KIYOSHI NAKAYAMA

Affiliation
TieSet, Inc.
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RESEARCH INTERESTS

Applications	Computer Vision, Distributed Systems, Blockchain, Anomaly Detection, Optimal Flows, Cloud Computing, Internet of Things, System Resiliency, Fault Tolerance
AI/Theories	Deep Learning, Distributed AI, Federated Learning, Reinforcement Learning, Bandit Learning, Invariant Learning, Graph Theory

PROFESSIONAL EXPERIENCE

Founder & CEO

TieSet, Inc., Santa Clara, CA   6/2020 - Present

Transitioning from Big Data to Collective Intelligence

- TieSet Inc. is an industrial institute with a research and development base in Silicon Valley that is creating truly innovative paradigm-shifting technologies in interdisciplinary fields of Artificial Intelligence and Distributed Systems, led by research scientists and engineers from world-class laboratories and Ph.D. programs.

- We are developing a STADLE (Scalable, Traceable, Asynchronous, Decentralize federated Learning) platform to address the fundamental problems that cloud-based AI and big data systems face today where data privacy has emerged as a global concern, but AI systems utilizing Big Data simply can't preserve privacy while learning.

- The STADLE platform preserves privacy while distributing intelligence to be shared. Because intelligence is created and gathered locally on edge AI devices, TieSet's low latency platform generates high-quality intelligence without uploading data, enabling AI systems to operate at scale while offline.

- With our STADLE platform, AI is now transitioning from the product of big data to collective Intelligence, and penetrating into a variety of areas of our daily life and work, robotics, healthcare, education, public infrastructure, transportation, smart cities and energies, among others.

Research Scientist

NEC Laboratories America, San Jose, CA   10/2015 - 5/2020

Design and Optimization of Computer Vision Systems in Media Analytics Department

- Long-term and rich understanding of videos by heterogeneous sources using detection, tracking, re-identification, prediction to support recognition based on analysis by leveraging outputs from multiple computer vision tools.

- Research on communication optimization, efficiency, robustness, computation trade-offs for distributed-camera platforms for various applications such as self-driving cars and airport boarding security systems with scalable environment.

Distributed AI and Blockchain Research in Smart Infrastructure Department

- Research and development of a decentralized federated learning (FL) platform based on blockchain that achieves aggregator-free privacy-preserving FL with distributed data on autonomous IoT devices, which has been demonstrated with a deep Q-learning application for maximizing the revenue of drivers of taxi and ride sharing services.

- Research on anomaly detection for system failures and/or false data injection attacks in cyber-physical infrastructure systems based on dynamic learning of invariant graphs and state estimation with time series data for distributed system-level resiliency.

- Research and development of a blockchain-based management and analytical platform for various auction services that integrates a distributed multi-armed bandit (MAB) learning framework. The blockchain-based P2P platform also supports real-time energy trading of distributed energy resources.

- Design and implementation of a cloud-based online energy management system (EMS) that integrates optimization algorithms for resilient demand charge and demand response management into distributed battery control application for commercial and industry building.

Postdoctoral Research Associate

FUJITSU LABORATORIES OF AMERICA, Sunnyvale, CA   9/2014 - 9/2015

Cloud IoT Platform Developement in Solutions for Electricity Distribution Networks (SEDN) Group

- Development of a cloud-based residential Demand Response (DR) System prototype with a web-based GUI leveraging IoT devices for use in utility pilot projects that realizes multiple DR programs and supports the Open Automated Demand Response (OpenADR) 2.0b standard.

- Research and development of basic machine learning algorithms including auto-regression techniques to maximize the benefits of the DR programs for both utilities and customers.

- Research on Virtual Power Plants (VPPs) with an emphasis on charging and discharging algorithms for effective energy storage management for increased renewable integration.

EDUCATION

Ph.D. in Computer Science

UNIVERSITY OF CALIFORNIA, IRVINE   2014
Research Areas: Distributed Networks, Systems, and Optimization, Graph Theory
Advisors: Prof. Lubomir F. Bic and Prof. Michael B. Dillencourt

Distributed Smart Energy Control Model (Dissertation Project)

- Proposed a decentralized model for optimal real-time distribution of renewable energy resources to minimize reliance on traditional sources of energy such as fossil fuels.

- Research on dynamic power flow control with energy storage to minimize the cost of power production by fossil fuels and the cost of using batteries across multiple time periods to balance the fluctuation of renewable power generation and loads.

- Research on power flow loss minimization for effectively distributing energy resources to consumers in a future large-scale power grid integrating many real-time distributed generation systems.

Distributed Network Flow Optimization

- Formulated and solved a Network Flow Optimization problem, which considered to be a minimum cost flow problem with quadratic edge functions, to radically improve total throughput against given traffics for a mesh network.

- Proposed a distributed control technique for flow optimization in energy-harvesting wireless sensor networks in order to balance the energy consumptions of sending packets assigned to routers that are sent from sensors to base stations.

Distributed Network Fault Tolerance

- Proposed an autonomous ring-based failure detection technique synchronized among logical loops created over a mesh network.

- Research on a mechanism for coping with single and double-link failure(s) in the Ethernet in an autonomous and distributed manner focused on loops in a bi-connected network.

HONORS AND AWARDS

- **Spot Recognition Award** 2018, NEC Laboratories America, Inc.

  In recognition of the contributions to the continued development and successful deployment of a cloud-based online energy management simulation platform at NEC Labs

- **Business Contribution Award** 2017, NEC Laboratories America, Inc.

  In recognition of key contribution to resilient demand charge management technology for distributed energy storage applications

- **Best Paper Award**, IEEE SmartGridComm 2012

  Title: *Complete Automation of Future Grid for Optimal Real-Time Distribution of Renewables*

- **Best Paper Award**, IEEE International Congress on Ultra Modern Telecommunications and Control Systems (ICUMT) 2010

  Title: *Distributed Control Based on Tie-Set Graph Theory for Smart Grid Networks*

PUBLICATIONS

Book Chapters

1. **K. Nakayama**, *"Chapter 5: Decentralized Models for Real-Time Renewable Integration in Future Grid,"* in *Smarter Energy: from Smart Metering to the Smart Grid*, Vol. 2, pp. 129, IET Press, 2016.

Journals

1. N. Muralidhar, C. Wang, N. Self, M. Momtazpour, **K. Nakayama**, R. Sharma, N. Ramakrishnan, *"illiad: InteLLigent Invariant and Anomaly Detection in Cyber Physical Systems,"* ACM Transactions on Intelligent Systems and Technology (TIST), Vol. 9, No. 3, 2018, pp. 35:1 - 35:20.

2. **K. Nakayama**, C. Zhao, L. Bic, M. Dillencourt, J. Brouwer, *"Distributed Power Flow Loss Minimization Control for Future Grid,"* Wiley International Journal of Circuit Theory and Applications, Vol. 43, No. 9, 2014, pp. 1209 - 1225.

3. **K. Nakayama**, N. Shinomiya, H. Watanabe, *"An Autonomous Distributed Control Method Based on Tie-set Graph Theory in Future Grid,"* Wiley International Journal of Circuit Theory and Applications, Vol. 41, No. 11, 2013, pp. 1154 - 1174.

4. **K. Nakayama**, N. Shinomiya, H. Watanabe, *"An Autonomous Distributed Control Method for Link Failure Based on Tie-Set Graph Theory,"* IEEE Transactions on Circuits and Systems-1: Regular Paper, Vol. 59, No. 11, 2012, pp. 2727 - 2737.

Conference and Symposium Proceedings

1. P. Ramanan, **K. Nakayama**, *"BAFFLE: Blockchain-Based Aggregator-Free Federated Learning,"* IEEE Blockchain-2020, Rhodes Island, Greece, Nov. 2020.

2. N. Muralidhar, S. Muthiah, **K. Nakayama**, R. Sharma, N. Ramakrishnan, *"Multivariate Long-Term State Forecasting in Cyber-Physical Systems: A Sequence to Sequence Approach,"* under review at IEEE BigData 2019, USA.

3. **K. Nakayama**, N. Muralidhar, C. Jin, R. Sharma, *"Detection of False Data Injection Attacks in Cyber-Physical Systems using Dynamic Invariants,"* IEEE International Conference on Machine Learning and Applications (ICMLA), FL USA, Dec. 2019.

4. Z. Zhao, **K. Nakayama**, R. Sharma, *"Decentralized Transactive Energy Auctions with Bandit Learning,"* IEEE PES Transactive Energy System Conference (TESC), Minneapolis, MN USA, Jul. 2019. (**Selected as Top 4 Papers**)

5. **K. Nakayama**, R. Moslemi, R. Sharma, *"Transactive Energy Management with Blockchain Smart Contracts for P2P Multi-Settlement Markets,"* IEEE Conference on Innovative Smart Grid Technologies (ISGT), Washington DC USA, Feb. 2019.

6. **K. Nakayama**, R. Sharma, *"Demand Charge and Response with Energy Storage,"* IEEE International Conference on Smart Grid Communications (SmartGridComm), pp. 72 - 77, Aalborg Denmark, Oct. 2018.

7. **K. Nakayama**, R. Sharma, *"Energy Management Systems with Intelligent Anomaly Detection and Prediction,"* IEEE Resilience Week, pp. 24 - 29, Wilmington DE USA, Sep. 2017.

8. M. Parandehgheibi, S. A. Pourmousavi Kani, **K. Nakayama**, R. Sharma, *"A Two-Layer Incentive-Based Controller for Aggregating BTM Energy Storage Devices,"* IEEE PES General Meeting, pp. 1 - 5, Chicago IL USA, Jul 2017.

9. **K. Nakayama**, R. Sharma, *"An Autonomous Energy Management Platform for Resilient Operation of MicroGrids,"* IEEE International Conference on Smart Grid Communications (SmartGridComm), pp. 167 - 173, Sydney Australia, Nov. 2016.

10. **K. Nakayama**, N. Dang, L. Bic, M. Dillencourt, E. Bozorgzadeh, N. Venkatasubramanian, *"Distributed Flow Optimization Control for Energy-Harvesting Wireless Sensor Networks,"* IEEE International Conference on Communications (ICC), pp. 4083 - 4088, Sydney Australia, Jun. 2014.

11. **K. Nakayama**, T. Koide, *"A Decentralized Algorithm for Network Flow Optimization in Mesh Networks,"* IEEE Global Communications Conference (Globecom), pp. 1554 - 1559, Atlanta GA USA, Dec. 2013.

12. **K. Nakayama**, C. Zhao, M. Dillencourt, L. Bic, J. Brouwer *"Distributed Real-Time Power Flow Control with Renewable Integration,"* IEEE International Conference on Smart Grid Communications (SmartGridComm), pp. 516 - 521, Vancouver Canada, Oct. 2013.

13. **K. Nakayama**, K. Benson, V. Avagyan, M. Dillencourt, L. Bic, N. Venkatasubramanian, *"Tie-set Based Fault Tolerance for Autonomous Recovery of Double-Link Failures,"* IEEE Symposium on Computers and Communications (ISCC), pp. 391 - 397, Split Croatia, Jul. 2013.

14. Y. Sakai, **K. Nakayama**, N. Shinomiya, *"A Node-Weight Equalization Problem with Circuit-Based Computations,"* IEEE International Symposium on Circuits and Systems (ISCAS), pp. 2525-2528, Beijing China, May 2013.

15. **K. Nakayama**, K. Benson, L. Bic, M. Dillencourt, *"Complete Automation of Future Grid for Optimal Real-Time Distribution of Renewables,"* IEEE International Conference on Smart Grid Communications (SmartGridComm), pp. 418 - 423, Tainan Taiwan, Nov. 2012 (**Best Paper Award**).

16. Y. Sakai, **K. Nakayama**, N. Shinomiya, *"A Property Verification of Node-Weight Equalization Focusing on Cycles of a Graph,"* 27th International Technical Conference on Circuits/Systems, Computers and Communications (ITC-CSCC), Jul. 2012, P-T2-236.

17. **K. Nakayama**, N. Shinomiya, *"Autonomous Recovery for Link Failure Based on Tie-Sets in Information Networks,"* IEEE Symposium on Computers and Communications (ISCC), pp. 671 - 676, Corfu Greece, Jun. 2011.

18. K. Kadena, **K Nakayama**, N. Shinomiya, *"Network Failure Recovery with Tie-Sets,"* IEEE International Conference on Advanced Information Networking and Applications Workshops (WAINA), pp. 467 - 472, Biopolis Singapore, Mar. 2011.

19. **K. Nakayama**, N. Shinomiya, *"Distributed Control Based on Tie-Set Graph Theory for Smart Grid Networks,"* IEEE International Congress on Ultra Modern Telecommunications and Control Systems (ICUMT), pp. 957 - 964, Moscow Russia, Oct. 2010 (**Best Paper Award**).

20. **K. Nakayama**, N. Shinomiya, H. Watanabe, *"Distributed Control for Link Failure Based on Tie-Sets in Information Networks,"* IEEE International Symposium on Circuits and Systems (ISCAS), pp. 3913 - 3916, Paris France, May 2010.

21. **K. Nakayama**, N. Shinomiya, *"Tie-set Graph Theory and its Application to Smart Grid,"* IEICE General Conference, Miyagi Japan, March 2010, BS-3-8, "S-38"-"S-39".

22. K. Kadena, **K Nakayama**, N. Shinomiya, *"A Way of Determining a Fundamental System of Tie-sets Considering a Link Failure Recovery,"* IEICE General Conference, Miyagi Japan, March 2010, BS-3-1, "S-24"-"S-25".

23. **K. Nakayama**, N. Shinomiya, *"A Distributed Control Method based on Tie-sets on a Network,"* Multimedia, Distributed, Cooperative and Mobile Symposium (DICOMO), Oita Japan, July 2009, No. 1, pp. 788 - 796.

24. **K. Nakayama**, N. Shinomiya, *"Autonomous Distributed Control for Optical Sensory Nerve Networks,"* IEICE General Conference, Ehime Japan, March 2009, B-20-32.

US Patents

1. Z. Askarzadeh, **K. Nakayama**, *"Privacy Preserved Framework for Speech Emotion Detection Applications,"* U.S. Provisional Patent filed.

2. J. Barreiros, **K. Nakayama**, *"System and methods for privacy-protecting crowdsourced learning for robotic manipulators and tools,"* U.S. Provisional Patent filed.

3. I. Ahmed, **K. Nakayama**, *"Framework and methods for private, interpretable, and adaptive data-driven controllers,"* U.S. Provisional Patent filed.

4. G. Ishigaki, **K. Nakayama**, *"Horizontally Clustered Federated Learning Platform,"* U.S. Provisional Patent filed.

5. **K. Nakayama**, P. Ramanan, R. Sharma, *"Decentralized Aggregator-Less Blockchain Based Federated Learning,"* U.S. Patent Application Under Review.

6. **K. Nakayama**, R. Moslemi, H. Hosseini, R. Sharma, *"A Decentralized IoT Infrastructure Management Platform with Distributed Ledger Technology Integrating AI Models,"* U.S. Patent Application Under Review.

7. **K. Nakayama**, R. Sharma, *"Autonomous Blockchain-Based Smart Warranty Management for Energy Storages,"* U.S. Patent Application Under Review.

8. **K. Nakayama**, Z. Zhao, R. Sharma, *"Autonomous Blockchain-Based Peer-To-Peer Energy Trading Platform for Transactive Energy Management in Distribution Network using Reinforcement Bandit Learning,"* U.S. Patent Application Under Review.

9. **K. Nakayama**, R. Moslemi, R. Sharma, *"Blockchain-Based Peer-To-Peer Transactive Energy Management for Multi-Settlement Markets,"* U.S. Patent Application Under Review.

10. **K. Nakayama**, R. Sharma, *"Decentralized Energy Management Utilizing Blockchain Technology,"* U.S. Patent Application Under Review.

11. **K. Nakayama**, R. Sharma, *"Demand Charge and Response Management using Energy Storage,"* U.S. Patent, No. 16/185,373.

12. **K. Nakayama**, N. Muralidhar, C. Jin, R. Sharma, *"Detection of False Data Injection Attacks in Power Systems using Multiplex Invariant Networks and Domain Knowledge,"* U.S. Patent, No. 16/151,544.

13. **K. Nakayama**, R. Sharma, *"Energy Management System with Intelligent Anomaly Detection and Prediction,"* U.S. Patent, No. 15/974,155.

14. **K. Nakayama**, R. Sharma, *"Autonomous Operational Platform for Micro-Grid Energy Management,"* U.S. Patent, No. 15/436,274.

15. **K. Nakayama**, W.P. Chen, *"Aggregated and Optimized Virtual Power Plant Control,"* U.S. Patent, No. 15/000,970.

GRANTS AND RESEARCH SUPPORT

- Full Scholarship from Japanese Student Services Organization (JASSO) 3,583,000 JPY/Year
  Covering all the tuition and living expenses for Ph.D. program from 2011 to 2014
  Elected as one of top 22 students from nationwide applicants
- Student Travel Grant, IEEE SmartGridComm held in Tainan Taiwan, $1000, 2012
- Grants from NEC C&C Foundation 250,000 JPY, 2010
  For Researchers Attending Prestigious International Conferences

PROFESSIONAL SERVICES

- TCF Independent Reviewer in support of U.S. Department of Energy, 2019
- TPC Member: IEEE International Conference on Smart Grid Communications (SmartGridComm), 2017, 2018, 2019
- TPC Member: IEEE Wireless Communications and Networking Conference (WCNC), 2019
- Invited Reviewer: IEEE Transactions on Vehicular Technology, 2018
- Guest Editor: IEEE Communications Magazine on Internet of Electric Vehicles and Smart Grid, 2018
- Associate Editor: IET Smart Grid Journals, 2018
- Guest Editor: IEEE Communications Magazine on Internet of Things and Information Processing in Smart Energy Applications, 2017
- TPC Member: IEEE Global Communications Conference (Globecom), 2017, 2018
- TPC Member: IEEE International Conference on Communications (ICC), 2015, 2016, 2017
- Guest Editor: IEEE Communications Magazine on Integrated Communications, Control, and Computing Technologies for Enabling Autonomous Smart Grid, 2016
- Invited Reviewer: IEEE Transactions on Smart Grid, 2016
- TPC Member: International Workshop on Integrating Communications, Control, and Computing Technologies for Smart Grid (ICT4SG) held in conjunction with IEEE ICC 2016
- Invited Reviewer: IEEE Transactions on Communications, 2014

CONFERENCE AND INVITED TALKS

- July 2019: Plenary Session Presentation, IEEE Transactive Energy System Conference, Minneapolis, MN.
- October 2018: Oral Presentation, IEEE SmartGridComm, Aalborg, Denmark.
- September 2017: Oral Presentation, IEEE Resilience Week, Wilmington, DE.
- November 2016: Oral Presentation, IEEE SmartGridComm, Sydney, Australia.
- July 2014: Invited Talk, Network Systems Research Group Seminar, Fujitsu Labs, Dallas, TX.
- June 2014: Invited Talk, CRISP Seminar, UC Davis, CA.
  Hosted by Prof. Anna Scaglione
- January 2014: Invited Talk, RSRG Seminar, Caltech, Pasadena, CA.
  Hosted by Prof. Steven Low
- December 2013: Invited Talk, Center for Nonlinear Studies, Los Alamos National Laboratory, NM.
  Hosted by Dr. Misha Chertkov
- December 2013: Oral Presentation, IEEE Globecom, Atlanta, GA.
- October 2013: Oral Presentation, IEEE SmartGridComm, Vancouver, Canada.

- November 2012: Invited Talk, Global Citizenship Program, Soka University, Tokyo, Japan.
- November 2012: Oral Presentation, IEEE SmartGridComm, Tainan, Taiwan.
- June 2011: Oral Presentation, IEEE ISCC, Corfu Greece.
- October 2010: Oral Presentation, IEEE ICUMT, Moscow, Russia.

MENTORING/SERVICE

- Zahra Askarzadeh from University of California, Irvine   Summer Intern 2020
  Privacy Preserved Framework for Speech Emotion Detection Applications
- Samira Zare from University of California, Santa Cruz   Summer Intern 2020
  Framework and Methods for Low Risk of Injury, Private, and Adaptive Smart Rehabilitation Devices
- Jose Barreiros from Cornell University   Summer Intern 2020
  System and methods for privacy-protecting crowdsourced learning for robotic manipulators and tools
- Ibrahim Ahmed from Vanderbilt University   Summer Intern 2020
  Framework and methods for private, interpretable, and adaptive data-driven controllers
- Genya Ishigaki from University of Texas, Dallas   Summer Intern 2020
  Horizontally clustered federated learning platform
- Paritosh Ramanan from Georgia Tech   Summer Intern 2019
  Project: Decentralized Blockchain-Based Aggregator-Less Federated Learning
- Zibo Zhao from Purdue University   Summer Intern 2018
  Project: Decentralized Pricing in Transactive Energy Trading by Bandit Learning
- Ehsan Raoufat from University of Tennessee   Summer Intern 2017
  Project: Energy Storage for PV-utilization and Demand Charge Management
- Nikhil Muralidhar from Virginia Tech   Summer Intern 2017
  Project: Detection of False Data Injection Attacks on Power Systems with Multilayer Invariant Networks and Domain Knowledge
- Marzieh Parandehgheibi from MIT   Summer Intern 2016
  Project: A Two-Layer Incentive-Based Controller for Aggregating BTM Energy Storage Devices

TECHNICAL SKILLS

Machine Learning	DNN, Q-Learning, Bandit Learning, Invariant Learning
Programming	Java, Python, C/C++, Javascript, Solidity
Database	Blockchain, MongoDB, MySQL
Dist. Systems	MPI, IPFS, Ethereum Frameworks, Web3 Libraries
Web Frameworks	RESTful, HTTP, HTML, JSP, AJAX, Flask, Eclipse (Dynamic Web App)

REFERENCES

Available Upon Request.