1. 自我介绍

My name is GUO Xiaofan, and I am now in the final year of my Engineering Diploma at ISEP Paris, where I specialize in Wireless Communication and IoT. At the moment, I am doing my graduation internship at Orange Innovation.

In terms of skills, I am comfortable with Python, Java, and C++, and I have good experience in data analysis and modeling. I also worked with system deployment and monitoring tools such as Docker, Kubernetes, and I have used MATLAB for signal processing, etc.

Now, during my internship, my research focuses on energy efficiency in 5G core networks. I mainly work with two open-source architectures, Free5GC and OAI (OPENAIRINTERFACE), and I use tools like Kepler, Prometheus, and Grafana to monitor and analyze their energy consumption.

My graduation project was supervised by Madame Wafa, about one year ago, and it focuses on indoor localization using Deep Neural Networks and Graph Neural Networks. With the UJIIndoorLoc dataset, I compared DNN and GNN models in terms of network architecture, localization accuracy, and prediction time. In addition, I have some hands-on experience in embedded hardware, a project related to health monitoring wearables using the TIVA microcontroller to collect sensor data and transmit it to the mobile via Bluetooth.

During my Bachelor studies at UCA, I also worked on several projects related to computer vision. These included tasks such as image classification for handwritten digit recognition, and object detection for path and obstacle recognition in the context of intelligent vehicles.

My studies and professional experiences in France have not only strengthened my technical background, but also helped me improve my communication skills, teamwork, and adaptability in an international environment. I chose to come ISEP because of my interest in wireless communication, and now I would really like to continue in this field. More specifically, I am highly interested in exploring indoor localization in healthcare, because it combines both scientific challenges and strong practical value.

I am also aware that in Wenzhou, there has been strong collaboration with many universities in recent years in the area of health monitoring wearables, which makes it a very attractive environment to connect research outcomes with real-world applications.

For me, having the opportunity to conduct research that can be directly applied to improve healthcare systems is extremely valuable and motivating. (Moreover, the University of Chinese Academy of Sciences has always been regarded as a dream institution for Chinese engineering students.)

So I cherish this opportunity. That’s my introduction. Thank you very much for your time.

2. 📝 Performance Evaluation of the Networks with Wi-Fi based TDMA Coexisting with CSMA/CA

📌 Background:

- Wi-Fi networks typically rely on CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) for medium access control. It's flexible, CSMA/CA introduces non-deterministic delays and collisions, so it unsuitable for real-time tasks.
- TDMA (Time Division Multiple Access) divides the channel into fixed-length time slots and assigns each device a slot to transmit data, it's collision-free and deterministic communication.

📌 Proposed Enhancements:

To enable TDMA and CSMA/CA to coexist and improve real-time performance, proposed three improvements:

1. Canceling Carrier Sensing 取消载波监听
    - TDMA devices transmit directly in their allocated time slots without checking channel availability, ensuring transmission timing.
2. Priority Mechanism 优先机制
    - By assigning shorter timeout values, TDMA devices gain priority over CSMA/CA devices on the shared channel.
3. Collision Handling
    - If no ACK (Acknowledgment) is received, TDMA devices immediately retransmit the data until successful, improving reliability.

📌 Results Summary:

- The TDMA mechanism significantly reduced delay for real-time applications and improved reliability through retransmission.
- As TDMA frame length and duty cycle increased, CSMA/CA throughput slightly decreased, but the impact remained manageable.

3. DNN vs GNN for Indoor Localization

📌 Background:

The goal of indoor positioning is to reduce the prediction error.

- DNN (Deep Neural Network) has been widely applied to Wi-Fi RSSI fingerprinting:
    - Advantages: capable of handling high-dimensional input and learning complex nonlinear relationships.

    - Limitations: lacks the ability to model spatial topology, limited generalization, etc.
- GNN models sample similarity through graph structures and leverages message passing to improve accuracy and robustness in complex environments.

📌 Proposed Methods and Enhancements:

- DNN: adopted an encoder–decoder structure with multi-task regression (longitude, latitude, and floor) as the baseline model.
- GNN: built graphs using k-NN and applied GCN layers to perform prediction.
- Evaluation included hidden layer configurations, localization error, and runtime performance.

4. Energy Optimization in 5G Core Networks (Internship Project)

📌 Background:
The 5G Core (5GC) is the central architecture of mobile networks, responsible for user access, authentication, session management, and data forwarding.
This project focused on two open-source 5GC implementations: Free5GC and OAI.

📌 Proposed Methods and Enhancements:

- Energy Monitoring Framework: deployed Kepler + Prometheus + Grafana on Kubernetes to enable container-level energy monitoring.
- Free5GC vs OAI Comparison:
    - Theoretical analysis suggested higher consumption in Free5GC, but experiments showed OAI consumed significantly more.
    - I proposed three hypotheses: database implementation differences, residual container processes, and frequent inter-Pod signaling.
- I found that the main reason for the high energy consumption was OAI's very frequent heartbeat signaling between its components.
- Then, I modified the OAI-AMF source code to extend the heartbeat cycle from ten seconds to one hundred seconds.
- Finally, the experimental results show that appropriately extending the heartbeat frequency can significantly reduce energy consumption while maintaining system stability.
- And all my achievements have been integrated into an assistance, which is used to train the AI chat in ORANGE, so that others can quickly query and deploy relevant settings information.

Wi-Fi Access Point Synchronization via PTP

- Background

Industrial Internet applications require precise time synchronization, but Wi-Fi networks do not provide any native synchronization mechanism.

- Method

In this project, I implemented Precision Time Protocol (PTP, IEEE1588, End-to-End mode) to synchronize Wi-Fi access points.

I designed two synchronization schemes:

- **Direct connection** using the Ethernet interfaces of the AC and AP devices.
- **Switch-based VLAN isolation**, where synchronization traffic is separated from regular data traffic to improve stability in larger networks.

(For implementation, I used the HLK-RM60 Wi-Fi6 embedded module with OpenWrt OS, and ported the Linux PTP stack to configure master and slave roles)

- Results

Compared to NTP, PTP achieved much higher precision, with most errors under 100 microseconds.

In the direct AC–AP setup, synchronization error stayed within 10 microseconds.

In switch-based VLAN networks（Virtual Local Area Network）, the error remained stable around 50 to 100 microseconds, which is suitable for scalable TSN-over-Wi-Fi applications.

5. 室内定位常见的技术有哪些？它们的优缺点是什么？What are the common techniques for indoor localization, and what are their advantages and disadvantages?

- From my experience, the most common techniques are Wi-Fi, Bluetooth Low Energy, and UWB(Ultra-wideband).
- **Wi-Fi** has wide coverage and existing infrastructure, but the accuracy is limited, usually at the meter level.
- **Bluetooth Low Energy** is low-cost and low-power, suitable for short-range localization, but it is easily affected by interference.
- **UWB** provides very high accuracy, at the centimeter level, and is robust to interference, but it requires higher deployment costs and its adoption is still limited.

6. AI 如何提升室内定位系统在复杂环境中的精度和鲁棒性？How can AI improve the accuracy and robustness of indoor localization in complex environments?

- AI can extract meaningful features from multi-source data and build adaptive models. This helps reduce the impact of noise, adapt to changing environments, and maintain high accuracy and stability even in complex scenarios such as hospitals.

7.在医疗环境中，室内定位面临哪些挑战？What are the main challenges for indoor localization in medical environments ?

- Hospitals are very dynamic and challenging environments.
  - First, medical devices may interfere with signals.
  - Second, patients and staff are moving frequently, which increases complexity.
  - Third, the large number of people, beds and instruments may block signals, and the channels are congested with heavy traffic.

- Finally, hospitals demand both high accuracy and very low latency, which is not easy to achieve simultaneously.

8. 你如何理解多模态数据融合？ What is your understanding of multimodal data fusion?

- **Multimodal data fusion** means combining multiple sources, such as Wi-Fi, Bluetooth, sensors, and even vision data. By leveraging their complementary strengths, we can increase robustness and accuracy of localization systems.

9. 信号处理和计算机视觉在室内定位中起什么作用？ What roles do signal processing and computer vision play in indoor localization?

- **Signal processing** helps to filter noise, extract useful features, and improve the quality of signals, which enhances localization accuracy.
- **Computer vision** can serve as an additional modality, for example, detecting falls or identifying patient activity patterns, which supports medical decision-making.

10. 你有处理过 IoT 设备数据的经验吗？ Do you have experience in handling IoT device data?

- Yes. In one project, I worked on a body temperature and fall detection system. I developed an Android application that connects to sensors via Bluetooth. The app displays personal information and sensor data in real time, and it triggers an alert if the temperature exceeds 37 degrees or if a fall is detected by a sudden drop in height.

11.如果设计一个实验来评估医院定位系统，你会选择哪些指标？ If you design an experiment to evaluate a hospital localization system, what metrics would you use?

- I would focus on four key metrics: positioning error, system latency, energy consumption, and robustness under complex hospital conditions.

12. AI 的行为分析在医疗中有什么作用？ What role can AI-based behavior analysis play in healthcare?

- It can detect abnormal states such as falls or unusual movement patterns, assist doctors in diagnosis, optimize hospital workflows, and improve patient safety.

13. 为什么想读博士 Why do you want to pursue a PhD?

- I would like to say that pursuing a doctorate has always been my plan because I think doing the research and getting results, writing report/papers is interesting. During my undergraduate studies, I figured out my desired path: continuing my studies in communications. So, I chose ISEP. While at ISEP, everyone said that engineering schools were better suited to direct employment, and since I had no work experience, I considered working for two years before pursuing a doctorate. But after completing my graduation project this year, Madame WAFA gave me great encouragement, so I immediately changed my mind and began preparing for my doctoral application. I also sought the advice of other doctoral advisors at ORANGE, and they all gave me positive feedback. And my family gave me great support.
- I've always been clear that it's not an easy decision, it’s hard to do the research, It's like gamble. I think it is very important to have a PhD topic that you are truly interested in. I'm fortunate to have come across your doctoral topic. Now, I'm confident and passionate about pursuing a doctorate.

14.你为什么觉得自己适合这个博士项目？ Why do you think you are a good fit for this PhD project?

- I already have a background in communications and network engineering, with experience in indoor localization and wearable health devices, both in hardware and software. I'm happy to have a chance to combine this knowledge and techniques to achieve new results.
- Furthermore, I'm fluent in Chinese, French and English, which I believe will be a significant advantage for such an international collaborative research project.

15.你希望获得什么？What do you hope to achieve from this research?

- Scientifically, I want to publish high-quality papers and advance indoor localization for healthcare.
- Practically, I hope to develop systems that can be applied to real hospitals, such as wearable devices and smart positioning systems.
- Personally, I want to strengthen my independent research ability and build a strong foundation for either an academic or industrial career.

16. 可以提出的优化方案

In my opinion, based on my past experience, it is possible to integrate energy conservation into positioning and devices. For example, when the detected human body information is normal, the frequency of positioning can be reduced, but positioning can be performed more frequently when actively requested or when abnormal information is present.

提问：

- Which university issues the diploma for this doctoral program?
- Regarding graduation requirements, how many papers are required? Are there any specific level requirements, such as IEEE divisions?
- Are there opportunities for academic exchange with University of Chinese Academy of Sciences? Or is it just remote collaboration?
- When can I know the result of this interview?