ZHIDA LI

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Postdoctoral fellow working on cybersecurity: using machine learning to detect network anomalies

EDUCATION

Ph.D. Engineering Science *Sept. 2015–Apr. 2022*
Simon Fraser University, Canada
- Dissertation: Machine Learning for Classifying Anomalies and Intrusions in Communication Networks

M.Eng.Sc. (thesis-based) Electrical and Electronic Engineering *Feb. 2013–Sept. 2015*
University College Cork, Ireland

M.Eng.Sc. (course-based) Microelectronic Engineering *Sept. 2011–Feb. 2013*
University College Cork, Ireland

B.E. (Hons.) Electrical and Electronic Engineering *Sept. 2009–Sept. 2011*
University College Cork, Ireland

B.E. Microelectronics *Sept. 2007–Sept. 2009*
Guilin University of Electronic Technology, China

TECHNICAL SKILLS

Programming Languages: Python, MATLAB, MySQL, JavaScript, Octave, C#, LaTeX

Machine Learning Libraries and Data Science Tools: PyTorch, Keras, Scikit-learn, NumPy, SciPy, Pandas, Matplotlib, Google Colab, Weka

Web Application Development: Flask, AWS Elastic Beanstalk

Certification: Cisco Certified Network Associate (CCNA)

RESEARCH AND WORK EXPERIENCE

Postdoctoral Fellow *June 2022–Present*
Faculty of Applied Sciences, Simon Fraser University Burnaby, BC
- Leading the project for developing new ML algorithms based on echo state networks
- Exploring applications of graph neural networks based on network topology

Research Assistant *(Advisor: Prof. Ljiljana Trajković)* *Sept. 2015–Apr. 2022*
Faculty of Applied Sciences, Simon Fraser University Burnaby, BC
- **Applications of Machine Learning Techniques for Classifying Network Anomalies**
  - Processed the raw network data: BGP data from RIPE and Route Views
  - Analyzed and implemented various ML algorithms as well as employing feature selection
  - Performed experiments (cross-validation and testing) using a supercomputer managed by Compute Canada
- **Development of Novel Machine Learning Algorithms: VFBLS, VCFBLS**
  - Developed two fast BLS-based algorithms: variable features BLS algorithms without and with cascades
  - Developed generalized models based on various subsets of input data based on selected features and expanded the network structure

- **Development of Tool for Detecting Network Anomalies: CyberDefense**
  - The tool consists of multiple modules: real-time data retrieval, feature extraction, label refinement, data partition, data processing, ML algorithms, parameter selection, ML models, and classification
  - Integrated various stages of the anomaly detection process
  - Detected BGP anomalies based on routing records collected worldwide from major Internet exchange points
  - Facilitated creating new machine learning models based on historical BGP anomalous events
  - Developed a web-based version for real-time anomaly detection and off-line classification

Data Analyst | Part-time *May 2021–Sept. 2021*
EVO-IN-MOTION Technology Richmond, BC

- Analyzed data from circuit simulations and experiments

Technical Documentation Specialist | Part-time *May 2020–Aug. 2020*
EVO-IN-MOTION Technology Richmond, BC

- Designed and wrote the lab manual related to DC experiments (analog circuits)

Research Assistant *(Advisor: Prof. Peter Kennedy)* *Oct. 2011–Jan. 2015*
Tyndall National Institute Cork, Ireland

- Designed nonlinearity-tolerant requantizer architectures for fractional-*N* frequency synthesizers

Electrical Engineer | Internship *May 2010–Aug. 2010*
Dell EMC Cork, Ireland

- Supplied details of failure return to the suppliers and involved in customer service

TEACHING EXPERIENCE

Teaching Assistant *Sept. 2015–Apr. 2022*
Faculty of Applied Sciences, Simon Fraser University Burnaby, BC

- **ENSC 427/894 Communication Networks**, 6 terms (undergraduate and graduate levels)
  - Delivered lectures as needed; Designed and graded assignments and exams; Helped students with their projects using ns-3 and Riverbed Modeler
- **ENSC 220 Electronic Circuits I**, 4 terms (undergraduate level)
  - Held lab sessions with both practical exercises and LTspice simulations: Kirchhoff's voltage and current laws, operational amplifiers, and RLC circuits; Graded assignments and exams
- **ENSC 120 Introduction to Electronics Laboratory Instruments Operation and Measurement Techniques**, 2 terms (undergraduate level)
  - Held lab sessions for operating electronics laboratory instrumentation such as linear power supply, digital multi-meter, function generator, and oscilloscope; Graded exams
- **ENSC 252 Fundamentals of Digital Logic and Design**, 2 terms (undergraduate level)
  - Held lab sessions for designing digital systems using VHDL on a FPGA; Proctored exams
- **ENSC 180 Introduction to Engineering Analysis**, 1 term (undergraduate level)
  - Helped design a lab assignment using MATLAB: Red Bull Stratos Jump; Proctored exams

Teaching Assistant *June 12, 2021*
IEEE SMC Society Summer School Tokyo, Japan (virtual)

- TA for Lecture 4: Data mining and machine learning for detecting traffic anomalies and intrusions
- Designed and presented a demo of anomaly detection (Slammer worm) with Python on Colab

AWARDS

- Graduate Fellowship Award, SFU *Fall 2017, Fall 2019*
- Faculty of Applied Sciences Graduate Fellowship Award, SFU *Summer 2016, Fall 2016*
- Travel and Minor Research Award, SFU *Summer 2016*

EXTERNAL SERVICE AND EVIDENCE OF IMPACT

Secretary *Feb. 2022–Present*
Membership Development Committee, IEEE Canada

Treasurer *Jan. 2018–Present*
IEEE Circuits and Systems Society joint Chapter of the Vancouver/Victoria Sections

Chair/ Secretary *Sept. 2020–Oct. 2021/ Sept. 2019–Sept. 2020*
IEEE SFU Student Branch

Technical Program Committee Membership

- IEEE International Conference on High Performance Computing and Communications: Member (*HPCC-2022*); Member and Session Chair (*HPCC-2020*)
- IEEE International Conference on Cyber, Physical and Social Computing: Member and Publicity Chair (*CPSCom-2022*); Member and Session Chair (*CPSCom-2020*)
- International Conference on E-Business and Internet: Member (ICEBI 2022)

Reviewer

- IEEE Journal on Selected Areas in Communications (J-SAC) (*2022*); Computers & Security (*2022)*; IEEE Transactions on Neural Networks and Learning Systems (*2021, 2022)*; Neural Networks (*2020–2022)*; IEEE International Conference on Systems, Man, and Cybernetics (*2020–2022)*; Concurrency and Computation: Practice and Experience (*2021*); IEEE Transactions on Emerging Topics in Computational Intelligence (*2019, 2021*); IEEE Access (*2019, 2020*)

PUBLICATIONS [Google Scholar]

Book Chapters:

1. Q. Ding, **Z. Li**, S. Haeri, and Lj. Trajković, "Application of machine learning techniques to detecting anomalies in communication networks: datasets and feature selection algorithms," in *Cyber Threat Intelligence*, A. Dehghantanha, M. Conti, T. Dargahi, Eds., Berlin: Springer, pp. 47–70, 2018.
2. **Z. Li**, Q. Ding, S. Haeri, and Lj. Trajković, "Application of machine learning techniques to detecting anomalies in communication networks: classification algorithms," in *Cyber Threat Intelligence*, A. Dehghantanha, M. Conti, T. Dargahi, Eds., Berlin: Springer, pp. 71–92, 2018.

Refereed Journals:

3. **Z. Li**, A. L. G. Rios, and Lj. Trajković, "Machine learning for detecting the WestRock ransomware attack using BGP routing records," *IEEE Commun. Mag*., submitted for publication (minor revision).
4. **Z. Li**, A. L. G. Rios, and Lj. Trajković, "Machine learning for detecting anomalies and intrusions in communication networks," *IEEE Journal on Selected Areas in Communications (J-SAC)*, vol. 39, no. 7, pp. 2254–2264, July 2021. (IF: 13.081)
5. M. P. Kennedy, **Z. Li**, and Z. Huang, "Programmable analog frequency divider based on p-switching," *Nonlinear Theory and Its Applications, IEICE*, vol. 4, no. 4, pp. 389–399, Oct. 2013.

Publications in Refereed Conference Proceedings:

6. **Z. Li** and Lj. Trajković, "CyberDefense: tool for detecting network anomalies and intrusions," *IEEE Int. Workshop on Computer-Aided Modeling and Design of Communication Links and Networks*, to be published.
7. **Z. Li**, A. L. G. Rios, and Lj. Trajković, "Classifying denial of service attacks using fast machine learning algorithms," in *Proc. IEEE Int. Conf. Syst., Man, Cybern*., Melbourne, Australia, Oct. 2021, pp. 1221–1226.
8. **Z. Li**, A. L. G. Rios, and Lj. Trajković, "Detecting Internet worms, ransomware, and blackouts using recurrent neural networks," in *Proc. IEEE Int. Conf. Syst., Man, Cybern.*, Toronto, Canada, Oct. 2020, pp. 2165–2172.
9. A. L. G. Rios, **Z. Li**, K. Bekshentayeva, and Lj. Trajković, "Detection of denial of service attacks in communication networks," in *Proc. IEEE Int. Symp. Circuits Syst.*, Sevilla, Spain, Oct. 2020.
10. **Z. Li**, A. L. G. Rios, G. Xu, and Lj. Trajković, "Machine learning techniques for classifying network anomalies and intrusions," in *Proc. IEEE Int. Symp. Circuits Syst.*, Sapporo, Japan, May 2019, pp. 1–5.
11. A. L. G. Rios, **Z. Li**, G. Xu, A. Diaz Alonso, and Lj. Trajković, "Detecting network anomalies and intrusions in communication networks," in *Proc. 23rd IEEE Int. Conf. Intell. Eng. Syst.*, Hungary, Apr. 2019, pp. 29–34.
12. **Z. Li**, P. Batta, and Lj. Trajković, "Comparison of machine learning algorithms for detection of network intrusions," in *Proc. IEEE Int. Conf. Syst., Man, Cybern*., Miyazaki, Japan, Oct. 2018, pp. 4248–4253.
13. P. Batta, M. Singh, **Z. Li**, Q. Ding, and Lj. Trajković, "Evaluation of support vector machine kernels for detecting network anomalies," in *Proc. IEEE Int. Symp. Circuits Syst.*, Florence, Italy, May 2018, pp. 1–4.
14. H. B. Yedder, Q. Ding, U. Zakia, **Z. Li**, S. Haeri, and Lj. Trajković, "Comparison of virtualization algorithms and topologies for data center networks," in *Proc. 26th Int. Conf. Comput. Commun. Netw., 2nd Workshop Netw. Security. Analytics Autom.*, Vancouver, Canada, Aug. 2017.
15. Q. Ding, **Z. Li**, P. Batta, and Lj. Trajković, "Detecting BGP anomalies using machine learning techniques," in *Proc. IEEE Int. Conf. Syst., Man, Cybern*., Budapest, Hungary, Oct. 2016, pp. 3352–3355.
16. S. Haeri, Q. Ding, **Z. Li**, and Lj. Trajković, "Global resource capacity algorithm with path splitting for virtual network embedding," in *Proc. IEEE Int. Symp. Circuits Syst.*, Montreal, Canada, May 2016, pp. 666-669.
17. M. P. Kennedy, H. Mo, **Z. Li**, G. Hu, P. Scognamiglio, E. Napoli, "The noise and spur delusion in fractional-N frequency synthesizer design," in *Proc. IEEE Int. Symp. Circuits Syst.*, Lisbon, Portugal, May 2015.
18. **Z. Li**, H. Mo, and M. P. Kennedy, "Comparative spur performance of a fractional-N frequency synthesizer with a nested MASH-SQ3 divider controller in the presence of memoryless piecewise-linear and polynomial nonlinearities", in *Proc. 25th IET Irish Signals Syst. Conf.*, Limerick, Ireland, June 2014, pp. 374–379.
19. **Z. Li** and M.P. Kennedy, "The switched injection-locked oscillator (SILO) concept," in *Proc. Int. Symp. Nonlinear Theory and Its Applications (NOLTA)*, Palma, Mallorca, October 2012, pp. 868–871.

REFERENCES

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