Frank (Sicong) Chen

119-D Remington Avenue, Syracuse, NY, 13210

Email : schen154@syr.edu

Mobile : +1-315-278-6961

EDUCATION

- **Syracuse University** — Syracuse, NY
  Ph.D. in Computer and Information Science and Engineering; GPA: 3.89   Aug 2020 - Present, expected graduation in May 2025
  Research area: Biometrics, Machine learning, Security

- **Syracuse University** — Syracuse, NY
  M.S. in Computer Science; GPA: 3.93   Aug 2018 - May 2020
  Reward: Received Research Assistant Fellowship from Syracuse University

- **Tianjin University** — Tianjin, China
  B.S. in Mathematics and Applied Mathematics; GPA: 2.94   Sep 2013 - July 2017

PUBLICATION

- Frank Sicong Chen, Jingyu Xin, and Vir V Phoha. Sspra: A robust approach to continuous authentication amidst real-world adversarial challenges. *ACM Transaction on Biometric, Behavior, and Identity Science, accepted*, 2024

- Frank Sicong Chen and Vir V Phoha. Selecting deep learning algorithms with stable performance: A measure of stability across multiple datasets. *ACM SIGMETRICS, under review*, 2024

- Frank Sicong Chen, Amith K Belman, and Vir V Phoha. Formalizing pqrst complex in accelerometer-based gait cycle for authentication. *arXiv preprint arXiv:2205.07108*, 2022

- Jiajing Chen, Huantao Ren, Frank Sicong Chen, Senem Velipasalar, and Vir V Phoha. Gaitpoint: A gait recognition network based on point cloud analysis. In *2022 IEEE International Conference on Image Processing (ICIP)*, pages 1916–1920. IEEE, 2022

- Diksha Shukla, Sicong Chen, Yao Lu, Partha Pratim Kundu, Ravichandra Malapati, Sujit Poudel, Zhanpeng Jin, and Vir Phoha. Brain signals and the corresponding hand movement signals dataset (bs-hms-dataset), 2019

- Liangfu Lu, Zhenzhai Huan, Xuyun Zhang, Lianyong Qi, Sicong Chen, and Yao Wu. Collaborative network traffic analysis via alternating direction method of multipliers. In *2018 IEEE 22nd International Conference on Computer Supported Cooperative Work in Design ((CSCWD))*, pages 547–552. IEEE, 2018

HONORS AND AWARDS

- Awarded the Outstanding Teaching Assistant Award, Syracuse University (2023)

SKILLS SUMMARY

- **Languages**: C/C++, Python, Swift
- **Tools**: MATLAB, XCode, Docker, Git

RESEARCH EXPERIENCE

- **Syracuse University** — Syracuse, NY
  Research assistant - Prof. Vir Phoha (Ph.D., IEEE Fellow, AAAS Fellow)   Aug 2020 - Present

  - **SSPRA: A Robust Approach to Continuous Authentication Amidst Real-world Adversarial Challenges**:
    - Proposed a State-Space Perturbation Resistant Approach (SSPRA) for multi-modality continuous authentication, which contains the following two main structures:
      - A two-level fusion mechanism: vertical-level fusion, which fuses simultaneously obtained observations from multiple modalities, and horizontal-level fusion, which considers the time-lapsing effect from the previous state while determining the present state.
      - Dual-state transition machines: activating different state transition machines given the detection of suspicious data, which enhances the system's resistance to low-quality and fluctuating data.
    - Deployed a continuous gait-based authentication system using the accelerometer and gyroscope signal from mobile devices and achieved an average true alarm rate of 80.48% against zero-effort attacks with an average detection time of 4.23 seconds, outperforming state-of-the-art deep learning-based models.
    - Accepted for publication in IEEE Transactions on Biometrics, Behavior, and Identity Science.

  - **Selecting Deep Learning Algorithms with Stable Performance: A Measure of Stability Across Multiple Datasets**:

- Introduced the Stability Index (SI), a new performance evaluation metric, to assess and compare deep learning algorithms across varied datasets. The SI uniquely combines the F1 score and silhouette coefficient to evaluate an algorithm's overall and subject-specific performance, and cross-dataset consistency. It addresses traditional metrics' limitations, which typically focus on singular dataset performance and a limited evaluative scope.
- Proposed the Model Recommendation Algorithm (MRA) for binary classification models, which streamlines the selection of optimal models for new, unseen data based on preliminary evaluation of models on reference datasets and the proximity of new samples to those in the reference sets. This approach circumvents the need for exhaustive model evaluation on each new sample.
- Validated the SI's efficacy by implementing and comparing five state-of-the-art deep learning algorithms across five benchmark datasets in biometric face recognition and multi-class object detection for autonomous driving, demonstrating a more holistic assessment compared to conventional metrics.
- Demonstrated the MRA's effectiveness in accurately recommending models for unseen samples in biometric face recognition, utilizing smaller reference datasets to guide selection.
- Currently under review by ACM SIGMETRICS.
- **GaitPoint: A Gait Recognition Network based on Point Cloud Analysis**:
  - Proposed a novel gait recognition method (GaitPoint) that combines convolutional features with features of human pose key points obtained by a point cloud analysis model.
  - Showed that skeleton key points could be regarded as a 3D point cloud and used a point cloud processing approach, namely PointNet, to extract features from these key points.
  - Consistently improved the gait recognition performance of the purely image- and convolution-based approaches compared to three SOTA baselines on the CASIA-B dataset.
  - Published the paper in IEEE ICIP 2022.
- **PQRST Complex: Capturing the Formal Structure in Gait Using Accelerometers in Mobile Devices**:
  - Proposed PQRST Complex, a novel structure in accelerometer readings in gait analysis.
  - Extract several new features from this novel structure, which can be used for any gait analysis.
  - Deploy an accelerometer-based gait authentication system using PQRST Complex and achieve an average correct classification rate (CCR) of 90.51%.
  - Deployed a gait-based gender recognition system with a modified Naive Bayes classifier using PQRST Complex and achieved a 91.35% overall accuracy, which outperforms the state-of-the-art gender recognition systems based on accelerometers through gait.
  - Was the first to propose a height prediction system based on accelerometer readings through gait and achieved 100% accuracy in predicting whether the subject's height is within a given range of five inches.
  - Published the paper to arXiv and submitted an extension to IMWUT 2022.
- **Normality is not the norm in mobile devices data − causes and way forward**:
  - Showed that the most commonly described features for mobile device-based biometric data from activities like typing, gait, and swiping do not have an underlying normal distribution with suitable non-parametric tests.
  - Discussed why the assumption of normality is widely accepted in this field, why these features depart from the normal distribution and performed the chi-square statistics to get distributions that best approximate these features, which provide an overall perspective of what kind of distribution these features conform to.
  - Performed tests on a large multi-modality dataset and seven single-modality datasets for gait, swipe, and Typing, which showed that our findings are consistent and can be generalized.
  - Discussed alternate approaches to mitigate or avoid the negative effects of assuming a non-existent normal distribution in data and presented the important implications of our findings for modeling distributions and classifier choices.
  - Submitted the paper to IMWUT 2023.

- **Syracuse University**   Syracuse, NY
  Research assistant - Prof. Vir Phoha (Ph.D., IEEE Fellow, AAAS Fellow)   *Jun 2019 - May 2020*
  - **Enhanced touch-based authentication systems for mobile devices**:
    - Proposed an improved touch-based authentication system to distinguish between genuine touch stroke samples and human and robot imposter samples.
    - Simulated a Generative Adversarial Networks (GAN) based attack and showed that the EER increased up to 400% on traditional authentication systems.
    - Developed an enhanced touch-based authentication system for mobile devices.
      - Performed detailed statistical analysis of GAN-generated fake samples and genuine samples and built an enhanced authentication system.
      - Reduced the GAN attack EER to 0.1%.
    - Prepared a paper for WIFS 2019 (GitHub: https://github.com/MrFrankChen/WIFS2019.)
  - **Brain Signals and the Corresponding Hand Movement Signals Dataset (BS-HMS-DATASET) Collection**:
    - Collected data on EEG signals, hand motion, and typing from more than 40 participants.
    - Published the dataset on IEEE Dataport.

- **Tianjin University** — Tianjin, China
  Research assistant - Prof. Liangfu Lv(Ph.D.) — *Aug 2015 - June 2017*
  - **Graduation Thesis**: Analysis on data visualization
    - Conceived a visualization method to theoretically improve the parallel axes in a parallel coordinates plane, termed as Double Arc Coordinate Plot (DACP).
      - DACP utilized two arc coordinates for visualizing one-dimensional data, which presented more information on each axis.
    - Developed a dimensional-based bounding method to reduce the visual clutters.
    - Performed two axes-reordering methods in DACP visualization:
      - A contribution-based method, which is based on the singular value decomposition (SVD) algorithm.
      - A similarity-based method, which is based on the combination of nonlinear correlation coefficient and SVD algorithm.
    - Increased the mean angle for each pair of axes up to 1.5 times larger than the conventional Parallel coordinate Plot (PCP) method.
  - **Research Paper**: Collaborative network traffic analysis via alternating direction method of multipliers
    - Identified the patterns of common malicious data packets.
    - Proposed an iterative scheme of the algorithm for network anomaly detection problem, named NTA-ADMM, which is a matrix decomposition model for analyzing network traffic data based on the Alternating Direction Multiplier Method (ADMM).
    - Reduced iterations up to 68% compared to the APG algorithm.
    - Visualized the results in a user-friendly format.
    - Designed a prototype system for network anomaly detection.
    - Published the paper in IEEE CSCWD 2018.

TEACHING EXPERIENCE

- **Syracuse University** — Syracuse, NY
  Teaching assistant for CIS 735 — *Jan 2022 - May 2022*
  Jan 2023 - may 2023
  Jan 2024 - Present

  - Made and graded homework assignments and exams, ensuring course assessment effectively demonstrated what students learned in class.
  - Delivered several lectures on topics such as neural network and performance evaluation.
  - Worked closely with the instructor to develop and deliver course lectures on machine learning and neural networks.
  - Held office hours twice a week to provide individualized support and assistance to students.

- **Syracuse University** — Syracuse, NY
  Teaching assistant for CIS 600/700 — *Aug 2021 - Dec 2021*
  Aug 2022 - Dec 2022
  Aug 2023 - Dec 2023

  - Assisted in the development and implementation of course materials, assignments, and exams.
  - Conducted weekly office hours to provide individualized support and assistance to students.
  - Delivered several lectures on various biometric topics, including gait, swipe, and authentication.
  - Held small group meetings regularly to help students with their course projects.

- **Syracuse University** — Syracuse, NY
  Teaching assistant for CIS 375: Introduction to Discrete Mathematics — *Aug 2020 - Dec 2020*
  Jan 2021 - May 2021
  Aug 2021 - Dec 2021

  - Graded homework assignments and exams, ensuring fair and consistent grading practices.
  - Conducted weekly recitation sessions to reinforce course material and provide additional support for students.
  - Held office hours twice a week to provide individualized support and assistance to students.