

# Shi-Yuan Wang

+1 (470) 351 7699  
<http://sywang1007.github.io/>

<shi-yuan.wang@gatech.edu>

## EDUCATION

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### 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

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### 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

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### 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

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**Ministry of Education, Taiwan (R.O.C)**

*Jun. 2022-PRESENT*

*Government 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

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**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

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**Graduate Teaching Assistant, Georgia Tech ECE**

*Fall 2021*

*ECE7750 Mathematical Foundations of Machine Learning*

## SELECTED COURSEWORKS AND PROJECTS

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**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

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- 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,  $\text{\LaTeX}$