Lannan Lisa Luo, Assistant Professor

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RESEARCH INTERESTS

My research mainly focuses on **software and systems security**. My research interests include software analysis and verification, vulnerability discovery, malware analysis, and software engineering. I am also interested in applying deep learning for cybersecurity problems. My research approaches are mainly empirical in tandem with formal methods, combining symbolic execution, theorem proving, taint analysis, control flow analysis, and data flow analysis.

EDUCATION

Ph.D., Information Sciences and Technology, Penn State University   2012–2017

M.Sc., Communication and Information Systems, University of Electronic Science and Technology of China   2009–2012

B.S., Telecommunications Engineering, Xidian University, Xi'an, China   2005–2009

PROFESSIONAL EXPERIENCE

George Mason University, Assistant Professor   08/2022–present

University of South Carolina (UofSC), Assistant Professor   08/2017–08/2022

Cyber Security Lab, Penn State University, Research Assistant   08/2012 – 05/2017

Microsoft Research Asia, Beijing, China, Research Intern   Summer 2015

PUBLICATIONS

NAMES underlined are my supervised students.

GOOGLE SCHOLAR: TOTAL CITATIONS: **723**, H-INDEX: **13**, I10-INDEX: **14** (AS OF JUNE 29TH, 2022).

Refereed Journal Articles

1. **[TMC'19]** **Lannan Luo**, Qiang Zeng, Chen Cao, Kai Chen, Jian Liu, Limin Liu, Neng Gao, Min Yang, Xinyu Xing, and Peng Liu. "Tainting-Assisted and Context-Migrated Symbolic Execution of Android Framework for Vulnerability Discovery and Exploit Generation." *IEEE Transactions on Mobile Computing (TMC)*, pp.2946-2964, 2019. [Impact Factor: 5.577]

2. **[TDSC'19]** Qiang Zeng, **Lannan Luo***, Zhiyun Qian, Xiaojiang Du, Zhoujun Li, Chin-Tser Huang, and Csilla Farkas (* Corresponding author). "Resilient User-Side Android Application Repackaging and Tampering Detection Using Cryptographically Obfuscated Logic Bombs." *IEEE Transactions on Dependable and Secure Computing (TDSC)*, pp.2582-2600, 2019. [Impact Factor: 7.329]

   Before joining UofSC

3. **[TSE'17]** **Lannan Luo**, Jiang Ming, Dinghao Wu, Peng Liu, and Sencun Zhu. "Semantics-Based Obfuscation-Resilient Binary Code Similarity Comparison with Applications to Software and Algorithm Plagiarism Detection." *IEEE Transactions on Software Engineering (TSE)*, pp.1157-1177, 2017. [Impact Factor: 6.226]

Refereed Conference Proceedings

1. [**MobiSys'22**] Chuxiong, Wu, Xiaopeng Li, **Lannan Luo**, and Qiang Zeng. "G2Auth: Secure Mutual Authentication for Drone Delivery Without Special User-Side Hardware." In *Proceedings of the 20th ACM International Conference on Mobile Systems, Applications, and Services (MobiSys)*, pp. 1-15, 2022. [Acceptance rate = **21%**]

2. [**ACSAC'21**] **Lannan Luo**, Qiang Zeng, Bokai Yang, Fei Zuo, Junzhe Wang. "Westworld: Fuzzing-Assisted Remote Dynamic Symbolic Execution of Smart Apps on IoT Cloud Platforms." In *Proceedings of the Annual Computer Security Applications Conference (ACSAC)*, pp. 982-995, 2021. [Acceptance rate = **24%**]

3. [**NDSS'21**] Haotian Chi, Qiang Zeng, Xiaojiang Du, and **Lannan Luo**. "PFirewall: Semantics-Aware Customizable Data Flow Control for Home Automation Systems." In *Proceedings of the 28th Annual Network and Distributed System Security Symposium (NDSS)*, pp. 1-18, 2021. [Acceptance rate = **15%**]

4. [**CCS'20**] Xiaopeng Li, Qiang Zeng, **Lannan Luo**, and Tongbo Luo. "T2Pair: Secure and Usable Pairing for Heterogeneous IoT Devices." In Proceedings of the 27th ACM Conference on Computer and Communications Security (CCS), pp. 309-323, 2020. [Acceptance rate = **17%**]

5. [**SANER'20**] **Lannan Luo**. "Heap Memory Snapshot Assisted Program Analysis for Android Permission Specification." In *Proceedings of the 27th IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER)*, pp. 435-446, 2020. [Acceptance rate = **23%**]

6. [**MobiCom'19**] Xiaopeng Li, Fengyao Yan, Fei Zuo, Qiang Zeng, and **Lannan Luo**. "Touch Well Before Use: Intuitive and Secure Authentication for IoT Device." In *Proceedings of the 25th Annual International Conference on Mobile Computing and Networking (MobiCom)*, pp. 1-17, 2019. [Acceptance rate = **16%** (the winter round)]

7. [**NDSS'19**] Fei Zuo, Xiaopeng Li, Patrick Young, **Lannan Luo**, Qiang Zeng, and Zhexin Zhang. "Neural Machine Translation Inspired Binary Code Similarity Comparison beyond Function Pairs." In *Proceedings of the 26th Network and Distributed System Security Symposium (NDSS)*, pp. 1-15, 2019. [Acceptance rate = **17%**]

8. [**RAID'19**] Fei Zuo, Bokai Yang, Xiaopeng Li, **Lannan Luo**, and Qiang Zeng. "Exploiting the Inherent Limitation of L_0 Adversarial Examples." In *Proceedings of the 22nd International Symposium on Research in Attacks, Intrusions and Defenses (RAID)*, pp. 293-307, 2019. [Acceptance rate = **22%**]

9. [**DSN'19**] Qiang Zeng, Jianhai Su, Chenglong Fu, Golam Kayas, **Lannan Luo**, Xiaojiang Du, Chiu Tan, and Jie Wu. "A Multiversion Programming Inspired Approach to Detecting Audio Adversarial Examples." In *Proceedings of the 49th IEEE/IFIP International Conference on Dependable Systems and Networks (DSN)*, pp. 39-51, 2019. [Acceptance rate = **21%**]

10. [**DSN'19**] Qiang Zeng, Golam Kayas, Emil Mohammed, **Lannan Luo**, Xiaojiang Du, and Junghwan Rhee. "HeapTherapy+: Efficient Handling of (Almost) All Heap Vulnerabilities Using Targeted Calling-Context Encoding." In *Proceedings of the 49th IEEE/IFIP International Conference on Dependable Systems and Networks (DSN)*, pp. 530-542, 2019. [Acceptance rate = **21%**]

11. [**CGO'18**] Qiang Zeng, **Lannan Luo**, Zhiyun Qian, Xiaojiang Du, and Zhoujun Li. "Resilient Decentralized Android Application Repackaging Detection Using Logic Bombs." In *Proceedings of IEEE/ACM International Symposium on Code Generation and Optimization (CGO)*, pp. 50-61, 2018. [Acceptance rate = **29%**]

   Before joining UofSC

12. [**MobiSys'17**] **Lannan Luo**,[*] Qiang Zeng,[*] Chen Cao, Kai Chen, Jian Liu, Limin Liu, Neng Gao, Min Yang, Xinyu Xing, and Peng Liu ([*]co-first authors). "System Service Call-oriented Symbolic Execution of Android Framework with Applications to Vulnerability Discovery and Exploit Generation."

In *Proceedings of the 15th ACM International Conference on Mobile Systems, Applications, and Services (MobiSys)*, pp. 225-238, 2017. [Acceptance rate = **18%**]

13. [**DSN'16**] **Lannan Luo**, Yu Fu, Dinghao Wu, Sencun Zhu, and Peng Liu. "Repackage-proofing Android Apps." In *Proceedings of the 46th Annual IEEE/IFIP International Conference on Dependable Systems and Networks (DSN)*, pp. 550-561, 2016. [Acceptance rate = **22%**]

14. [**ICSE-SEET'16**] **Lannan Luo** and Qiang Zeng. "SolMiner: Mining Distinct Solutions in Programs." In *Proceedings of the 38th International Conference on Software Engineering (ICSE), SEET track*, pp. 481-490, 2016. [Acceptance rate = **34%**]

15. [**FSE'14**] **Lannan Luo**, Jiang Ming, Dinghao Wu, Peng Liu, and Sencun Zhu. "Semantics-Based Obfuscation-Resilient Binary Code Similarity Comparison with Applications to Software Plagiarism Detection." In *Proceedings of the 22nd ACM SIGSOFT International Symposium on the Foundations of Software Engineering (FSE)*, pp. 389-400, 2014. **Best Paper Award Nomination**. [Acceptance rate = **22%**]

Refereed Workshop Papers

1. [**DCDS'22**] Junzhe Wang, and **Lannan Luo**. "Privacy Leakage Analysis for Colluding Smart Apps." In *the DSN Workshop on Data-Centric Dependability and Security (DCDS)*, pp. 1-7, 2022.

2. [**BAR'19**] Kimberly Redmond, **Lannan Luo**, and Qiang Zeng. "A Cross-Architecture Instruction Embedding Model for Natural Language Processing-Inspired Binary Code Analysis." In *the NDSS Workshop on Binary Analysis Research (BAR)*, pp. 1-8, 2019.

3. [**AICS'19**] Qiang Zeng, Jianhai Su, Chenglong Fu, Golam Kayas, and **Lannan Luo**. "A Multiversion Programming Inspired Approach to Detecting Audio Adversarial Examples." In *the AAAI Workshop on Artificial Intelligence for Cyber Security (AICS)*, pp. 1-8, 2019.

   Before joining UofSC

4. [**ASCE'13**] Nan Yu, Yufei Jiang, **Lannan Luo**, Sanghoon Lee, Abdou Jallow, Dinghao Wu, John Messner, Robert Leicht, and John Yen. "Integrating BIMserver and OpenStudio for Energy Efficient Building." In *the ASCE International Workshop on Computing in Civil Engineering (ASCE)*, pp. 516-523, 2013.

Technical Reports

1. Gautham Ramajayam, Tao Sun, Chiu C. Tan, **Lannan Luo**, Haibin Ling. "Deep Learning Approach Protecting Privacy in Camera-Based Critical Applications." arXiv preprint arXiv:2110.01676, pp. 1-4, 2021.

2. Ravshanbek Norboev, Zakia Hossain, Qiang Zeng, and **Lannan Luo**. "On the Robustness of Stochastic Stealthy Network against Android App Repackaging." Technical Report, pp. 1-6, 2017.

RESEARCH GRANTS

Total project funding	Total project funding as PI	Total personal share
$1,097,981	$765,820	$765,820

1. SaTC: CORE: Small: Semantics-Oriented Binary Code Analysis Learning from Recent Advances in Deep Learning (CNS-1953073)

   - **My Role: Sole PI**
   - Funding Agency: NSF

- Total: $416,947
- Personal Share: $416,947 (100%)
- Dates: 10/1/2020–9/30/2023

2. CRII: SaTC: A Malware-Inspired Approach to Mobile Application Repackaging and Tampering Detection (CNS-1850278)
   - **My Role: Sole PI**
   - Funding Agency: NSF
   - Total: $174,879
   - Personal Share: $174,879 (100%)
   - Dates: 6/15/2019–5/31/2022

3. SaTC: CORE: Small: Collaborative: Enabling Precise and Automated Insecurity Analysis of Middleware on Mobile Platforms (CNS-1815144)
   - **My Role: PI**
   - PI: Peng Liu (Penn State University) and Qiang Zeng (University of South Carolina)
   - Funding Agency: NSF
   - Total: $491,161
   - Personal Share: $159,000 (33%)
   - Dates: 10/1/2018–9/30/2021

4. Vulnerability Discovery and Test Input Generation for Android System Services
   - **My Role: Sole PI**
   - Funding Agency: University of South Carolina, ASPIRE-I
   - Total: $14,994
   - Personal Share: $14,994 (100%)
   - Dates: 8/16/2018–8/15/2019

ACADEMIC SERVICE

Technical Program Committee

- [**NDSS**] Network and Distributed System Security Symposium: 2021, 2022, 2023
- [**USENIX Security**] USENIX Security Symposium: 2023
- [**ACSAC**] Annual Computer Security Applications Conference: 2019, 2020, 2021, 2022
- [**DSN**] Annual IEEE/IFIP International Conference on Dependable Systems and Networks: 2022
- [**AsiaCCS**] ACM ASIA Conference on Computer and Communications Security: 2020, 2021, 2022
- [**GLOBECOM**] IEEE Global Communications Conference: 2020
- [**MASS**] IEEE International Conference on Mobile Ad hoc and Sensor Systems: 2018, 2019, 2021
- [**ICME**] IEEE International Conference on Multimedia and Expo: 2019

Journal Reviewer

- [**TSE**] IEEE Transactions on Software Engineering: 2018 (x1), 2021 (x1), 2022 (x2)

- [**T-IFS**] IEEE Transactions on Information Forensics & Security: 2019 (x1), 2021 (x1)
- [**Access**] IEEE Access: 2021 (x1)
- [**TOIT**] ACM Transactions on Internet Technology (TOIT): 2020 (x1)
- [**TOPS**] ACM Transactions on Privacy and Security (TOPS): 2021 (x1),
- [**SP**] IEEE Security & Privacy: 2021 (x1)
- [**Cybersecurity**] Cybersecurity: 2020 (x1)
- [**TR**] IEEE Transactions on Reliability: 2019 (x1)
- [**EMSE**] Empirical Software Engineering (EMSE): 2018 (x1)

Conference Organization

- [**SecureComm**] Workshops Chair for EAI International Conference on Security and Privacy in Communication Networks: 2022
- [**ICSE**] Judge for the ICSE Student Research Competition: 2020
- [**CNS**] Publicity Co-Chair for IEEE Conference on Communications and Network Security: 2018

Other Services

- [**NSF**] National Science Foundation Review Panel: 2022 (x2)
- [**NSF**] National Science Foundation Review Panel: 2021 (x1)
- [**NSF**] National Science Foundation Review Panel: 2019 (x1)

DEPARTMENTAL & UNIVERSITY SERVICE

- **Graduate Committee** in the CSE department at UofSC: 2017–2022
- **Faculty Search Committee** in the CSE department at UofSC: 2019
- **Faculty Senator** at UofSC: 2019
- [**GHC**] Faculty advisor for the Grace Hopper Celebration of Women in Computing (GHC): 2018–2022
- [**RISE**] Reviewer for the Research Initiative for Summer Engagement (RISE) program at UofSC, 2019
- [**Cybersecurity Symposium**] Panel Member for the Cybersecurity Symposium hosted by Benedict College, Columbia: 2017

AWARDS/HONORS

- Young Investigator Research Award in College of Engineering and Computing at UofSC, 2020
- NSF CRII Award, 2019
- Best Paper Award Nomination in ACM SIGSOFT FSE, 2014
- Top-class Scholarship with Honor, UESTC, 2010–2012
- Excellent Graduate Student, UESTC, 2010–2012
- Top-class Scholarship with Honor, Xidian University, 2006–2009
- Excellent Student, Xidian University, 2006–2009
- First Prize in the Mathematical Modeling Contest of Shaanxi, 2007

SOFTWARE RELEASE

- [**Westworld**] The first fuzzing-assisted dynamic symbolic execution tool for smart apps (ACSAC'21)
  Code and datasets: `https://github.com/lannan/Westworld`

- [**InnerEye**] An Neural Machine Translation inspired binary code similarity comparison model (NDSS'19)
  Code, datasets, and trained models: `https://nmt4binaries.github.io`

- [**AEPecker**] A tool that detects image adversarial examples and rectifies classification results (RAID'19)
  Code, datasets, and trained models: `https://github.com/fzuo/AEPecker`

- [**MVP-Ears**] A tool that detects audio adversarial examples at accuracies over 99% (DSN'19)
  Code, datasets, and trained models: `https://github.com/quz105/MVP-audio-AE-detector`

- [**CAIE**] A model that learns cross-architecture instruction embeddings for binary code analysis (BAR'19)
  Code, datasets, and trained models: `https://github.com/nlp-code-analysis/cross-arch-instr-model`

- [**Centaur**] A first symbolic execution system for analyzing Android Framework (MobiSys'17)
  Code: `https://github.com/Android-Framework-Symbolic-Executor/Centaur`.

TALKS

- Westworld: Fuzzing-Assisted Remote Dynamic Symbolic Execution of Smart Apps on IoT Cloud Platforms
  The Annual Computer Security Applications Conference (ACSAC), 2021

- Heap Memory Snapshot Assisted Program Analysis for Android Permission Specification
  IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER), 2020

- A Cross-Architecture Instruction Embedding Model for Natural Language Processing-Inspired Binary Code Analysis
  NDSS Workshop on Binary Analysis Research (BAR), 2019

- System Service Call-oriented Symbolic Execution of Android Framework with Applications to Vulnerability Discovery and Exploit Generation
  ACM International Conference on Mobile Systems, Applications, and Services (MobiSys), 2017

- Repackage-proofing Android Apps
  Annual IEEE/IFIP International Conference on Dependable Systems and Networks (DSN), 2016

- SolMiner: Mining Distinct Solutions in Programming Submissions
  International Conference on Software Engineering (ICSE), SEET track, 2016

- Semantics-Based Obfuscation-Resilient Binary Code Similarity Comparison with Applications to Software Plagiarism Detection
  ACM SIGSOFT International Symposium on the Foundations of Software Engineering (FSE), 2014

TEACHING

University of South Carolina

- Spring 2022, *CSCE 548: Building Secure Software*, Undergraduate and Graduate, Instructor
    - Student Enrollment: 54
    - Student Responses: 23 (42.59%)
    - Course Rating: **4.55/5**
    - Instructor Rating: **4.64/5**
- Fall 2021, *CSCE 201: Introduction to Computer Security*, Undergraduate, Instructor
    - Student Enrollment: 46
    - Student Responses: 15 (32.16%)
    - Course Rating: **4.33/5**
    - Instructor Rating: **4.43/5**
- Spring 2021, *CSCE 548: Building Secure Software*, Undergraduate and Graduate, Instructor
    - Student Enrollment: 45
    - Student Responses: 16 (35.56%)
    - Course Rating: **4.47/5**
    - Instructor Rating: **4.67/5**
- Fall 2020, *CSCE 790: Introduction to Software Analysis*, Graduate, Instructor
    - **New Course Developed**
    - Student Enrollment: 14
    - Student Responses: 11 (78.57%)
    - Course Rating: **4.91/5**
    - Instructor Rating: **4.91/5**
- Fall 2019, *CSCE 813: Internet Security*, Graduate, Instructor
    - Student Enrollment: 12
    - Student Responses: 11 (91.67%)
    - Course Rating: 4.6/5
    - Instructor Rating: 4.82/5
- Spring 2019, *CSCE 201: Introduction to Computer Security*, Undergraduate, Instructor
    - Student Enrollment: 41
    - Student Responses: 24 (58.54%)
    - Course Rating: **4/5**
    - Instructor Rating: **4.14/5**
- Spring 2019, *CSCE 791: Seminar in Advances in Computing*, Graduate, Instructor
    - Student Enrollment: 17
    - Student Responses: 16 (94.12%)
    - Course Rating: **4.25/5**
    - Instructor Rating: **4.4/5**

- Fall 2018, *CSCE 790: Introduction to Software Analysis*, Graduate, Instructor
  - **New Course Developed**
  - Student Enrollment: 20
  - Student Responses: 18 (90%)
  - Course Rating: **4.53/5**
  - Instructor Rating: **4.72/5**
- Spring 2018, *CSCE 548: Building Secure Software*, Undergraduate and Graduate, Instructor
  - Student Enrollment: 45
  - Student Responses: 32 (71.11%)
  - Course Rating: **4.47/5**
  - Instructor Rating: **4.77/5**
- Fall 2017, *CSCE 813: Internet Security*, Graduate, Instructor
  - Student Enrollment: 12
  - Student Responses: 12 (100%)
  - Course Rating: **4.83/5**
  - Instructor Rating: **4.82/5**

Penn State University

- Fall 2015, *IST 451: Network Security*, Teaching Assistant.
- Spring 2015, *IST 220: Networking and Telecommunications*, Teaching Assistant
- Fall 2014, *IST 451: Network Security*, Teaching Assistant
- Spring 2014, *IST 451: Network Security*, Teaching Assistant

STUDENT SUPERVISION

Current Students

PhD Students

- Junzhe Wang (Fall 2020–present; co-advised with Dr. Qiang Zeng)
  - *Publications: DCDS'22, ACSAC'21*
- Xiaoyue Ma (Fall 2021–present)

Former Students

PhD Students

- Xiaopeng Li (Fall 2017–Spring 2020; co-advised with Dr. Wenyuan Xu)
  - *Publications: MobiSys'22, CCS'20, MobiCom'19, RAID'19, NDSS'19*
  - *First Employment: Applied & Data Scientist, Microsoft*
  - *Dissertation: "Smart Sensing Enabled Secure and Usable Pairing and Authentication"*

Master Students

- Fengyao Yan (Fall 2017–Spring 2019)

- *Publications: MobiCom'19*
- *Continued PhD study at UofSC*

- Kimberly Redmond (Spring 2018–Spring 2019)

  - *Publications: BAR'19*
  - *First Employment: Software Engineer, Motorola Solutions, Inc.*
  - *Thesis: "An Instruction Embedding Model for Binary Code Analysis"*

- Alex Scott (Fall 2021–Spring 2022)

Undergraduate Students

- Jason Abraham (Fall 2017–Spring 2019)
- Franco Godoy (Spring 2018)
- Steven Maxwell (Spring 2019)
- Andrew Cox (Spring 2019)

Thesis Committee at UofSC (PhD Students)

- Zhenyao Wu, Graduated in 2022
- Xinyi Wu, Graduated in 2022
- Lan Fu, Graduated in 2022
- Yuhang Lu, Graduated in 2022
- Jun Zhou, Graduated in 2022
- John Ravan, Graduated in 2021
- Fei Zuo, Graduated in 2021
- Yang Mi, Graduated in 2020
- Dazhou Guo, Graduated in 2019
- Kang Zheng, Graduated in 2019
- Mark Daniels, Graduated in 2018