasirimedhi Institute of Science and Technology, Thailand); Pooria Namyar (University of Southern California, USA); Mingyang Zhang (University of Science and Technology of China, China); Minlan Yu (Harvard University, USA); Ramesh Govindan (University of Southern California, USA) pp. 1988-1997

# B-9: Graph Machine Learning

# MalGraph: Hierarchical Graph Neural Networks for Robust Windows Malware Detection

Xiang Ling (Institute of Software, Chinese Academy of Sciences & Zhejiang University, China); Lingfei Wu (JD.COM Silicon Valley Research Center, USA); Wei Deng, Zhenqing Qu, Jiangyu Zhang and Sheng Zhang (Zhejiang University, China); Tengfei Ma (IBM T. J. Watson Research Center, USA); Bin Wang (Hangzhou Hikvision Digital Technology Co., Ltd, China); Chunming Wu (College of Computer Science, Zhejiang University, China); Shouling Ji (Zhejiang University, China & Georgia Institute of Technology, USA) pp. 1998-2007

#### Nadege: When Graph Kernels meet Network Anomaly Detection

Hicham Lesfari (Université Côte d'Azur, France); Frederic Giroire (CNRS, France) pp. 2008-2017

#### RouteNet-Erlang: A Graph Neural Network for Network Performance Evaluation

Miquel Ferriol-Galmés (Universitat Politècnica de Catalunya, Spain); Krzysztof Rusek (AGH University of Science and Technology, Poland); Jose Suarez-Varela (Universitat Politècnica de Catalunya, Spain); Shihan Xiao, Xiang Shi, Xiangle Cheng and Bo Wu (Huawei Technologies, China); Pere Barlet-Ros and Albert Cabellos-Aparicio (Universitat Politècnica de Catalunya, Spain) pp. 2018-2027

# xNet: Improving Expressiveness and Granularity for Network Modeling with Graph Neural Networks

Mowei Wang, Linbo Hui and Yong Cui (Tsinghua University, China); Ru Liang (Huawei Technologies Co., Ltd., China); Zhenhua Liu (Huawei Technologies, China) pp. 2028-2037

# C-9: Machine Learning

#### ABS: Adaptive Buffer Sizing via Augmented Programmability with Machine Learning

Jiaxin Tang, Sen Liu and Yang Xu (Fudan University, China); Zehua Guo (Beijing Institute of Technology, China); Junjie Zhang (Fortinet, Inc., USA); Peixuan Gao (Fudan University, USA & New York University, USA); Yang Chen and Xin Wang (Fudan University, China); H. Jonathan Chao (NYU Tandon School of Engineering, USA)

pp. 2038-2047

#### Network Link Weight Setting: A Machine Learning Based Approach

Murali Kodialam (Nokia Bell Labs, USA); T. V Lakshman (Bell Labs, Nokia, USA) pp. 2048-2057

#### *NeuroMessenger: Towards Error Tolerant Distributed Machine Learning Over Edge Networks*

Song Wang (University of California San Diego, USA); Xinyu Zhang (University of California San Diego & University of Wisconsin-Madison, USA) pp. 2058-2067

#### Real-time Machine Learning for Symbol Detection in MIMO-OFDM Systems

Yibin Liang, Lianjun Li, Yang (Cindy) Yi and Lingjia Liu (Virginia Tech, USA) pp. 2068-2077

## D-9: Reinforcement Learning

Cost Effective MLaaS Federation: A Combinatorial Reinforcement Learning Approach

Shuzhao Xie and Yuan Xue (Tsinghua University, China); Yifei Zhu (Shanghai Jiao Tong University, China); Zhi Wang (Tsinghua University, China) pp. 2078-2087

## Landing Reinforcement Learning onto Smart Scanning of The Internet of Things

Jian Qu and Xiaobo Ma (Xi'an Jiaotong University, China); Wenmao Liu and

Hongqing Sang (NSFOCUS Inc., China); Jianfeng Li (Xi'an Jiaotong University, China); Lei Xue and Xiapu Luo (The Hong Kong Polytechnic University, Hong Kong); Zhenhua Li (Tsinghua University, China); Li Feng (Center of Dependable and Secure Computing (CDSC), China); Xiaohong Guan (Xi'an Jiaotong University & Tsinghua University, China) pp. 2088-2097

### *Multi-Agent Distributed Reinforcement Learning for Making Decentralized Offloading Decisions*

Jing Tan (Paderborn University, Germany); Ramin Khalili (Huawei Technologies, Germany); Holger Karl (Hasso Plattner Institute & University of Potsdam, Germany); Artur Hecker (Huawei, Germany) pp. 2098-2107

## Reinforcement Learning for Dynamic Dimensioning of Cloud Caches: A Restless Bandit Approach

Guojun Xiong and Shufan Wang (Binghamton University, USA); Gang Yan (Binghamton University-SUNY, USA); Jian Li (Binghamton University, USA) pp. 2108-2117

# E-9: Networks and Monitoring

# Accelerating Deep Learning classification with error-controlled approximate-key caching

Alessandro Finamore (HUAWEI France, France); Massimo Gallo (Huawei, France); James Roberts (Telecom ParisTech, France); Dario Rossi (Huawei Technologies, France) pp. 2118-2127

# Lightweight Trilinear Pooling based Tensor Completion for Network Traffic Monitoring

Yudian Ouyang and Kun Xie (Hunan University, China); Xin Wang (Stony Brook University, USA); Jigang Wen (Chinese Academy of Science & Institute of Computing Technology, China); Guangxing Zhang (Institute of Computing Technology Chinese Academy of Sciences, China) pp. 2128-2137

#### LossLeaP: Learning to Predict for Intent-Based Networking

Alan Collet (IMDEA Networks Institute, Spain); Albert Banchs (Universidad Carlos III de Madrid, Spain); Marco Fiore (IMDEA Networks Institute, Spain) pp. 2138-2147

#### Network Tomography based on Adaptive Measurements in Probabilistic Routing

Hiroki Ikeuchi (NTT Corporation, Japan); Hiroshi Saito (University of Tokyo & Mathematics and Informatics Center, Japan); Kotaro Matsuda (NTT, Japan) pp. 2148-2157

## F-9: Video Streaming

#### **Batch Adaptative Streaming for Video Analytics**

Lei Zhang (Shenzhen University, China); Yuqing Zhang (ShenZhen University, China); Ximing Wu (Shenzhen University, China); Fangxin Wang (The Chinese University of Hong Kong, Shenzhen, China); Laizhong Cui (Shenzhen University, China); Zhi Wang (Tsinghua University, China); Jiangchuan Liu (Simon Fraser University, Canada) pp. 2158-2167

#### CASVA: Configuration-Adaptive Streaming for Live Video Analytics

Miao Zhang (Simon Fraser University, Canada); Fangxin Wang (The Chinese University of Hong Kong, Shenzhen, China); Jiangchuan Liu (Simon Fraser University, Canada) pp. 2168-2177

## Deadline-aware Multipath Transmission for Streaming Blocks

Xutong Zuo and Yong Cui (Tsinghua University, China); Xin Wang (Stony Brook University, USA); Jiayu Yang (Beijing University of Posts and Telecommunications, China)

pp. 2178-2187

#### LSync: A Universal Event-synchronizing Solution for Live Streaming

Yifan Xu, Fan Dang, Rongwu Xu and Xinlei Chen (Tsinghua University, China); Yunhao Liu (Tsinghua University & The Hong Kong University of Science and Technology, China) pp. 2188-2197

## G-9: Networks Protocols 2

## AoDNN: An Auto-Offloading Approach to Optimize Deep Inference for Fostering Mobile Web

Yakun Huang and Xiuquan Qiao (Beijing University of Posts and Telecommunications, China); Schahram Dustdar (Vienna University of Technology, Austria); Yan Li (Shanxi Transportation Planning Survey and Design Institute, China) pp. 2198-2207

#### Muses: Enabling Lightweight Learning-Based Congestion Control for Mobile Devices

Zhiren Zhong (University of Chinese Academy of Sciences, China & Huawei, China); Wei Wang and Yiyang Shao (Huawei, China); Zhenyu Li, Heng Pan and Hongtao Guan (Institute of Computing Technology, Chinese Academy of Sciences, China); Gareth Tyson (Queen Mary, University of London, United Kingdom (Great Britain)); Gaogang Xie (CNIC Chinese Academy of Sciences & University of Chinese Academy of Sciences, China); Kai Zheng (Huawei Technologies, China) pp. 2208-2217

## NMMF-Stream: A Fast and Accurate Stream-Processing Scheme for Network Monitoring Data Recovery

Kun Xie and Ruotian Xie (Hunan University, China); Xin Wang (Stony Brook University, USA); Gaogang Xie (CNIC Chinese Academy of Sciences & University of Chinese Academy of Sciences, China); Dafang Zhang (Hunan University, China); Jigang Wen (Chinese Academy of Science & Institute of Computing Technology, China)

pp. 2218-2227

#### PACC: Proactive and Accurate Congestion Feedback for RDMA Congestion Control

Xiaolong Zhong and Jiao Zhang (Beijing University of Posts and Telecommunications, China); Yali Zhang and Zixuan Guan (Huawei, China); Zirui Wan (Beijing University of Posts and Telecommunications, China) pp. 2228-2237