Shi-Yuan Wang

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EDUCATION

Georgia Institute of Technology   *Aug. 2018 - PRESENT*
Ph.D. candidate in School of Electrical and Computer Engineering
Advisor: Prof. Matthieu R. Bloch
Proposed Dissertation Topic: *Information-Theoretically Covert Communications under Variational Distance Constraint: Limits and Algorithms*

Georgia Institute of Technology   *Aug. 2022 - PRESENT*
M.Sc. student in School of Mathematics

National Taiwan University (NTU), Taipei, Taiwan   *Sept. 2013 - Jan. 2018*
B.S.E in Electrical Engineering
- Overall GPA: 4.22/4.3 (top 3%)

RESEARCH EXPERIENCE

Georgia Tech - Adaptive Communication Decision and Information Systems Research Group   *Jan. 2019 - PRESENT*
Advisor: Prof. Matthieu R. Bloch
Research Project: **Joint Quantum Communication and Sensing**
- Investigate the fundamental limits of a joint communication and sensing strategy over a quantum channel with unknown channel parameter.
- Characterize an explicit communication rate/sensing-error exponent region for non-adaptive strategy.
- Accepted to *Proc. of 2022 IEEE Information Theory Workshop*.

Research Project: **Towards a Characterization of the Covert Capacity of Bosonic Channels under Trace Distance**
- Investigate fundamental limits of covert communications over a lossy thermal-noise bosonic channel.
- Develop information-theoretic analysis of covertness based on quantum fidelity and quantum trace distance.
- Accepted to *Proc. of 2022 IEEE International Symposium on Information Theory*.

Research Project: **Explicit Design of Provably Covert Channel Codes**
- Design and implement covert channel codes with MLCPPM, polar codes, and invertible extractors
- Analyze the covert channel code in terms of *variational distance*.
- Our scheme is efficient in terms of secret key usage and requires **2 orders of magnitude fewer secret key bits** than previous work.
- Accepted to *Proc. of 2021 IEEE International Symposium on Information Theory*.

Research Project: **Covert MIMO Communications under Variational Distance Constraint**
- Studied fundamental limit of communication without detecting by malicious adversary.
- Developed information-theoretic analysis and **characterize covert capacity of MIMO-AWGN channels**.
- Accepted to *Proc. of 2020 IEEE International Symposium on Information Theory* and IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY.

Research Project: **Online Learning for Dynamic Spectrum Access**
- Minimized coordination overhead between users and learning access policy in a distributed manner.

- Proposed an online bandit learning framework to estimate the channel availability and user behaviors.

NTU - Speech Processing and Machine Learning Laboratory *Sept. 2016 - Jan. 2018*
Advisor: Prof. Hung-Yi Lee

Research Project: **Learning Asking via Interacting with Insufficient Labeled Data**
- Addressed the problem of **insufficient labeled data** in **Question Answering** task of Natural Language Processing.
- Proposed a learner-expert interaction Reinforcement Learning framework to generate training data. and pretrained expert model gives an answer and a reward signal.
- Improved baseline with 32.6% gain on accuracy under limited labeled data on bAbI dataset.
- Utilized the Attention-based Seq2seq model with copy mechanism to study **Question Generation** in SQuAD dataset.

NTU - MicroSystem Research Laboratory *June 2016 - July 2017*
Advisor: Prof. Tzi-Dar Chiueh

Research Project: **Low-density Parity-check (LDPC) Decoder Implemented on OpenCL**
- Utilized the parallelism of **Sum-product algorithm (SPA)** for GPU programming with OpenCL.
- Speed up 1000x in comparison with the baseline sequential decoder.
- The work has been documented as *a technical reference* by MediaTek Inc.

PUBLICATION

Submitted

1. M.-C. Chang, S.-Y. Wang, T. Erdoğan, and M. R. Bloch, "Rate and Detection-Error Exponent Tradeoff for Joint Communication and Sensing of Fixed Channel States," *arxiv preprint*, vol. 2210.07963, 2022, submitted to *IEEE Journal on Selected Areas in Information Theory*

Articles

1. S.-Y. Wang and M. R. Bloch, "Covert MIMO Communications Under Variational Distance Constraint," *IEEE Transactions on Information Forensics and Security*, vol. 16, 2021

Conference Proceedings

1. S.-Y. Wang, T. Erdoğan, U. Pereg, and M. R. Bloch, "Joint Quantum Communication and Sensing," in *Proc. of IEEE Information Theory Workshop (ITW)*, Mumbai, India, 2022

2. M.-C. Chang, S.-Y. Wang, and M. R. Bloch, "Controlled Sensing with Corrupted Commands," in *Proc. of 58th Allerton Conference on Communication, Control, and Computing*, Monticello, IL, 2022

3. S.-Y. Wang, T. Erdoğan, and M. R. Bloch, "Towards a Characterization of the Covert Capacity of Bosonic Channels under Trace Distance," in *Proc. of 2022 IEEE International Symposium on Information Theory (ISIT)*, Espoo, Finland, Jun. 2022

4. M.-C. Chang, T. Erdoğan, S.-Y. Wang, and M. R. Bloch, "Rate and detection error-exponent tradeoffs of joint communication and sensing," in *proc. of IEEE International Hybrid Symposium on Joint Communications & Sensing*, Seefeld (Tirol), Austria, Mar. 2022

5. S.-Y. Wang and M. R. Bloch, "Explicit Design of Provably Covert Channel Codes," in *Proc. of IEEE International Symposium on Information Theory*, Melbourne, Australia, Jul. 2021

6. ——, "Covert MIMO Communications under Variational Distance Constraint," in *Proc. of IEEE International Symposium on Information Theory*, Los Angeles, CA, Jun. 2020

AWARDS & HONORS

Ministry of Education, Taiwan (R.O.C) *Jun. 2022-PRESENT*
Goverment Scholarship to Study Abroad

Department of Electrical Engineering, National Taiwan University
- Dean's List Award (**5 times**)
- **3rd place**, Undergraduate Innovation Award
- Cadence EE3011 (Data Structure & Programming) Competition Award

WORKING EXPERIENCE

Qualcomm, San Diego *May 2022 - Aug. 2022*
Interim Engineering Intern at Modem Tech System Group, Wireless Research & Development
- Designed adaptive filtering algorithms to solve **frequency-dependent** I-/Q-branch mismatch problem at receiver.
- Achieved significant gain in terms of Image-Rejection Ratio compared to frequency-independent compensators, while increasing the hardware complexity moderately.

MediaTek, Taiwan *July 2017 - Aug. 2017*
Summer Intern in Department of Wireless Communication Technology
- Designed an **Inter-Processor Communication** mechanism in hardware using Verilog.
- Verified the datapath and interface protocol of a **Vector Operation Engine**.
- Developed a **simulation tool** for vector operation engine in C++.

TEACHING EXPERIENCE

Graduate Teaching Assistant, Georgia Tech ECE *Fall 2021*
ECE7750 Mathematical Foundations of Machine Learning

SELECTED COURSEWORKS AND PROJECTS

Sparse MIMO Channel Estimation with Compressed Sensing and Learning Schemes *Fall 2018*
Final Project of ECE6604 (Personal & Mobile Communications)
- Implemented several *compressed sensing* algorithms for MIMO channel estimation, including orthogonal matching pursuit, compressed sampling matching pursuit, and expectation maximization.

User Coexistence via Online Learning *Spring 2019*
Final Project of ECE6254 (Statistical Machine Learning)
- Investigated the problem of *user coexistence* in multi-user communication networks.
- Formulated the problem into online learning scheme and solved with *online mirror descent* and *bandit convex optimization*.

RELATED SKILLS

- Standardized Test
  - TOEFL score: 105/120 (R:28/30, L:28/30, S:22/30, W:27/30) *Oct. 2017*
  - GRE score: 330/340 (V:161/170, Q: 169/170), AW: 3.5 *Sept. 2017*
- Programming: C++, Python, Matlab, Verilog
- Libraries&Tools: PyTorch, Tensorflow, OpenCV, OpenCL, LaTeX