2021 IEEE Sixth International Conference on Data Science in Cyberspace (DSC 2021)

Shenzhen, China 9 – 11 October 2021



IEEE Catalog Number: CFP21E91-POD **ISBN:**

978-1-6654-1816-4

Copyright © 2021 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:	CFP21E91-POD
ISBN (Print-On-Demand):	978-1-6654-1816-4
ISBN (Online):	978-1-6654-1815-7

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



2021 IEEE Sixth International Conference on Data Science in Cyberspace (DSC) **DSC 2021**

Table of Contents

Message from the General Chairs	xxi
Conference Organization	xxii
Program Committee	xxiii

Main Conference

The Survey on the Development of Secure Multi-Party Computing in the Blockchain
 Modeling Connection Strength in Graph Neural Networks for Social Influence Prediction
Rumor Detection on Social Media using Temporal Dynamic Structure and Emotional Information 16 Chenming Wang (National University of Defense Technology, China), Bin Zhou (National University of Defense Technology, China), Hongkui Tu (National University of Defense Technology, China), and Yujia Liu (National University of Defense Technology, China)
 Network Security Situation Prediction Model Based on Security Situation Factors

Sampled Data Debugging via Fuzzy C-Means Xiayu Xiang (Beijing University of Posts and Telecommunications, China), Shaoming Duan (Harbin Institute of Technology (Shenzhen), China), Hezhong Pan (Beijing University of Posts and Telecommunications, China), Peiyi Han (Harbin Institute of Technology (Shenzhen), China), and Chuanyi Liu (Harbin Institute of Technology (Shenzhen), China)	32
Adversarial Residual Variational Graph Autoencoder with Batch Normalization Qisheng Liao (Beijing University of Posts and Telecommunications, China; Key Laboratory of Trustworthy Distributed Computing and Service, Ministry of Education, China), Xu Wu (Beijing University of Posts and Telecommunications, China; Key Laboratory of Trustworthy Distributed Computing and Service, Ministry of Education, China), Xiaqing Xie (Beijing University of Posts and Telecommunications, China; Key Laboratory of Trustworthy Distributed Computing and Service, Ministry of Education, China), Jingchen Wu (Beijing University of Posts and Telecommunications, China; Key Laboratory of Trustworthy Distributed Computing and Service, Ministry of Education, China), Jingchen Wu (Beijing University of Posts and Telecommunications, China; Key Laboratory of Trustworthy Distributed Computing and Service, Ministry of Education, China), Lirong Qiu (Beijing University of Posts and Telecommunications, China; Key Laboratory of Trustworthy Distributed Computing and Service, Ministry of Education, China), and Lijuan Sun (Beijing University of Posts and Telecommunications, China; Key Laboratory of Trustworthy Distributed Computing and Service, Ministry of Education, China)	40
 Sensitive Image Information Recognition Model of Network Community Based on Content Text Li Gao (Key Laboratory of Trustworthy Distributed Computing and Service; Beijing University of Posts and Telecommunications, China), Xu Wu (Key Laboratory of Trustworthy Distributed Computing and Service; Beijing University of Posts and Telecommunications, China), Jingchen Wu (Key Laboratory of Trustworthy Distributed Computing and Service; Beijing University of Posts and Telecommunications, China), Xiaqing Xie (Key Laboratory of Trustworthy Distributed Computing and Service; Beijing University of Posts and Telecommunications, China), Xiaqing Xie (Key Laboratory of Trustworthy Distributed Computing and Service; Beijing University of Posts and Telecommunications, China), Lirong Qiu (Key Laboratory of Trustworthy Distributed Computing and Service; Beijing University of Posts and Telecommunications, China), and Lijuan Sun (Key Laboratory of Trustworthy Distributed Computing and Service; Beijing University of Posts and Telecommunications, China), and Lijuan Sun (Key Laboratory of Trustworthy Distributed Computing and Service; Beijing University of Posts and Telecommunications, China), and Lijuan Sun (Key Laboratory of Trustworthy Distributed Computing and Service; Beijing University of Posts and Telecommunications, China) 	47
Malware Classification Based on Visualization and Feature Fusion	53

A Security-Enhanced Modbus TCP Protocol and Authorized Access Mechanism	
 Relation Extraction Based on Data Partition and Representation Integration	
 Mining Open-Source Cyber Threat Intelligence with Distant Supervision from the Web	
 Sequence Attention for Multivariate Time Series Forecasting	
Identification Domain Fronting Traffic for Revealing Obfuscated C2 Communications	

 Bit-FP: A Traffic Fingerprinting Approach for Bitcoin Hidden Service Detection
TCABRS: An Efficient Traceable Constant-Size Attribute-Based Ring Signature Scheme for Electronic Health Record System 106 Aoran Lu (University of Science and Technology of China, China), 106 Weihai Li (University of Science and Technology of China, China), 107 Yuanzhi Yao (University of Science and Technology of China, China), 108 and Nenghai Yu (University of Science and Technology of China, China), 108
Bow-tie Technology Analysis of Safety Risks of Lithium-ion Battery in Air Transport 114 Yan Zhang (Civil Aviation Management Institute of China, China), Hongli Zhao (Civil Aviation Management Institute of China, China), and Bin Li (Civil Aviation Management Institute of China, China)
 LoginSoEasy: A System Enabling both Authentication and Protection of Personal Information Based on Trusted User Agent
ResNet Approach for Coding Unit Fast Splitting Decision of HEVC Intra Coding
MilKBQA: A Complex Knowledge Base Question Answering Dataset on Chinese Military Field 136 Pike Xu (National University of Defense Technology, China), Tiejun Li (National University of Defense Technology, China), Zhen Huang (National University of Defense Technology, China), Min Guo (National University of Defense Technology, China), Jiezhong He (National University of Defense Technology, China), and Ding Sun (National University of Defense Technology, China)

A Review of Entity Alignment Based on Graph Convolutional Neural Network	4
 Survey on Knowledge Graph Embedding Based on Hyperbolic Geometry	2
Survey on Social Event Detection	9
A Proxy-Protected Proxy Signature Based on SM9	6
 APT Behaviors Detection Based on Email Business Scenarios	1
A Universal Targeted Attack Method Against Image Classification	9
A Survey on Translating Embedding Based Entity Alignment in Knowledge Graphs	7
 FedDeepFM: Ad CTR Prediction Based on Federated Factorization Machine	5

 GRU and Multi-Autoencoder Based Insider Threat Detection for Cyber Security	03
A Decentralized Access Control Framework For DDS	.11
Improving the Transferability of Adversarial Examples with Advanced Diversity-Ensemble 2 Method 2 Yinhu Xu (University of Science and Technology of China, China), Qi 2 Chu (University of Science and Technology of China, China), and 2 Nenghai Yu (University of Science and Technology of China, China), and 3	.19
PTMT: Multi-Target Stance Detection with PTM-Enhanced Multi-Task Learning	26
Research on Label Based Data Flow Control Mechanism	.33
 Universal Pre-Calculating Structure: Reducing Complexity of Ising Chips with Arbitrary Connectivity	40

 FIGAT: Accurately Predict Individual Crime Risks with Multi-Information Fusion	18
 Audio Steganography with Speech Recognition System	56
 PRFP: Privacy-Respecting and Accurate Device Fingerprint Identification	54
Generate Adversarial Examples Combined with Image Entropy Distribution	72
 Attack-Words Guided Sentence Generation for Textual Adversarial Attack	30
A Novel Deep Neural Network Model for Credit Risk Prediction of Chinese Farmers	38

Multi-dimensional Data Association and inTelligent Analysis (MDATA 2021)

 Survey on Temporal Knowledge Graph	.94
Hierarchical Cooperative Social Spider Algorithm for Community Detection in Large Network3 Peng Chen (Anhui Normal University, China), Jun Zhang (Wuhu Institute of Technology, China), Yang Wang (Anhui Normal University, China), Jiawei Xu (Anhui Normal University, China), and Shenghao Cao (Anhui Normal University, China)	01
 RanPAS: A Behavior-Based System for Ransomware Detection	09
 Dynamic Topic Model for Tracking Topic Evolution and Measuring Popularity of Scientific Literature	15
 Identifying Reply Relationships from Telegram Groups using Multi-Features Fusion	21

A Manifold Learning Method to Passage Retrieval for Open-Domain Question Answering Ruidong Ding (National University of Defense Technology, China), Bin Zhou (National University of Defense Technology, China), and Hongkui Tu (National University of Defense Technology, China)	328
A Method for Discovering Hidden Patterns of Cybersecurity Knowledge Based on Hierarchical Clusterin Zhaoyun Ding (National University of Defense Technology, China), Deqi Cao (National University of Defense Technology, China), Lina Liu (Soochow University, China), Donghua Yu (Shaoxing University, China), Haoyang Ma (National University of Defense Technology, China), and Fei Wang (National University of Defense Technology, China)	334
An Overview of Entity Alignment: Cross-Lingual and Graph Approaches Fang Wang (Academy of Military Sciences, China), Yongqiang Xie (Academy of Military Sciences, China), and Kai Zhang (Academy of Military Sciences, China)	339
BDCP: An Improved Nested Named Entity Recognition Model Based on LSTM Ling Zhou (Guangzhou University, China), Tianjiao Luan (China Academy of Launch Vehicle Technology, China), Na Yao (Beijing Aerospace Automatic Control Institute, China), Jianming Li (Guangzhou University, China), and Jie Ding (Guangzhou University, China)	346

Vulnerability Analysis and Adversarial Learning (VAAL 2021)

Gradient-Oriented Gray-Box Protocol Fuzzing	353
Yinfan Qin (Institute Of System Engineering AMS.PLA, National Key	
Laboratory of Science and Technology on Information System Security,	
China), Xiang Li (Institute Of System Engineering AMS.PLA, National	
Key Laboratory of Science and Technology on Information System	
Security, China), Jianwen Tian (Institute Of System Engineering	
AMS.PLA, National Key Laboratory of Science and Technology on	
Information System Security, China), Taotao Gu (Institute Of System	
Engineering AMS.PLA, National Key Laboratory of Science and Technology on Information System Security, China), and Xiaohui Kuang (Institute	
Of System Engineering AMS.PLA, National Key Laboratory of Science and	
Technology on Information System Security, China)	
reennology on myor manon byoten becany, ennag	
Software Misconfiguration Troubleshooting Based on State Analysis	361
Ke Li (Beijing Institute of Technology, China), Yuan Xue (Academy of	
Military Science, China), Yujie Shao (Beijing Institute of Technology,	
China), Bing Su (Beijing Institute of Technology, China), Yu-an Tan	
(Beijing Institute of Technology, China), and Jingjing Hu (Beijing	
Institute of Technology, China)	
A Multilevel Non-Interference Vulnerability Analysis Method for Information Leakage	
Problem	367
Wenjing Zhong (National Key Laboratory of Science and Technology on	
Information System Security, China; Xidian University, China), Jinjing	
Zhao (National Key Laboratory of Science and Technology on Information	
System Security, China), and Hesuan Hu (Xidian University, China,	
Xi'an Jiaotong University, China; Nanyang Technological University,	
Singapore)	

Deep Learning Framework Fuzzing Based on Model Mutation	375
Li Zhou (University of Electronic Science and Technology of China, China), Minhuan Huang (National Key Laboratory of Science and Technology on Information System Security, China), Yujun Li (University of Electronic Science and Technology of China, China), Yuanping Nie (National Key Laboratory of Science and Technology on Information System Security, China), Jin Li (National Key Laboratory of Science and Technology on Information System Security, China), and Yiwei Liu (University of Electronic Science and Technology of China, China)	381
IfCut: If Branch Cutting Based Fuzzing System Xumeng Liu (Nankai University, China), Tianqi Sun (Nankai University, China), Zijie Zhao (Nankai University, China), Du Wu (Nankai University, China), Qi Hu (Nankai University, China), Weijia Chen (Nankai University, China), and Li Gu (Nankai University, China)	389
Machine Learning for Software Vulnerability Analysis: A Survey	396
Code Decoupling Execution Isolating Based on TF Card Firmware Extension <i>Zhiwei Shi</i> (<i>China Information Technology Security Evaluation Center</i> , <i>China</i>), <i>Tian Chen</i> (<i>Beijing Institute of Technology, China</i>), <i>Yuan Xue</i> (<i>Academy of Military Science, China</i>), <i>Yuanzhang Li</i> (<i>Beijing Institute</i> <i>of Technology, China</i>), <i>Quanxin Zhang</i> (<i>Beijing Institute of Technology,</i> <i>China</i>), <i>Yu-an Tan</i> (<i>Beijing Institute of Technology, China</i>), <i>and</i> <i>Jingjing Hu</i> (<i>Beijing Institute of Technology, China</i>)	403

Network Security Analysis for Cyberspace (NSAC 2021)

 Artificial Intelligence Security for Hydraulic Machinery System
Investigations on Answer Selection Based on Co-Attention Guided Stacked BiLSTM with BERT 420 Mingli Wu (North China University of Technology, China), Shuaibo Li (North China University of Technology, China), Ke Teng (North China University of Technology, China), Chunlai Du (North China University of Technology, China), and Jianyong Duan (North China University of Technology, China)
 A Joint Warning and Notification Mechanism for Cybersecurity Incidents
Review on Fuzz Testing for Protocols in Industrial Control Systems
A Survey of Cyber Security Approaches for Prediction
 Focus on the Stability of Large Systems: Toward Automatic Prediction and Analysis of Vulnerability Threat Intelligence

Digital Humanities and Computer Arts (DHCA 2021)

Art Experience Innovation Design in Digital Media Era Feng Ye (Beijing Film Academy, China) and Yong Liang (Phoenix Publishing & Media Group, China)	454
Analysis of Visual Subject Types in Immersive Image	458
Research on the Application of Digital Media Technology in Media Convergence Jing Li (Beijing Film Academy, China) and Yong Liang (Phoenix Publishing & Media Group, China)	462

Big Data Mining for Cyberspace (BDMC 2021)

Generating Highly Structured Inputs: A Survey Yabin Li (Beijing University of Posts and Telecommunications, China), Yinfan Qin (Academy of Military Sciences, China), Jianwen Tian (Academy of Military Sciences, China), Taotao Gu (Academy of Military Sciences, China), Yuanping Nie (National Key Laboratory of Science and Technology on Information System, China), and Xiaohui Kuang (National Key Laboratory of Science and Technology on Information System, China)	466
A Survey of DeepFakes Generation and Detection Kaihan Lin (Guangzhou University, China), Weihong Han (Guangzhou University, China), Zhaoquan Gu (Guangzhou University, China), and Shudong Li (Guangzhou University, China)	474
Research on Strategy Selection of Dynamic Defense Based on Game Theory Tong Peng (Beijing University of Posts and Telecommunications, China), Yueming Lu (Beijing University of Posts and Telecommunications, China), Jinxin Zuo (Beijing University of Posts and Telecommunications, China), and Jiefu Gan (China Cyber security Review Technology and Certification Center, China)	479
Research on Requirements Recommendation Method for High-end Equipment Based on Generativ Adversarial Networks Zeshui Liu (College of Systems Engineering National University of Defense Technology, China), Xiangqian Xu (College of Systems Engineering National University of Defense Technology, China), Nan Xiang (College of Systems Engineering National University of Defense Technology, China), Zhuoqian Li (College of Systems Engineering National University of Defense Technology, China), Yajie Dou (College of Systems Engineering National University of Defense Technology, China), and Yuejin Tan (College of Systems Engineering National University of Defense Technology, China)	re 485
 Self-Attention UNet Model for Radar Based Precipitation Nowcasting Tengfei Nie (National University of Defense Technology, China), Kefeng Deng (National University of Defense Technology, China), Chengcheng Shao (National University of Defense Technology, China), Chengwu Zhao (National University of Defense Technology, China), Kaijun Ren (National University of Defense Technology, China), and Junqiang Song (National University of Defense Technology, China) 	493

Adversarial Attacks on Vehicle Re-Identification	500
Haiyang Yu (Guangzhou University, China), Fashan Dong (Guangzhou	
University, China), Jianming Li (Guangzhou University, China), Wenrong	
Xie (Guangzhou University, China), Jing Qiu (Guangzhou University,	
China), and Zhaoquan Gu (Guangzhou University, China)	
The Controlled Sharing Mechanism for Private Data Based on Blockchain	508
Li Wenqing (Beijing University of Posts and Telecommunications,	
China), Dong Wenjie (Beijing Aerospace Automatic Control Institute,	
China), Zhang Xu (Beijing University of Posts and Telecommunications,	
China), and Lu Yueming (Beijing University of Posts and	
Telecommunications, China)	
Research on Progress of Blockchain Access Control	516
Tao Liu (Shenzhen Power Supply Bureau Co.Ltd, China), Xiaowei Chen	
(Shenzhen Power Supply Bureau Co.Ltd, China), Jin Li (School of	
Cyberspace Security Beijing University of Posts and	
Tel-ecommunications, China), Shaocheng Wu (Shenzhen Power Supply	
Bureau Co.Ltd, China), Wenlong Sun (Shenzhen Power Supply Bureau	
Co.Ltd, China), and Yueming Lu (School of Cyberspace Security Beijing	
University of Posts and Tel-ecommunications, China)	

Cybersecurity for Critical Infrastructure Systems (CCIS 2021)

A Honeypot-Enabled SDN-Based Selector for Industrial Device Access Control Jun Li (China Industrial Control Systems Cyber Emergency Response Team, China), Chunhui Wang (Guilin University of Electronic Technology, China), Zhenyu Li (Guilin University of Electronic Technology, China), and Yong Ding (Guilin University of Electronic Technology, China)	523
Differential Cryptanalysis of TweGIFT-128 Based on Neural Network Runlian Zhang (Guilin University of Electronic Technology, China), Mi Zhang (Guilin University of Electronic Technology, China), Jiaxu Yan (Guilin University of Electronic Technology, China), Yixing Li (Guilin University of Electronic Technology, China), Xiaonian Wu (Guilin University of Electronic Technology, China), and Lingchen Li (Guilin University of Electronic Technology, China)	529
Enhancing Continuous Service of Information Systems Based on Cyber Resilience Jinxin Zuo (Beijing University of Posts and Telecommunications, China), Ziyu Guo (Beijing University of Posts and Telecommunications, China), Jiefu Gan (China Cyber Security Review Technology and Certification Center, China), and Yueming Lu (Beijing University of Posts and Telecommunications, China)	535
Networked Device Identification: A Survey Yu Jiang (Guangzhou University, China), Yuying Li (Guangzhou University, China; Key laboratory of Ministry of Industry and Information Technology, China), and Yanbin Sun (Guangzhou University, China)	543

Information Security Detection Technology for Industrial Control Equipment Modeling	
Generated by Excitation Traversal Test Based on Big Data	549
Chen Cui (Shenzhen Y&D Electronics Information Co., Ltd., China),	
Jianhuai Qi (Shenzhen Y&D Electronics Information Co., Ltd., China),	
Jing Song (Shenzhen Y&D Electronics Information Co., Ltd., China),	
Peng Luo (Shenzhen Y&D Electronics Information Co., Ltd., China), and	
Juan Tang (Shenzhen Y&D Electronics Information Co., Ltd., China)	
Review of Firmware Homology Detection: A System Aspect	556
Song Yan (State Grid Shanghai Municipal Electrical Power Research	
Institute, China), Wang Binbin (State Grid Shanghai Municipal	
Electrical Power Research Institute, China), Yu Xiaohu (East China	
Normal University, China), Li Tinghui (East China Normal University,	
China), Zhu Shanshan (East China Normal University, China), He Daojing	
(East China Normal University, China), Yang Guisong (University of	
Shanghai for Science and Technology, China), and Chan Sammy (City	
University of Hong Kong, China)	

Big Data and Business Analytics (BDBA 2021) & Multi-Source Network Fusion and Analysis (MSNFA 2021)

Insider Threat Detection Based on User Historical Behavior and Attention Mechanism
Graph Neural Network Based User Group Comments Interaction Behavior Prediction on
Microblog Websites
Yisen Chen (Beijing University of Posts and Telecommunications, China;
Key Laboratory of Trustworthy Distributed Computing and Service,
Ministry of Education, China), Xu Wu (Beijing University of Posts and
Telecommunications, China; Key Laboratory of Trustworthy Distributed
Computing and Service, Ministry of Education, China), Xiaqing Xie
(Beijing University of Posts and Telecommunications, China; Key
Laboratory of Trustworthy Distributed Computing and Service, Ministry
of Education, China), Jingchen Wu (Beijing University of Posts and
Telecommunications, China; Key Laboratory of Trustworthy Distributed
Computing and Service, Ministry of Education, China), Lirong Qiu
(Beijing University of Posts and Telecommunications, China; Key
Laboratory of Trustworthy Distributed Computing and Service, Ministry
of Education, China), and Lijuan Sun (Beijing University of Posts and
Telecommunications, China; Key Laboratory of Trustworthy Distributed
Computing and Service, Ministry of Education, China)

Interframe Variance in Vehicle Re-Identification	577
A Survey on Smart Home Privacy Data Protection Technology	583
Pneumonia Detection with U-EfficientNet	591
Multi-Dimensional Intelligent Network Asset Identification	595
Rooted Subtrees Recursive Neural Networks on Graphs	502

Situation Awareness Analysis for Cyberspace Security (SAACS 2021)

A Survey of Advanced Persistent Threats Attack and Defense
A Novel Malware Encrypted Traffic Detection Framework Based On Ensemble Learning
APT Detection Based on Association Rule Mining with Bayesian Model
A New Method for Malware Detection Based on Energy
An Android Malware Detection Approach using Multi-Feature Fusion and TF-IDF Algorithm 629 Haipeng Zhang (Cyberspace Institute of Advanced Technology Guangzhou University, China), Shudong Li (Cyberspace Institute of Advanced Technology Guangzhou University, China), Xiaobo Wu (Guangzhou University, China), Weihong Han (Cyberspace Institute of Advanced Technology Guangzhou University, China), and Laifu Wang (Research Institute of China Telecom Co., Ltd, China)

An APT Malware Classification Method Based on Adaboost Feature Selection and LightGBM 635 Na Xu (Guangzhou University Guangzhou, China), Shudong Li (Guangzhou University Guangzhou, China), Xiaobo Wu (Guangzhou University Guangzhou, China), Weihong Han (Guangzhou University Guangzhou, China), and Xiaojing Luo (Guangzhou University Guangzhou, China)
 Smart grid Terminal Security Assessment Method Based on Subjective and Objective Comprehensive Weighting
Intelligent Device Identification Method Based on Network Packet Fingerprint
The Overview of SPIN in Software Model Checking
Detecting Adversarial Samples in Neural Network with Statistical Metrics: A Practical Approach
High Efficient and Secure Chaos-Based Compressed Spectrum Sensing in Cognitive Radio IoT Network