

Statement of Purpose

Chih-ho Hsu

I aspire to pursue a PhD degree in the area of Wireless Communication and Networking. My long-term goal is to become a researcher in the laboratory of a high-tech company with an aspiration to completely reform the way we connect with the world. I believe I can reach this goal with the opportunity and resources provided at the ECE department of Virginia Tech.

Before pursuing wireless research, I had planned to become a software engineer. To learn more about enterprise-level software development, I had joined 3 different companies during college. I first came to **Foxconn Advanced Communication Academy** for a one-year internship in my sophomore year. During that time, we had collaborated with Intel to develop a commercial platform for the 5G network infrastructures, realizing lifecycle management of network micro services. Meanwhile, I also remotely collaborated with **BroadMission** on several software projects, including home supervision system with anomaly detection, customized CICD tracking tools, and a serverless Chatbot with user classification and customized responses. Later, I sought summer internship at **Cinnamon AI**, a start-up found in Tokyo, to further pursue knowledge about deep learning and its real-world applications. From these industrial experiences, I had not only strengthened my programming skills but also boosted my ability to recognize and solve technical problems in software development.

A major life event has completely changed my career plan as an engineer. I had undergone lung surgery in my junior year. During my hospitalization, whenever my mobile phone ran out of battery, I had difficulty untangling the charging cords due to the drainage tube on my chest. Motivated by this event, I aspire to develop more convenient wireless technologies, making ubiquitous wireless connectivity become a reality. After reflecting on my past experiences, I realized it requires solving the problem fundamentally, instead of manipulating the well-known tools as I did before, to achieve my aspiration. Since then, I had made up my mind to pursue research in the area of wireless networks.

Despite my GPA was only 2.28 in the semester in which I was hospitalized, I receive an A in both courses “**Introduction to Wireless and Mobile Networking**” and “**Personal Communications Services**” in the following semester. Through these courses, I first learned the principles of radio propagation, channel modeling and multiple access in wireless networks. Then, I become familiar with the key techniques in modern communication systems such as OFDM and beamforming. As I gained a better understanding of wireless research, I’m more convinced that it is my life's ambition.

To delve deeper into wireless technologies, I joined Prof. Hung-Yu Wei’s **Wireless Mobile Network Lab**. My first research project focused on cache-enabled adaptive video streaming. Through studying the literature, I found the social impact of online users has huge potential to enhance the hit ratio of video cache, thus enhancing Quality of Experience (QoE). I also found that due to different playback request patterns and downlink capacity of mobile users, a video can be partially cached and be transcoded in real-time to improve resource utilization and adapt to the fast-changing channel condition. By integrating the above findings, I developed a social-aware and QoE-driven video cache framework to improve existing video streaming schemes. Combining my proficiency in programming, I further conduct a series of experiments based on real-world data to validate my proposed framework.

My second study aimed to address the task offloading problem in the UAV-assisted vehicular network, which is NP-hard in general. I found that current algorithms often take a long time to obtain a decent solution and thus may fail to fulfill the latency requirements of emerging vehicular services regarding their high mobility. By taking advantage of both Deep Neural Network (DNN) and Particle Swarm Optimization (PSO), I developed a hybrid learning framework that can jointly optimize UAV positions, computation offloading decision and spectrum allocation in Radio Access Network (RAN) with low-complexity while dynamically tuning the DNN in order to adapt to the time-varying wireless environment. This series of studies was published as 2 conference papers.

As an undergraduate member in the collaborative project “**B5G smart cross-layer multi-access edge computing**”, I have worked on a survey paper with the topic of service orchestration and resource management for edge computing. After analyzing over 350 related papers from various aspects, I have identified the limitations of existing techniques and outlined potential research directions. Meanwhile, as Network Function Virtualization (NFV) and Software-Defined Network (SDN) become a promising paradigm for the 5G core network, I also collaborated with Prof. Chun-Ting Chou on the mathematical model design of virtual network embedding system and reliable QoS flow routing. These experiences have laid the rigor foundation for my research methodology and provided me with profound insights into research.

After completing 3 research projects and co-authored 7 papers in top journals/conferences, including *IEEE Transactions on Multimedia*, *IEEE Access*, *IEEE GLOBECOM*, *IEEE ICC* and *IEEE VTC*, I would like to continue my research in wireless communication and networking with graduate training. With both distinguished faculties and integrated courses in your department, pursuing my PhD in your prestigious program will be the best choice for me to achieve my goal.

During graduate school, I’m eager to attend advanced courses to enhance my mathematical background required in wireless research. With the stochastic process and optimization techniques introduced in the courses of “*Stochastic Signals and Systems*” and “*Convex Optimization*”, I’m confident that I will be able to model and analyze any problem in the wireless network. Besides, by taking “*Multi-Channel Communications*” and “*Spread Spectrum Communications*”, I can acquire sufficient knowledge to address academic challenges in the research of wireless communication.

I’m highly attracted by the research of your esteemed research group, **Wireless@Virginia Tech**. If possible, I would like to work with **Prof. Lingjia Liu**, **Prof. Harpreet S. Dhillon** and **Prof. Walid Saad**. Specifically, **Prof. Liu**’s expertise on reservoir computing for the MIMO system, including channel estimation, symbol detection and dynamic spectrum sharing, unveils the essence of wireless technologies that I’m pursuing. In addition, **Prof. Dhillon**’s recent study on wireless caching and vehicular networks perfectly match my research background. I also found **Prof. Saad**’s research on UAV communications, federated learning and applications of game theory appealing to me as they serve as critical solutions to realize the emerging 6G network paradigm. I believe working with them can equip me with the latest knowledge required to achieve my aspiration of future wireless networks. I also believe that both my strong academic ability, firm industrious experiences together with my research passion, would make me a suitable candidate for admission.