Jinhyun So

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RESEARCH INTEREST

Federated Learning
Privacy-preserving Machine Learning
Information Theory
Coded Distributed Computing
Well defined mathematical problems of engineering interest

EDUCATION

University of Southern California, Los Angeles, USA 2017 – Present
Ph.D Student., Electrical and Computer Engineering
- *Advisor*: Professor Salman Avestimehr

Korea Advanced Institute of Science and Technology (KAIST), Daejon, Korea 2012
M.S., Electrical Engineering
- *Advisor*: Professor Yong Hoon Lee
- *Thesis*: Digital Predistortion Techniques Based on Envelope Feedback
- *GPA*: 4.12/4.30

Korea Advanced Institute of Science and Technology (KAIST), Daejon, Korea 2010
B.S., Electrical Engineering
- *Major GPA*: 4.05/4.30

HONORS AND AWARDS

Baidu Best Paper Award at NeurIPS -SpicyFL workshop 2020 Dec 2020
FedML: A Research Library and Benchmark for Federated Machine Learning

Annenberg Fellowship, University of Southern California Aug 2017 – May 2021
Full support for Tuition Fee and Stipend of Ph.D. program

Outstanding Employee, Samsung Electronics Dec 2015
Novel time tracking algorithms without voltage controlled-TCXO

Graduate Student Fellowship, Korea Advanced Institute of Science and Technology Feb 2011 – Aug 2012
Full Support for Tuition Fee and Stipend of Graduate Study

U.S. Army Jan 2010
Army commendation Medal

Korea Student Aid Foundation (KOSAF) Fellowship Mar 2004 – Feb 2008
Full Support for Tuition Fee and Stipend of Undergraduate Study

Samsung SDI Fellowship Mar 2003 – Feb 2008
Scholarship in recognition of outstanding academic excellence
(Top 5% Science High School Student)

PUBPLICATIONS

Journal Papers

J1. **Jinhyun So**, Basak Guler, and Salman Avestimehr, "Byzantine-Resilient Secure Federated Learning," IEEE Journal on Selected Areas in Communications (JSAC) 2020.

J2. **Jinhyun So***, Basak Guler*, Salman Avestimehr, " CodedPivateML: A Fast and Privacy-Preserving Framework for Distributed Machine Learning," accepted to IEEE Journal on Selected Areas in Information Theory (JSAIT) 2021.

J3. **Jinhyun So**, Basak Guler, and Salman Avestimehr, "Turbo-Aggregate: Breaking the Quadratic Aggregation Barrier in Secure Federated Learning," accepted to IEEE Journal on Selected Areas in Information Theory (JSAIT) 2021.

Conference Papers

C1. Ramy E. Ali, **Jinhyun So**, and Salman Avestimehr. "On Polynomial Approximations for Privacy-Preserving and Verifiable ReLU Networks." NeurIPS 2020 PPML Workshop, available online at arXiv:2011.05530

C2. Chaoyang He, Songze Li, **Jinhyun So**, Mi Zhang, Hongyi Wang, Xiaoyang Wang, Praneeth Vepakomma et al. "Fedml: A research library and benchmark for federated machine learning." NeurIPS 2020 SpicyFL Workshop **(Bast Paper Award)**, available online at arXiv:2007.13518

C3. **Jinhyun So**, Basak Guler, and Salman Avestimehr, "A Scalable Approach for Privacy-Preserving Collaborative Machine Learning," Advanced in Neural Information Processing Systems **(NeurIPS)**, vol. 33, 2020

C4. **Jinhyun So**, Basak Guler, and Salman Avestimehr, "Turbo-Aggregate: Breaking the Quadratic Aggregation Barrier in Secure Federated Learning," ICML Workshop on Federated Learning for User Privacy and Data Confidentiality **(Long Presentation)**, 2020

C5. **Jinhyun So***, Basak Guler*, Salman Avestimehr, and Payman Mohassel, "CodedPrivateML: A Fast and Privacy-Preserving Framework for Distributed Machine Learning," ICML *2019* CodML workshop (Poster), 2019.

C6. **Jinhyun So**, Sungho Choi, Seung Hyeok Ahn, Eui-Rim Jeong, and Yong H. Lee, "Digital Predistortion Based on Envelope Feedback," *IEEE International Conference on Acoustics, Speech, and Signal Processing(ICASSP)*, Tokyo, 2012 Mar.

C7. Sungho Choi, Eui-Rim Jeong, Byonghwan Lee, **Jinhyun So**, and Yong H. Lee, "New Predistortion Technique for Wideband Power Amplifiers of Dual-Band Transmission Systems," *The 21st Joint Conference on Communications & Information 2011*, Busan, Korea, May, 2011.

Patents

1. **Jinhyun So**, Seokjoong Heo, Soobok Yeo, Sejin Kong, Jaehak Lee, and Mingu Kim, "Communication device and control method thereof," *Pending*, U.S. Patent (US9712345), and Korea Patent (No.2015-0151308)
2. Seokjoong Heo, **Jinhyun So**, Soobok Yeo, and Mingu Kim, "Receiver apparatus and reception method in wireless communication system," *Grant*, U.S. Patent (US9479360), Korea Patent(10-0118975)
3. **Jinhyun So**, Sungho Choi, Seung Hyeok Ahn, Eui-Rim Jeong, and Yong H. Lee, "Low-cost digital predistortion apparatus and method using envelope detection feedback," *Grant*, U.S. Patent (US9148093), Korea Patent (10-1389880)
4. Sungho Choi, Seung Hyeok Ahn, Eui-Rim Jeong, **Jinhyun So**, and Yong H. Lee, "Method and Appratus for pre-compensation of self-local oscillator coupling effect in transmitters," *Grant,* Korea Patent (10-1265241)

(*: equal contribution)

PROFESSIONAL EXPERIENCE

Research Assistant, vITAL Lab, University of Southern California Aug 2017 – Present

- **Privacy-preserving distributed machine learning [C1, C3, C5, J2]**

  • I have developed COPML, a fully-decentralized training framework that achieves scalability and privacy-protection simultaneously. COPML keeps both the data and the model information-theoretically private, while allowing efficient parallelization of training across distributed workers. I have characterized COPML's privacy threshold and prove its convergence for logistic (and linear) regression. Furthermore, via experiments over Amazon EC2, we have demonstrated that COPML can provide an order of magnitude speedup (up to ~16×) over the state-of-the-art cryptographic approaches.

- **Federated Learning [J1, J3, C4]**

  • Proposed a secure aggregation protocol, named Turbo-Aggregate, that in a network with N users achieves a secure aggregation overhead of O(N logN), as opposed to O(N^2), while tolerating up to a user dropout rate of 50% and providing model privacy against up to 50% colluding users.

  • Proposed the first single-server Byzantine-resilient secure aggregation framework for federated learning.

- **FedML: A research library and benchmark for federated machine learning [C2]**

  • Implemented an open research library and benchmark that facilitates the development of new federated

learning algorithms and fair performance comparisons. Especially, implemented secure aggregation protocols for federated learning.

Research Engineer, Systems Development Team, Samsung Electronics, Korea Jan 2013 – May 2017

- **Developed and implemented algorithms for cellular modem chips [P1, P2]**
  - Commercialized + 200 million chips in +17 nations, +34 network operators with various phones and tablets including flagship Galaxy S series.
  - Designed block of channel state information generator (CSI) and feedback protocols for LTE-A system
    - Researched advanced CSI (linear combination codebook) algorithm for eFD-MIMO system.
  - Designed block of channel estimator / adaptive equalizer/ digital front-end for HSPA system.
- **Researched algorithms for 5G cellular system**
  - Researched hybrid receiver beamforming algorithm for massive MIMO system.
  - Researched link adaptation algorithms for NR system.
- **Researched and developed algorithms for IoT chips**
  - Developed link adaptation algorithm for eMTC and NB-IoT system.
  - Developed decoding skip algorithm based on mean mutual information per bit (MMIB).

Korea Advanced Institute of Technology (KAIST), Daejon, Korea Sep 2010 – Jan 2013

Research Assistant, Digital communication Laboratory

- Digital pre-distortion (DPD) Project [C6, C7, P3, P4]
- Beam division multiple access (BDMA) Project

Teaching assistant

- EE450 Electrical engineering experiment for undergraduate students Spring 2012

SKILLS

Languages : C++/C, Python, MATLAB

Software : GIT, Simulink, LATEX, Clearcase

Test Apparatus : Agilent 8960, Spirent channel emulator, Anritsu 8480

EXTRACURRICULAR ACTIVITIES

Treasurer, University of Southern California Aug 2019 – Jul 2020
Korean Graduate Student Association

Campus Recruiter, Samsung Electronics Mar 2016 – Aug 2016
Served as a Technical Job Interviewer for Ph. D and M.S Candidates

Career Consultant, Samsung Electronics Sep 2013 – Aug 2014
Career consulting and Job Interview for undergraduate students

Korean Augmentation to the United States Army (KATUSA) Feb 2008 – Jan 2010
HHC, 501st Military Intelligence Brigade, Seoul, Korea
Platoon Leader

KAPEX (Undergraduate Integrated Circuit Design Club), KAIST Jul 2007 – Feb 2009
Project Leader