Programming for modern microcontrollers

2nd year internship report

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As part of the course

2nd Year Internship

August 2024

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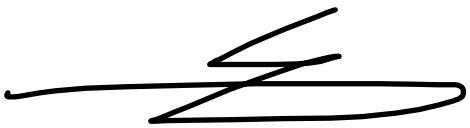

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Résumé et Mots-clés

Abstract

This report details my internship at the Thai-French Innovation Institute (TFII), part of King Mongkut's University of Technology North Bangkok, located in Bangkok, the capital of Thailand. During this internship, I was able to apply my skills in electronics and programming within a professional and multicultural setting. The objective of the internship was to develop energy management techniques for electric vehicles equipped with solar panels, using a microcontroller programmed with MATLAB and Simulink.

As its name suggests, the institute benefits from a strong collaboration between France and Thailand, focused on technology innovation. I participated in one of the institute's projects, which involved energy management using a control board that included transducers as well as Buck and Boost converters. This experience allowed me to solidify my technical skills.

Another task assigned to me was the design of educational materials. Acquiring this new skill was for me a discovery and a pleasure, especially due to continuous interactions in a diverse environment. The internship was extremely fruitful, allowing me to develop both personal and professional skills while making a significant contribution to the institute's initiatives.

The prospects look promising: the skills acquired in the fields of electronics and programming can be applied in my future engineering career but also offer an opportunity not previously considered, that of international experience. This internship was crucial for me, confirming my interest in electronics and programming, and thus paving the way for my professional life as an engineer.

Résumé

Ce rapport détaille mon stage effectué au Thai French Innovation Institute (TFII), au sein de King Mongkut's University of Technology North Bangkok, située dans la ville de Bangkok, capitale de la Thaïlande. Durant ce stage, j'ai pu appliquer mes compétences en électronique et en programmation dans un cadre professionnel et multiculturel. L'objectif du stage était de développer des techniques de gestion de l'énergie pour les véhicules électriques équipés de panneaux solaires, en utilisant un microcontrôleur programmé par MATLAB et Simulink.

Comme son nom l'indique, l'institut bénéficie d'une forte collaboration entre la France et la Thaïlande, axée sur l'innovation en technologie. J'ai participé à l'un des projets de l'institut, qui portait sur la gestion de l'énergie via une carte de commande impliquant des transducteurs ainsi que des convertisseurs Buck et Boost. Cette expérience m'a permis de solidifier mes compétences techniques.

Une autre tâche qui m'a été demandée a été de concevoir des supports pédagogiques. L'acquisition de cette nouvelle compétence a été pour moi synonyme de découverte et de plaisir, grâce notamment aux interactions continues dans un environnement diversifié. Le stage a été extrêmement fructueux, permettant de développer des compétences tant personnelles que professionnelles, tout en contribuant de façon significative aux initiatives de l'institut.

Les perspectives s'annoncent prometteuses : les compétences acquises dans le domaine de l'électronique et de la programmation pourront être appliquées dans ma future carrière d'ingénieur, mais offrent aussi une opportunité non considérée auparavant, celle de l'expérience à l'international. Ce stage a été salvateur pour moi, confirmant mon intérêt pour l'électronique et la programmation, et préparant ainsi le terrain pour ma vie professionnelle en tant qu'ingénieur.

Key words

- Energy management
- Solar electric vehicles
- MATLAB and Simulink programming
- TI F28335 electronic board
- Microcontroller
- LV 25-P and LA 55-P transducers

- Buck and Boost converters
- Technical teaching
- Technical documentation writing
- International collaboration
- Engineering innovation
- Electronic diagnostics
- Energy optimization
- Electrical engineering
- System integration
- High-tech equipment
- Electrical measurement
- PWM (Pulse Width Modulation)
- King Mongkut's University of Technology North Bangkok
- Thai French Innovation Institute

Mots-clés

- Gestion de l'énergie
- Véhicules électriques solaires
- Programmation MATLAB et Simulink
- Carte électronique TI F28335
- Microcontrôleur
- Transducteurs LV 25-P et LA 55-P
- Convertisseurs Buck et Boost
- Enseignement technique
- Rédaction de supports techniques
- Collaboration internationale
- Innovation en ingénierie
- Diagnostics électroniques
- Optimisation énergétique
- Ingénierie électrique
- Intégration de systèmes
- Équipements de haute technologie
- Mesure électrique
- PWM (Modulation de Largeur d'Impulsion)
- King Mongkut's University of Technology North Bangkok
- Thai French Innovation Institute

Contents

Acknowledgements

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I am also very grateful to Mr. Pornsak, Director of the Thai-French Innovation Institute, for his leadership and for creating a stimulating and welcoming work environment. His vision and commitment to innovation greatly enriched my internship experience.

A special thanks to Mr. Cédric Anthierens, my academic supervisor and professor at Seatech, whose valuable advice guided me both before and during my internship. His academic presence and support have been pillars in my journey.

I would also like to warmly thank all the members of the institute's team, whose collaboration was a key aspect of my daily learning. Each day spent with you was a lesson in teamwork and engineering.

My gratitude also extends to my family and close ones for their unwavering support and constant encouragement, which were an unfailing source of motivation throughout my journey.

Finally, I would like to thank my school, Seatech, for offering me this international opportunity. The experience gained here is the result of your commitment to providing quality education and opening international horizons for your students.

These acknowledgements are addressed to all those who contributed, directly or indirectly, to this enriching internship experience, allowing me to grow both professionally and personally.

1 Introduction

1.1 Personal Introduction and Internship Context

I am Enzo CHERIF, a student at Seatech Engineering School, located in Toulon, in the south of France. This school is part of the INP (Institut National Polytechnique) group, which offers several training programs in various fields of engineering. At 22 years old, I am pursuing my education in the SYSMER program (Mechatronic and Robotic Systems), a program that lies at the crossroads of mechanics, electronics, and computer science, preparing engineers to design and improve automated systems and robotic solutions.

1.1.1 Origins and Motivations

Originally from the Paris region, my fascination with mechanics, electronics, and computer systems naturally led me to Seatech, an engineering school renowned for its innovative approach, commitment to emerging technologies, and its focus on marine engineering. My interest in mechatronics and robotics guided me toward the SYSMER program, where I have been able to develop my skills in designing and analyzing autonomous systems.

1.1.2 Internship Context

As part of my education, and to validate my second year of studies, I must complete a 17-week period abroad. I chose to undertake an internship during this period to have the opportunity to apply the theoretical skills I have acquired in class within a real, dynamic professional setting.

1.1.3 Choosing the Thai-French Innovation Institute

The choice of the Thai-French Innovation Institute (TFII) at King Mongkut's University of Technology North Bangkok (KMUTNB) was strategic. Asian countries are known for their expertise in electronic boards, a field I wish to improve in. Moreover, TFII is renowned for its excellence in research and innovation. The collaboration between TFII and KMUTNB offers an environment enriched by cultural diversity and technical expertise, ideal for an international internship. Additionally, TFII benefits from its collaboration with both France and Thailand, fostering a dynamic exchange of knowledge and practices.

This internship choice was strongly supported by recommendations from Mr. Leandri, a research lecturer at Seatech, and Mr. Gies, a lecturer at the University of Toulon. Both confirmed the prestigious reputation of KMUTNB, highlighting its academic excellence and commitment to research and innovation.

1.1.4 Internship Objective

My internship at TFII is centered on the development of a control system for an electric car equipped with solar panels. This project aims to optimize how electrical energy is managed within the vehicle, as its energy is sensitive to the variability of solar power. The main tasks of my internship include:

- **Research and Development**: Study and optimize voltage and current transducers to efficiently measure and manage high voltages and currents.
- **Technical Experimentation**: Set up and test electrical circuits using specialized equipment to evaluate the performance of the developed control system.
- **Technical Support**: Prepare lab documents to help future interns and students understand and use the developed technologies. For each experiment, a support document is written.

By conducting my internship at TFII, I embarked on an adventure where innovation, learning, and collaboration are at the heart of every activity undertaken. This internship is, therefore, a crucial step toward my goal of becoming a competent engineer capable of understanding and solving complex systems.

1.2 Report Objectives

The main objective of this internship report is to clearly and precisely document the list of activities, learning experiences, and contributions made during my internship at the Thai-French Innovation Institute (TFII) at King Mongkut's University of Technology North of Bangkok (KMUTNB). This document is not only a written record of my professional experience but also a reflection on the skills acquired and the knowledge deepened during this period. The specific objectives of this report are as follows:

- **Present the Thai-French Innovation Institute (TFII) at King Mongkut's University**
  - Describe the institutional and academic environment of the institute.
  - Highlight the missions, values, and objectives of KMUTNB that align with my interests in mechatronics and robotics.
- **Details of Projects and Tasks Completed**
  - Provide a detailed description of the projects I worked on, particularly a microcontroller with the aim of properly controlling it for an electric car.
  - Explain the technical processes, the challenges encountered, and the solutions developed during the internship.
- **Analysis of Skills Developed**
  - Assess the specific skills related to my training that I was able to strengthen or acquire.
  - Reflect on the interpersonal and organizational skills developed through interactions with the research team and other interns.
- **Evaluation of Learning Objectives**
  - Evaluate to what extent the objectives set at the beginning of the internship were achieved.
  - Discuss the new knowledge gained and how it will be applied in my academic and professional fields.
- **Personal and Professional Synthesis**
  - Provide a summary of the internship experience, including the most beneficial aspects and areas for improvement.
  - Project this experience into my future professional life, identifying how it will contribute to my future career as an engineer.

In summary, this internship report presents a critical approach to my immersion in an international research context. Its primary goal is to demonstrate how the experiences gained contribute to my engineering education and how they prepare me for my future career as an engineer.

2 The Institute and Its Environment

2.1 General Presentation of the Thai-French Innovation Institute (TFII)

The Thai-French Innovation Institute (TFII) was born from a strategic collaboration between the Thai government and the French government[5]. Located within King Mongkut's University of Technology North Bangkok (KMUTNB), TFII plays a pivotal role in technological development and the training of human resources in Thailand's industrial science and technology sectors.

Figure 1: Logos of King Mongkut's University of Technology North Bangkok (KMUTNB) and the Thai-French Innovation Institute (TFII).

2.1.1 Foundation and Key Agreements

The genesis of TFII dates back to October 13, 1991, when representatives from the French and Thai governments, notably the Ministers of Finance, signed the initial agreement in Bangkok as part of an assistance program for Thailand's economic development. This agreement marked the beginning of France's commitment to transferring modern technologies to educational institutions and developing facilities.

On December 18, 1991, and January 3, 1992, in Paris and Bangkok respectively, the two governments formalized the operational agreement, thereby concretely implementing the project. Additionally, on October 29, 1991, in Paris, a specific agreement was concluded between King Mongkut's Institute of Technology and the French Industrial Council to establish the Thai-French Innovation Center.

2.1.2 Initial Contribution and Ongoing Support

During the first three years following its creation, TFII benefited from support from the French government and partners such as AIR LIQUIDE, the French Federation of Mechanical Industries, and France DIDAC, with an initial investment of approximately 140 million baht. This financial contribution facilitated the development of technologies in the fields of energy, aeronautics, electronics, and computer science.

2.1.3 Significant Events and Developments

Figure 2: Princess Maha Chakri Sirindhorn at the cornerstone laying ceremony for TFII.

On October 2, 1990, Princess Maha Chakri Sirindhorn honored TFII by presiding over the cornerstone laying ceremony (see figure 2). On June 5, 1992, the official inauguration of the building took place, highlighted by an exhibition demonstrating modern technology offered by French companies as part of this academic cooperation program.

Figure 3: 20th anniversary of TFII, showcasing Thai and French technology exhibitions.

In 2010, on the occasion of the institute's 20th anniversary, an exhibition showcasing Thai and French technologies was organized, highlighting TFII's academic activities (see figure 3).

2.1.4 Legal and Institutional Status

On December 26, 2007, the act establishing King Mongkut's University of Technology North Bangkok was proclaimed, integrating TFII as a faculty-level entity within the university. This integration, formalized in the official journal on April 4, 2008, marked an important milestone in the evolution of TFII, strengthening its role in technological development and education in Thailand.

2.2 Geographical Situation and Economic Environment

2.2.1 Location and Strategic Importance

The Thai-French Innovation Institute (TFII) is strategically located in the north of Bangkok, on the campus of King Mongkut's University of Technology North of Bangkok (KMUTNB) at the following address: 1518 Pracharat 1 Road, Wongsawang, Bangsue (see figure 4). This location offers several significant advantages that strengthen its role in technological development and international cooperation.

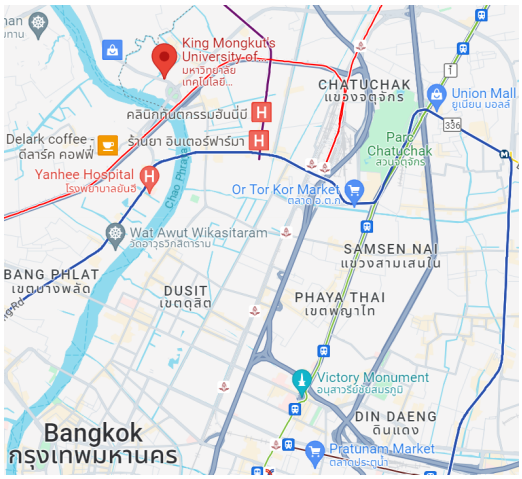


Figure 4: Location of King Mongkut's University of Technology North of Bangkok and TFII, showing access and proximity to major Bangkok infrastructure, taken from Google Maps.

Access and Connectivity

Figure 5: Bus line 203 in Bangkok

Figure 6: BTS Sukhumvit Line in Bangkok

Although TFII is not directly connected to the Skytrain (BTS) or the Subway (MRT) (see figure 6), the institute remains easily accessible via a network of bus lines (see figure 5). The proximity of the institute to these transportation networks, as well as major roadways, provides easy connections to other parts of the city and international airports. This connectivity is a major advantage for staff, students, researchers, and international visitors who participate in the institute's programs and projects.

Proximity to Industrial and Commercial Zones

Figure 7: The Gateway Center in Bang Sue

Located near several major commercial and industrial areas in Bangkok, such as the Gateway Center in Bang Sue (see figure 7), TFII's location facilitates collaborations with industries, tech companies, startups, and incubators, which are essential for technology transfer and applied research partnerships.

Strategic Importance for Cooperation Initiatives

TFII's location plays an important role in strengthening relations between Thailand and France, serving as a hub for bilateral initiatives in education, research, and technological development. TFII positions itself as a true hub of Franco-Thai innovation, attracting talent, investments, and technologies from around the world, thus contributing to Bangkok's prominence as a regional innovation center in Southeast Asia.

2.2.2 The Institute within KMUTNB

The Thai-French Innovation Institute (TFII) is located on the campus of King Mongkut's University of Technology North of Bangkok (KMUTNB), one of Thailand's leading technological institutions (see figure 8). This integration into the campus is a major asset for TFII as it allows it to be part of a dynamic academic and technological ecosystem, conducive to innovation and research[2].

Figure 8: Aerial view of KMUTNB campus

Synergy with KMUTNB

KMUTNB is part of the King Mongkut group of universities (KMUT), which also includes King Mongkut's Institute of Technology Ladkrabang (KMITL) and King Mongkut's University of Technology Thonburi (KMUTT). These institutions are known not only for their academic excellence but also for being public universities. Indeed, they were jointly founded by the Royal Thai Government and the Federal Republic of Germany in 1959.

Role of KMUTNB

KMUTNB's role as a member of the KMUT group is pivotal in industry-oriented education and research in Thailand. The university specializes in key technological fields such as mechanical engineering, electrical engineering, and information technology, making the institute a key player in training highly qualified professionals. Through its collaboration with TFII, KMUTNB strengthens its commitment to technological development and international cooperation, particularly with France.

KMUTNB Facts and Figures

Figure 9: KMUTNB rankings in various academic fields

- **THE Subject Ranking 2021:** KMUTNB is ranked 7th among Thai universities in engineering, 4th in computer science, and 6th in physical sciences. These rankings highlight the university's expertise in these key areas and its ability to offer high-quality education[3].

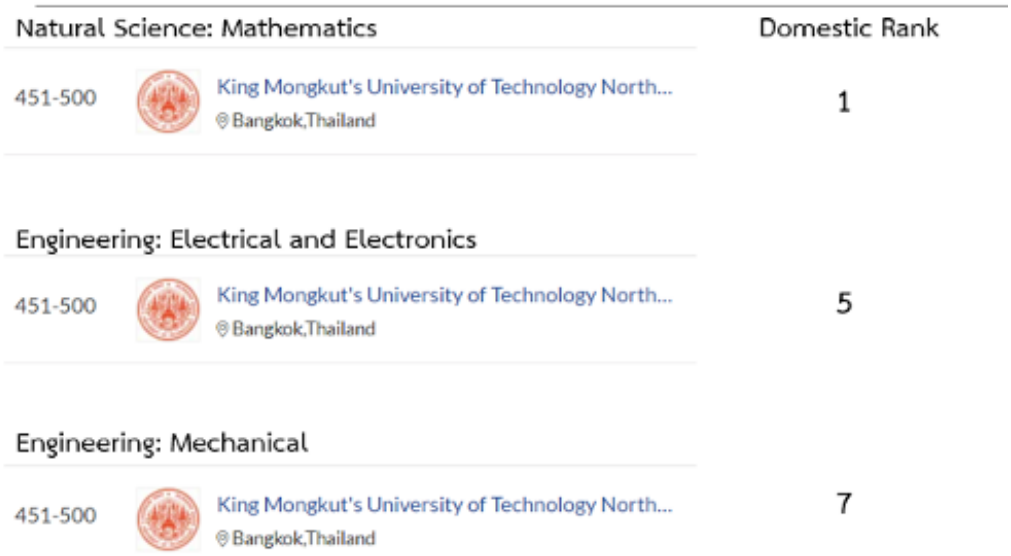


Figure 10: QS Subject Rankings for King Mongkut's University of Technology North of Bangkok

- **QS Subject Ranking 2021:** KMUTNB excels particularly in technical and technological sciences, ranking 1st among Thai universities in mathematics. This ranking demonstrates KMUTNB's expertise and teaching quality in this fundamental field.

Figure 11: World University Rankings 2021

- **THE World Ranking 2021:** KMUTNB is ranked 13th among Thai universities, indicating its competitiveness and global recognition. This international ranking confirms the university's status as a preferred institution for students and researchers.

Impact of Rankings

These rankings illustrate the academic excellence and strong reputation of KMUTNB, further enhancing the appeal of the Thai-French Innovation Institute (TFII) located within the university. The prominence in these rankings also provides a favorable environment for international collaborations and innovative research initiatives, attracting a global academic community.

2.2.3 Infrastructure and Access

As mentioned earlier, the *Thai-French Innovation Institute* (TFII) benefits from numerous advantages due to its location on the campus of *King Mongkut's University of Technology North of Bangkok* (KMUTNB), facilitating its integration into the global innovation network and its interaction with the industrial sector.

Modern Infrastructures

TFII boasts modern facilities designed to support both research and education. These include specialized laboratories equipped with the latest technologies for research in renewable energies, mechatronics, robotics, and information technology. These laboratories allow researchers and students to carry out their research and studies successfully.

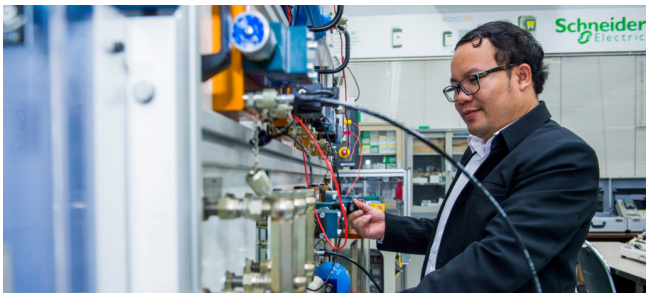


Figure 12: A technician working in one of TFII's advanced laboratories.

Additionally, TFII also benefits from classrooms dedicated to both theoretical and practical teaching, equipped with all the necessary tools to facilitate learning.

TFII-Schneider Electric Centre of Excellence

Furthermore, TFII recently initiated a collaboration with one of the energy giants, *Schneider Electric*, and the *Schneider Electric Foundation*. This collaboration was inaugurated on February 28, 2024, as part of TFII's new *Centre of Excellence*. The opening ceremony took place on the 9th floor of the Science and Technology Research Institute building, in the hall dedicated to the *Schneider Electric Centre*. The event was attended by the French Ambassador to Thailand, Mr. Jean-Claude Poimboeuf, as well as senior executives from KMUTNB and Schneider Electric[4].

Figure 13: Opening ceremony of the TFII-Schneider Electric Centre of Excellence showing the equipment, with the French Ambassador to Thailand, Mr. Jean-Claude Poimboeuf, and Mr. Pornsak, representative of TFII.

The purpose of this center is to train competent and qualified professionals in the fields of automation, renewable energies, and smart systems, thereby contributing to technological advancement and high-quality training.

2.3 Mission, Vision, and Objectives of KMUTNB

2.3.1 Mission and Vision

The mission and vision of the Thai-French Innovation Institute (TFII) are to contribute significantly to technological progress and socio-economic development, both locally and internationally.

Mission

The mission of TFII is to promote innovation and technological development through educational programs. The institute aims to develop advanced technological solutions that address the contemporary challenges and needs of industrial and technological sectors. By focusing on education and research, TFII is committed to:

- Providing high-quality education that prepares students to become competent professionals in their field.
- Enhancing the competitiveness of Thai and international industries by encouraging new technologies and methodologies.
- Strengthening international collaborations, particularly between France and Thailand, to facilitate the transfer of knowledge and technologies.

Vision

The vision of TFII is to be a leader in technological innovation and engineering education. Positioned at the intersection of research and industrial development, TFII aspires to:

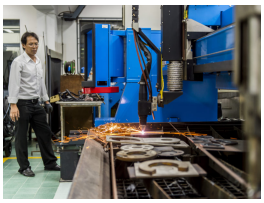
- Be recognized as a center of excellence in the various fields of engineering it hosts.
- Play a key role in transforming industries by using cutting-edge technologies to meet sustainability and efficiency requirements.
- Train competent professionals who will not only be technically skilled but also aware of the challenges our world faces for the future.

2.3.2 The Institute's Departments

The Thai French Institute of Innovation (TFII) at KMUTNB is equipped with several departments, each focused on a specific field with a strong orientation towards industrial and practical applications [5].

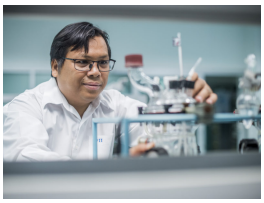
Welding Technology Department

This department aims to study various welding techniques, including materials and advanced welding technologies, for application areas such as the automotive industry and construction.



Corrosion Technology Department

This department addresses various corrosion issues and materials used in different industries, while developing coatings and treatments to protect materials.



Electrical and Energy Technology Department

This department develops innovative solutions for optimizing the production, distribution, and use of energy, while offering comprehensive educational programs in this field.

Research, Development and Technological Transfer Department

This department focuses on applying research directly to industries. It bridges the gap between fundamental research and the market by closely collaborating with industries to develop solutions directly related to their challenges.

Computer for Industrial Applications Department

This department develops software and computer systems adapted to industrial environments, with a focus on improving operational efficiency through automation and digitization.

Automated Manufacturing Systems Department

It explores all the possibilities of automated manufacturing, ranging from simple robotics to computer numerical control (CNC).

Metrology and Computer Applications Department

As the name suggests, this department focuses on precision in industrial measurements and the development of computer applications for measurements.

Research Department

This department focuses on applied research with the goal of commercializing the developed technologies, ensuring the link between academic research and the concrete needs of the industry.

3 Internship Experience

3.1 Internship Context and Objectives

3.1.1 Internship Context

My internship took place within the premises of the Thai French Innovation Institute. The main objective of this institute is to explore new solutions in various sectors, such as renewable energy and electric vehicle technologies.

In this context, I had the opportunity to work on the Texas Instruments TF28335 board. This is a powerful tool designed for managing electrical energy. In this case, during the internship, it was used to manage the electrical energy of an electric car equipped with solar panels. This project aligns perfectly with my studies at Seatech in the Sysmer (mechatronics and robotics) program, where the focus is on integrating advanced technological solutions into complex systems.

3.1.2 Internship Objectives

The goal of the internship was to properly manage the flow of electrical energy via the TF28335 board. To achieve this, we developed knowledge on this board through several key areas:

1. **Mastery of the TI F28335 Board**: Learning how to configure, program, and deploy the board in the context of energy management for electric vehicles.
2. **Contribution to Technical Documentation**: Writing detailed technical documentation to facilitate the future use of the board and the systems developed by future engineers, technicians, and students.
3. **Creation of Lab Materials**: Developing explanatory laboratory materials aimed at teaching the uses of the TI F28335 board to students or technicians, to facilitate knowledge transfer and practical training.

4. **PWM Signal Management**: Learning to manage PWM signals in two ways. The first method is fixed, with a set value, and the second is dynamic, using a potentiometer. This approach allows precise control over converters based on energy variations.
5. **Measurement of Current and Voltage with Transducers**: Acquiring the ability to accurately measure current and voltage using electronic tools such as transducers, which are essential for monitoring and correctly adjusting the performance of energy systems.
6. **Design and Testing of DC-DC Converters**: Studying and improving the efficiency of Buck and Boost converters used to modulate the distribution of electrical energy.
7. **Development of Energy Management Solutions**: Creating algorithms capable of dynamically managing energy based on the vehicle's needs and external conditions.
8. **Collaboration with a Multidisciplinary Team**: Working in synergy with engineers, researchers, and other interns to carry out complex and multidisciplinary projects.

This internship not only allowed me to bridge the gap between theory and practice but also to contribute to innovative projects that have a direct impact on the development of clean technologies. The experience gained during this period is essential for my professional future, preparing me to become a key player in the advanced technology industry.

3.2 Projects Completed

3.2.1 Lab 1: Exploration and Use of the TI 28335 Board

The first lab session served as a general introduction to the Texas Instruments TF28335 board. It aimed to familiarize participants with the basics of its operation and architecture. The objective was to provide a comprehensive document on understanding the board, including details on the pins, internal structure, and the capabilities it offers (see figure 14). There were no direct activities in this document; it primarily aimed to lay a solid foundation for more advanced and specific work to follow.

Results Achieved

This introductory lab session highlighted several fundamental aspects of the TI F28335 board. Participants were able to gain a solid understanding of the board's architecture.

Feature	Description
Processor	TMS320F28335, 32-bit DSP, 150 MHz
DMA Controller	6 channels, efficient data management without overloading the CPU
External Interface	Configurable in 16 or 32 bits
I2C Bus	Allows integration of additional sensors and communication modules
∫ ADC	12 bits, 16 channels, rapid reading of analog signals
Communication Interfaces	UART, SPI, CAN
ePWM	Precise power control for motor command and power conversion
0Memory Capabilities	Integrated flash memory and SRAM

3 Description of the Pins on the TI 28335 Board

The TI 28335 board is equipped with a variety of pins that offer extended capabilities for control applications and signal processing. The layout of these pins, as per the provided table, is essential for understanding their functionality and usage. Here is a detailed description of the pins on the board:

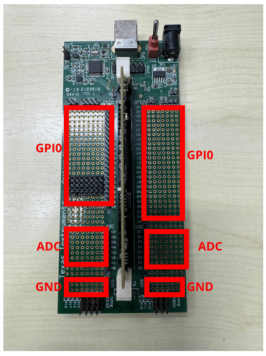


Figure 1: Layout of the main pins on the TI 28335 board

Power and Ground

- **+5V in (Pins 77, 82, 87, 92, 96)**: These pins provide the necessary voltage to power the board.
- **GND / GND_ISO (Pins 6, 8, 10, 12, 14, 27, 37, 47)**: Ground points used to stabilize and secure the electrical operations on the board.

Serial Communication

- **RS232 (ISO-RX-RS232 Pin 2, ISO-TX-RS232 Pin 52)**: Pins for RS232 communication, often used to connect computer or telecommunication devices.
- **CAN (CANRX-A Pin 44, CANTX-A Pin 94)**: Pins for CAN communication, used in automotive and industrial applications for reliable and robust communications.

Figure 14: Page 3 of Lab 1

Analysis of Results

Although the lab was more informative and less focused on advanced technical practice, it was crucial in establishing a solid knowledge base for all participants. There were no major technical issues encountered, given the exploratory and descriptive nature of this lab. However, the discussion raised relevant questions about the board's capabilities and limitations.

Lessons Learned and Future Application

This familiarization with the TI F28335 board during this lab is essential for future work with it. Acquiring various concepts will allow participants to fully utilize its functionalities in more complex applications.

This lab not only strengthened the participants' technical understanding but also laid the groundwork for competent and innovative use of the board in future projects, ensuring that everyone had a clear and complete understanding of the tools at their disposal. Additionally, this lab helped participants learn how to write technical and educational documentation.

3.2.2 Lab 2: Installation Guide for the TI F28335 Control

Lab 2, like the previous one, is not strictly a lab session. However, it does require active participation from the users. In fact, it is more of a user guide designed to ensure that the Texas Instruments TF28335 board is set up correctly. The objective of this lab is to guide participants through the detailed installation of all the necessary software and add-ons required to program the board using MATLAB. This step is crucial to lay the foundation and prepare for subsequent development applications.

The activities of this lab included installing MATLAB 2022, specifically chosen for its compatibility with the tools required for the TI F28335 board. In addition to MATLAB, the lab guided users through the installation of the Embedded Coder Support Package for the Texas Instruments C2000 processor, an essential add-on that allows embedded C programming directly from MATLAB.

Results Achieved

By the end of this lab, participants had successfully installed MATLAB 2022, along with all the necessary add-ons and packages, including support for the C2000 processor. Each step was meticulously documented; illustrations and screenshots were provided to ensure users could follow the process without confusion and check their own progress.

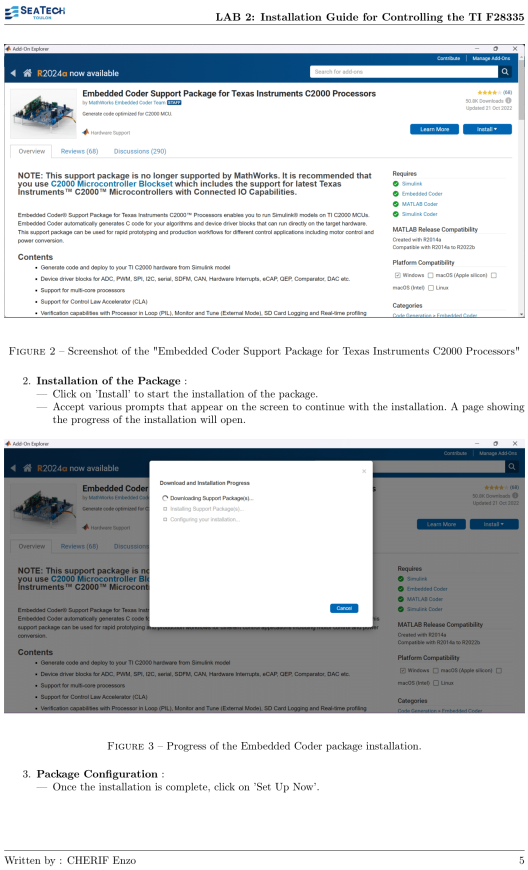

SEATECH TOULON LAB 2: Installation Guide for Controlling the TI F28335

Figure 2 – Screenshot of the "Embedded Coder Support Package for Texas Instruments C2000 Processors"

2. **Installation of the Package** :
   — Click on 'Install' to start the installation of the package.
   — Accept various prompts that appear on the screen to continue with the installation. A page showing the progress of the installation will open.

Figure 3 – Progress of the Embedded Coder package installation.

3. **Package Configuration** :
   — Once the installation is complete, click on 'Set Up Now'.

Written by : CHERIF Enzo 5

Figure 15: Page 5 of Lab 2

Analysis of Results

This installation of the various required software and add-ons ensured that each participant had a functioning environment with which they could follow future labs. Systematic checks were included in this lab to prevent users from getting lost or making mistakes (see figure 15).

Lessons Learned and Future Application

This lab allowed participants to correctly install the required software and verify that everything was set up properly. There were no major lessons learned during this lab, as its purpose was not to teach but to ensure that participants were well-prepared to tackle more complex tasks with confidence.

3.2.3 Lab 3: PWM Control with the TI F28335

The third lab session focused on mastering Pulse Width Modulation (PWM) control via the TI F28335 board. Participants concentrated on installing, configuring, and practically manipulating PWM signals for digital control and signal processing applications. This is the first lab where participants could truly engage in hands-on practice, aiming to give them both a theoretical and practical understanding of the basics of PWM control.

Results Achieved

In previous labs, participants installed MATLAB and Simulink along with the necessary packages. For this lab, they were able to generate and observe PWM signals using the board and MATLAB, and they used an

oscilloscope to precisely adjust these signals. Here is an example of the curve that was requested to be produced during the lab (see figure 16).

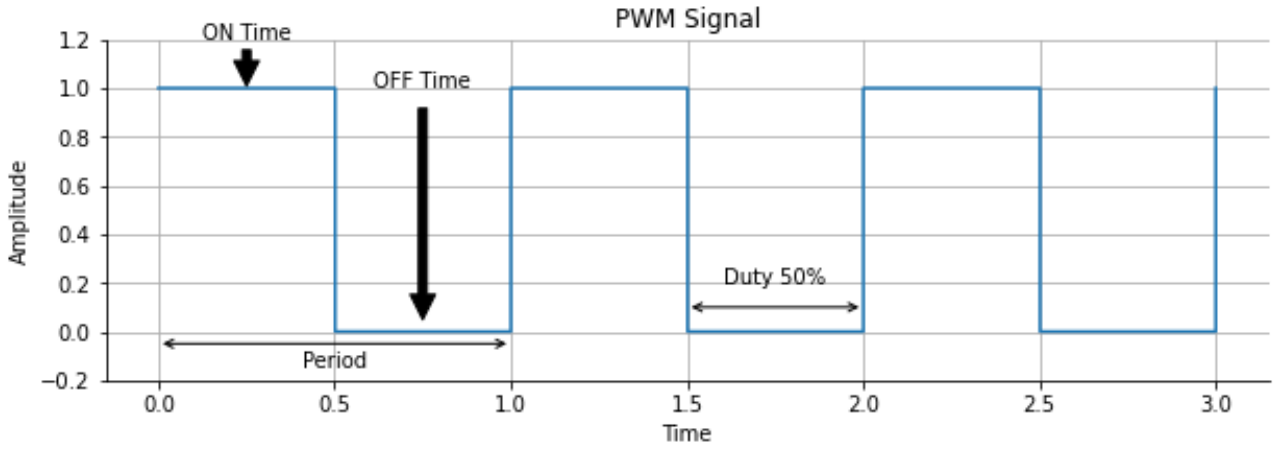


Figure 16: Illustration of a PWM signal with a 50% duty cycle, clearly showing T_{on} and T_{off} for a period of $T = 1$ clock cycle (Python plot).

Analysis of Results

Participants were able to acquire theoretical skills on PWM control and subsequently apply these skills in practice. The challenges encountered during this session, such as adjusting PWM parameters and synchronizing signals, were resolved through successive iterations and adjustments based on direct observation of the results.

Key Formulas and Calculations

During this lab, participants expanded their technical skills. Managing a PWM signal requires an understanding of the formulas governing it.

- **Timer Period Calculation (T-Board)**:

$$T_{\text{Board}} = \frac{\text{Main Clock Frequency}}{f_s} \tag{1}$$

  Where f_s is the desired switching frequency. For example, for a f_s of 10 kHz and a main clock frequency of 150 MHz:

$$T_{\text{Board}} = \frac{150,000,000}{10,000} = 15,000 \text{ clock cycles} \tag{2}$$

- **Duty Cycle Calculation**:

$$T_{\text{ON}} = D \times T_{\text{Board}} \tag{3}$$

  Where D is the duty cycle expressed as a percentage. For a duty cycle of 20

$$T_{\text{ON}} = 0.2 \times 15,000 = 3,000 \text{ clock cycles} \tag{4}$$

Exploration and Adjustment of PWM Signals

To further their understanding, participants were invited to manipulate various variable parameters such as frequency, duty cycle, and more. In this lab, the manipulation of PWM1A and PWM1B signals was also performed to explore different phase and amplitude configurations. By adjusting these parameters, participants could understand how they affected the system's performance. For example:

- **Complementary Signal Configuration (Deadband Polarity)**: Using Deadband polarity options to temporally separate PWM1A and PWM1B signals to prevent short circuits in motor control applications. This demonstrated how to adjust the phase and amplitude of signals to ensure safe and efficient operation.

Lessons Learned and Future Application

Throughout this lab, participants acquired essential skills for the development of embedded systems. The concept of PWM is fundamental and is used in a multitude of fields. The knowledge gained allows participants to understand how parameter adjustments directly influence device performance.

This lab strengthened both theoretical and practical aspects, enabling participants to work autonomously while being guided through the use of the TI F28335 board.

3.2.4 Lab 4: Duty Cycle Control via PWM on the TI F28335

The fourth lab session focuses on the dynamic adjustment of the duty cycle of Pulse Width Modulation (PWM) signals using the TI F28335 board. For this, participants use a potentiometer to modulate the pulse width (see figure 17). The main objective of this session is to understand the PWM signal by adjusting the duty cycle in real time. Knowing how to modulate this signal is crucial in many electronic and control applications.

Specific Objectives

- **Practical manipulation of the duty cycle**: Use a potentiometer connected to an analog-to-digital converter (ADC) to adjust the PWM signal's duty cycle in real time.
- **Application in simulation and real time**: Integrate theoretical concepts with practice by using simulation tools like MATLAB/Simulink to model the PWM signal behavior with different duty cycle values.

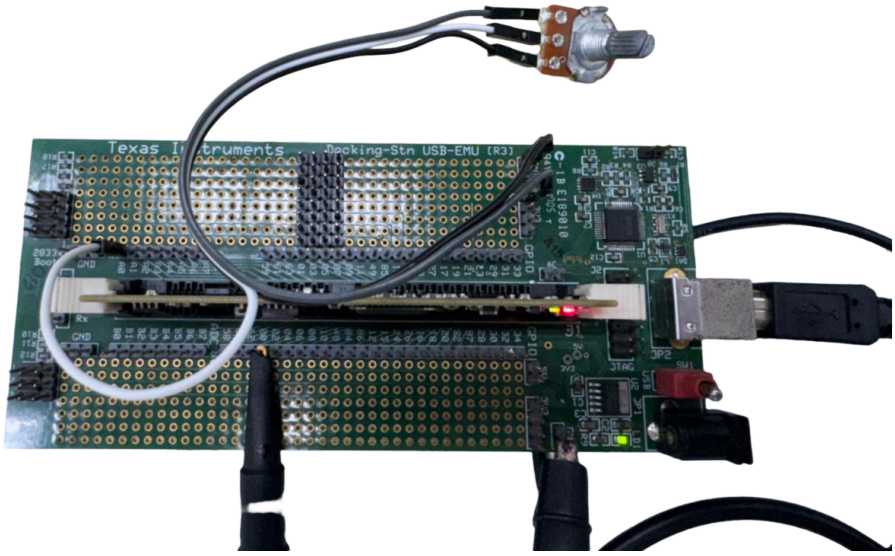


Figure 17: TI TF28335 Board with Potentiometer

Results Achieved

The students successfully:

- Configured and programmed the board to generate adjustable PWM signals.
- Directly observed how changes in the duty cycle affected the system outputs.

Analysis of Results

Participants were able to see how dynamically changing the PWM duty cycle affected performance and power delivered to the controlled device. The challenges during this lab included the precise calibration of the signal and the real-time response to rapid adjustments of the potentiometer. These challenges provided a deeper understanding of the relationship between analog inputs and digital outputs in embedded systems.

Key Formulas and Calculations

- **Duty Cycle Calculation Formula**:

$$\text{Duty Cycle}(\%) = \left(\frac{T_{\text{ON}}}{T}\right) \times 100 \tag{5}$$

where T_{ON} is the time during which the signal is high and T is the total cycle period.

- **Gain Formula**: The gain required to convert the ADC output to a suitable duty cycle is calculated as follows:

$$\text{Gain} = \frac{\text{Max Duty Cycle Range}}{\text{Max ADC Value}} \tag{6}$$

For a 12-bit ADC with a maximum output value of 4095 (as the ADC can produce values from 0 to 4095), and a duty cycle range from 0% to 100%, the gain formula becomes:

$$\text{Gain} = \frac{100\%}{4095} \tag{7}$$

This means that each unit increase in the ADC value increases the duty cycle by:

$$\frac{100}{4095} \approx 0.0244\% \tag{8}$$

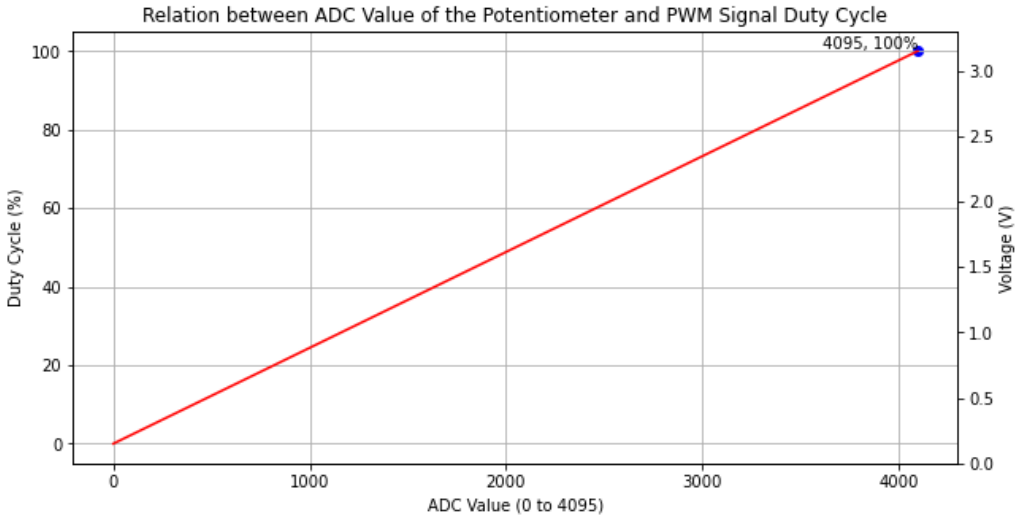


Figure 18: Relationship between ADC value of the potentiometer and PWM signal duty cycle (Python plot)

Lessons Learned and Future Application

This lab not only added to the participants' technical foundations, particularly in real-time pulse modulation, but also enhanced their ability to control and optimize electronic systems in practical contexts. Participants are now familiar with PWM. Additionally, at the end of the lab, theoretical and practical questions were included to ensure a comprehensive understanding by participants during the session.

3.2.5 Lab 5: Voltage and Current Measurement with LV 25-P and LA 55-P Transducers

Lab session 5 was designed to provide an in-depth understanding of the LV 25-P voltage and LA 55-P current transducers. These two devices are crucial in embedded systems, used for accurate measurement of electrical quantities in various industrial contexts. The primary goal of this lab was to teach students the theory behind these transducers, detailing their operating principles, analyzing their datasheets, and understanding the theory behind the calculations necessary for their optimal use.

Activities Performed

- **Introduction to Transducers**: Presentation of the LV 25-P and LA 55-P transducers, highlighting their role and importance in embedded systems.

- **Operating Principles**:
  - **LV 25-P**: Exploration of the voltage measurement mechanism.
  - **LA 55-P**: Discussion on current measurement based on the Hall effect.
- **Examination of Datasheets**: Detailed analysis of the technical datasheets to understand specific characteristics, measurement ranges, accuracy, and required configurations.

Results Achieved

Students gained a clear understanding of:

- The technical specifications and configurations of the transducers.
- How these devices convert physical quantities into measurable and usable electrical signals.

Analysis of Results

This session allowed students to link theory to practice by visualizing how datasheet information translates into performance in real applications. In-class discussions helped clarify the complex aspects of the transducer specifications and applications.

Theory and Calculations

- **Calculations for LV 25-P**:

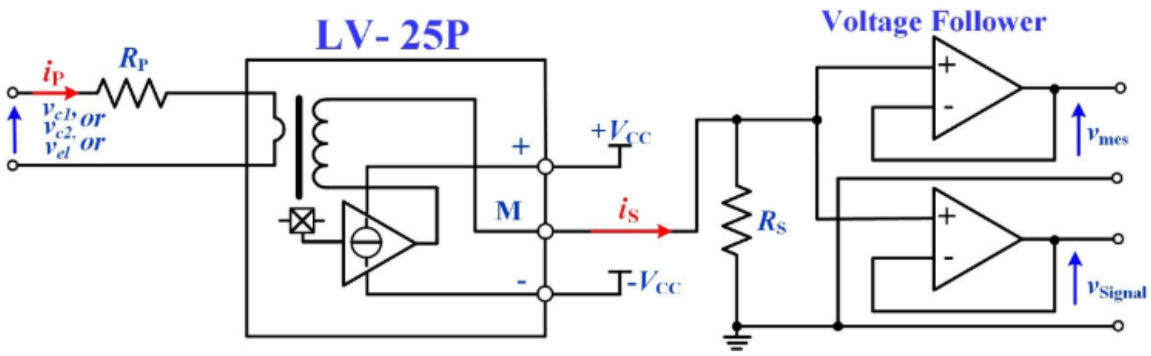


Figure 19: Electrical diagram of the LV 25-P transducer

$$R_p = \frac{V_{c1} \text{ or } V_{c2} \text{ or } V_{el}}{I_p} \tag{9}$$

where:

- R_p is the primary resistance.
- V_{c1} or V_{c2} or V_{el} is the maximum voltage to be measured.
- I_p is the nominal primary current.

$$R_S = \frac{V_{Signal}}{I_S} \tag{10}$$

where:

- V_{Signal} is the desired output voltage.
- I_s is the nominal secondary current.

- **Calculations for LA 55-P**:

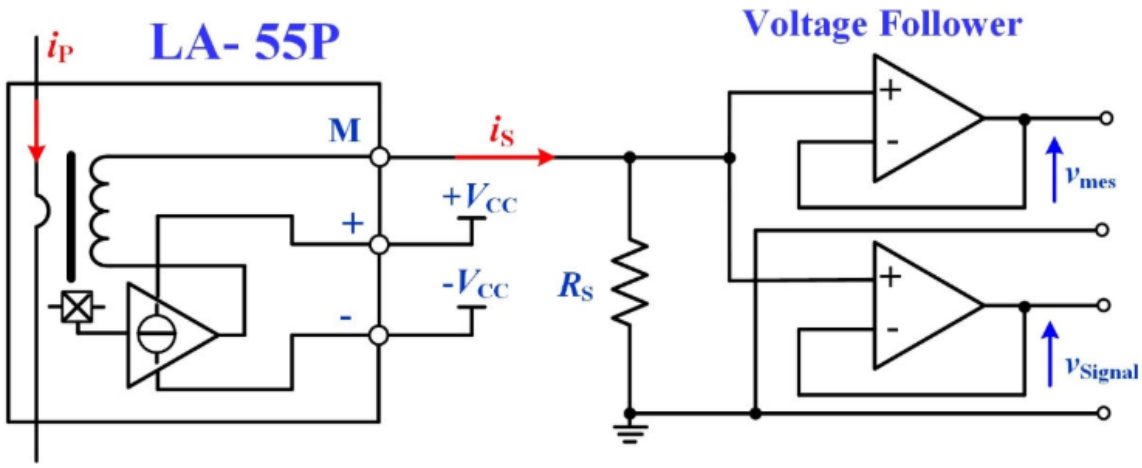


Figure 20: Electrical diagram of the LA-55P transducer

$$V_{Signal} = \left(\frac{N_P}{N_S}\right) \times I_P \times R_M \tag{11}$$

where:

- N_P/N_S is the transducer ratio, also called the Hall constant.
- B is the magnetic field created by the primary current.
- I_0 is the current through the conductor.

Lessons Learned and Future Application

Students not only consolidated their theoretical knowledge of transducers but also developed the ability to interpret and use datasheets to properly select and configure these devices for various applications. These skills are essential for any engineer working with electrical measurement systems, ensuring that the measurements taken are both accurate and reliable—crucial elements for quality control and preventive maintenance in industrial environments.

In conclusion, this lab prepared students to effectively apply their technical knowledge in their future careers, with a deep understanding of transducers and their application in the real world.

3.2.6 Lab 6: Voltage Measurement Accuracy with the LV 25-P Transducer

This lab session is the logical continuation of the previous one, where we used two transducers, the LA-55P and the LV 25-P. This session focuses on the latter, with an emphasis on the precise measurement of voltage. The goal is to apply the theory learned in the previous lab in a practical context, verify the calculation equations through experimental measurements, and develop measurement and analysis skills.

Activities Performed

1. **Theory**: Review of the theory and various formulas related to the LV 25-P.
2. **Circuit Setup**: Configuration of a circuit to test the transducer under various voltage conditions.
3. **Calibration**: Calibration of measurement instruments to ensure data accuracy.

Results Achieved

During the lab, participants successfully measured voltages using the LV 25-P transducer with precision. They were able to observe the transducer's ability to convert high voltages into lower, more usable voltages. They also verified the accuracy of their measurements by comparing them with the expected theoretical values. Multimeters and oscilloscopes were used as measurement tools to verify the accuracy of the results. Thus, participants were able to handle these devices. Here is an example of the results obtained during the lab:

V_{in} (V)	Theoretical $V_{mes} = \frac{V_{in}}{166.67}$ (V)	Measured V_{mes} (V)	Deviation (%)
10	$\frac{10}{166.67} \approx 0.06$	0.05	$((0.06 - 0.05)/0.06) \times 100 \approx 16.67$ %
20	$\frac{20}{166.67} \approx 0.12$	0.09	$((0.12 - 0.09)/0.12) \times 100 \approx 25.00$ %
50	$\frac{50}{166.67} \approx 0.30$	0.27	$((0.30 - 0.27)/0.30) \times 100 \approx 10.00$ %

Analysis of Results

The measurements taken were analyzed and were found to be consistent with the theoretical expectations. However, discrepancies existed, partly due to inaccuracies in the measuring instruments or calibration errors. Class discussions helped resolve these discrepancies and improve the understanding of the measurement processes.

Lessons Learned and Future Application

The various skills acquired during this lab are essential. Indeed, voltage measurement is fundamental in the monitoring of electronic circuits. Participants learned how to handle measurement equipment such as multimeters and oscilloscopes, as well as how to critically interpret data. They were able to apply their theoretical knowledge and confront it with reality. These skills will be highly useful for future projects.

3.2.7 Lab 7: Exploration of DC-DC Converters: Boost and Buck

This lab session 7 focuses on a very important piece of electronic equipment in modern power electronics applications. Specifically, this session addresses DC-DC converters of the Boost and Buck types. The objective is to understand not only the basic formulas governing these converters but also to grasp their practical limitations by analyzing the different factors that can affect their performance.

Activities Performed

- **Theoretical and Practical Study**: Participants were invited to review the various formulas related to the output voltage of the converters. They were able to compare these results with different duty cycle values.
- **Circuit Configuration**: The different components of the Boost and Buck circuits were carefully described and analyzed. This includes inductors, switches, diodes, capacitors, and load resistors.
- **ON and OFF State Analysis**: Participants were able to understand the circuits by establishing differential equations for each circuit in both ON and OFF states.

Results Achieved

Students directly observed how duty cycles influence the output voltage and identified deviations from theoretical predictions due to component imperfections and inherent system losses. They were also able to determine the internal dynamic behavior of each circuit.

Key Formulas and Calculations

Boost Converter:

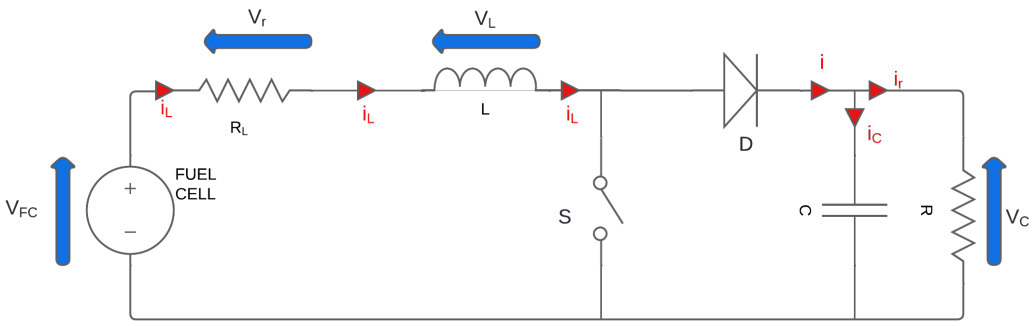


Figure 21: Boost Circuit Diagram

- **Output Voltage**:

$$V_{\text{out}} = \frac{V_{\text{in}}}{1 - D} \tag{12}$$

where D is the duty cycle of the PWM signal.

- **Differential Equations**:
  - **Inductor Current Equation for ON State (i_L)**:

$$\frac{di_L}{dt} = \frac{V_{FC} - i_L R_L}{L} \tag{13}$$

  - **Capacitor Voltage Equation for ON State (v_C)**:

$$\frac{dV_C}{dt} = -\frac{i_R}{C} \tag{14}$$

  - **Inductor Current Equation for OFF State (i_L)**:

$$\frac{di_L}{dt} = \frac{V_{FC} - i_L R_L - V_C}{L} \tag{15}$$

  - **Capacitor Voltage Equation for OFF State (V_C)**:

$$\frac{dV_C}{dt} = \frac{i_L - i_R}{C} \tag{16}$$

Buck Converter:

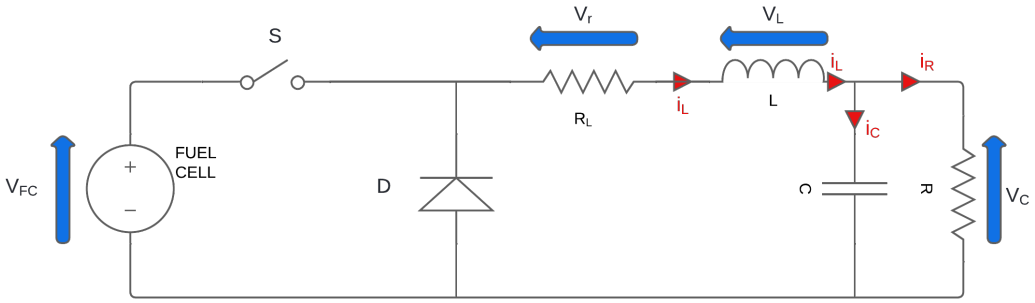


Figure 22: Buck Circuit Diagram

- **Output Voltage**:

$$V_{\text{out}} = V_{\text{in}} \times D \tag{17}$$

  where D is also the duty cycle of the PWM signal.

- **Differential Equations**:
  - **Inductor Current Equation for ON State (i_L)**:

$$\frac{di_L}{dt} = \frac{V_{FC} - i_L R_L - V_C}{L} \tag{18}$$

  - **Capacitor Voltage Equation for ON State (V_C)**:

$$\frac{dV_C}{dt} = \frac{i_L - i_R}{C} \tag{19}$$

  - **Inductor Current Equation for OFF State (i_L)**:

$$\frac{di_L}{dt} = \frac{-i_L R_L - V_C}{L} \tag{20}$$

  - **Capacitor Voltage Equation for OFF State (V_C)**:

$$\frac{dV_C}{dt} = \frac{i_L - i_R}{C} \tag{21}$$

Analysis of Results

During this lab, participants noted the importance of carefully selecting components and meticulously designing the circuits to minimize losses. However, they were able to establish the behavior of each circuit in its different states using various electronic laws.

Lessons Learned and Future Application

Students gained an understanding of a new concept regarding DC-DC converters. This knowledge will enable them to:

- Design systems that require precise voltage manipulation.
- Understand the different limitations of these circuits and their performance.

In conclusion, this lab enriched the participants' technical skills by providing them with the tools needed to navigate between theory and practice while developing their critical thinking. Understanding Boost and Buck circuits is essential in developing innovative and efficient technologies.

3.2.8 Lab 8: Deepening Understanding of Boost Converter and Practical Tests

This lab session follows up on the Boost converter started in the previous session, with a particular focus on the practical application and optimization of this type of converter. The objective of this lab is to review the theoretical basics from the previous study while detailing the hardware configuration used and to conduct tests on the Boost circuit to compare theoretical results with the actual performance of the circuit.

Activities Performed

- **Theoretical Review**: A brief recap of the key concepts of the Boost converter covered previously, including fundamental equations and operating principles.
- **Hardware Presentation**:
  - **Function Generator**: Usage and advantages compared to other options for generating the PWM signal required to control the converter.
  - **Circuit Components**: Detailed description of the components used, including:
    - **IRF740 MOSFET**: Specifications and operation in the circuit.
    - **SF54 Diode**: Specifications and operation in the circuit.
    - **TPL250 H-Bridge**: Specifications and operation in the circuit.
    - **Capacitor, Inductor, Load Resistor**: Function and importance in the Boost circuit setup.
- **Circuit Setup**: Step-by-step instructions for assembling and connecting the Boost circuit. As shown in the image below:

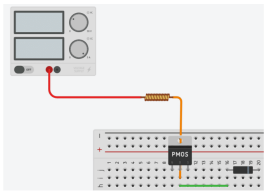


Figure 14: Connecting the inductor to the MOSFET and to the diode in a Boost circuit.

3. **Configuring the Diode and Capacitor:**
   - **Diode to Capacitor:** Connect the output of the diode to the input of the capacitor.
   - **Capacitor to Load Resistances:** Connect the output of the capacitor to the load resistances.

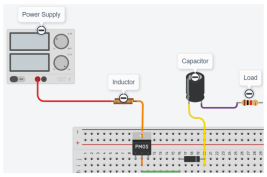


Figure 15: Connecting the output of the diode to the capacitor, and from there to the load resistances in the Boost circuit.

4. **Completing the Circuit:**
   - **Return to the MOSFET:** Connect the Source (S) pin of the MOSFET directly to the negative terminal of the Power Supply.
   - **Ground Return:** The output from the load resistances should also be connected to the negative terminal of the Power Supply to complete the circuit.

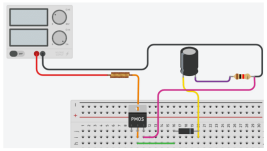


Figure 16: Final connection of the Boost circuit, including the return of the Source pin of the MOSFET and the load resistances to the negative terminal of the Power Supply.

Figure 23: Page 12 of Lab 8

Results Achieved

Students successfully assembled their own Boost circuit by following the step-by-step assembly instructions. They then used the Boost circuit to measure output voltages with different input voltage values and duty cycles.

Analysis of Results

During the lab, participants performed several measurements. Here is an example of the measurements taken during the study:

- **Test Configuration**: Setting up the circuit to measure the output at a 50% duty cycle, with a 10V input.

Figure 24: Measurement with a 150 load resistor

Figure 25: Measurement with a 92 load resistor

- **Observations and Tests**: The measurements showed an output voltage of 18.79V for a 150 load resistor and 18.37V for a 92 load resistor, lower than the expected theoretical 20V, illustrating the inherent losses and practical limitations of the circuit (see figures 24 and 25).

Participants were able to verify the formula established in the previous lab:

$$V_{\text{out}} = \frac{V_{\text{in}}}{1 - D} \tag{22}$$

They observed discrepancies between practice and theory and justified these differences.

Lessons Learned and Future Application

Students applied their theoretical knowledge to the circuit and gained practical experience. Participants learned to evaluate the discrepancies between theory and practice for DC-DC converters under different conditions. Their understanding of the Boost circuit was enhanced, and they now possess the tools to fully grasp this circuit and navigate the various applications of energy conversion.

3.2.9 Lab 9: Deepening Understanding of Buck Converter and Practical Tests

Lab session 9 complements lab session 8, where we focused on the Boost circuit. This session, however, focuses on the Buck circuit through practical experiments. The objective is to master and understand these DC-DC converters under real conditions.

Activities Performed

- **Concept Review**: A review of the basic principles of Buck converters, including the importance of the duty cycle and its impact on the output voltage.
- **Circuit Assembly**: Assembly of a Buck circuit, following detailed instructions to correctly configure key components such as the IRF740 MOSFET, the SF54 diode, and the TLP250 connection point. Particular attention was given to the details to ensure participants could assemble the circuit smoothly.
- **Practical Experimentation**: Setting up the function generator to generate a PWM signal and adjusting the duty cycle to reach the desired output voltage. A function generator was used for the PWM signal, as in the previous session, for its precision and to avoid errors.

Results Achieved

Students were able to assemble a Buck circuit on their own and conduct tests to observe the effects of modifying the duty cycle or input voltage. They measured output voltages with different input parameters, noting the discrepancies between the expected results and actual observations.

Analysis of Results

- **Circuit Assembly and Connection**: Detailed instructions for assembling the Buck circuit were followed, with particular attention to safety and checking the connections.
- **Power Management**: Use of two power supplies to avoid interference and optimize circuit performance.

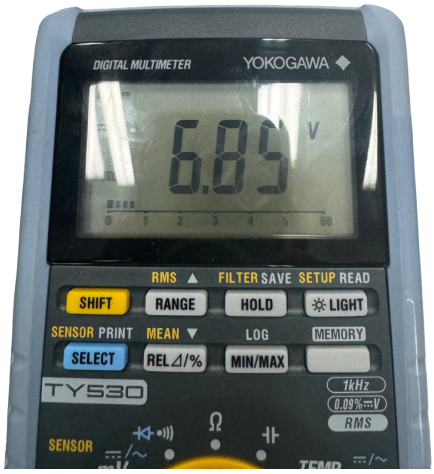


Figure 26: Measurement with a 150Ω load resistor

Figure 27: Measurement with a 92Ω load resistor

- **Tests and Observations**: The tests showed that the output voltages were lower than the theoretical expectations, with specific measurements of 6.85V for a 150Ω load resistor and 6.53V for a 92Ω load resistor (see figures 26 and 27).

Key Formulas and Calculations

Buck Converter Formula:

$$V_{\text{out}} = D \times V_{\text{in}} \tag{23}$$

where D represents the duty cycle of the PWM signal.
Participants were able to verify the formula established in the previous session and observed various discrepancies between practice and theory, providing justifications for these differences.

Lessons Learned and Future Application

This lab allowed students to apply their theoretical knowledge of the Buck circuit to practical work and develop skills in precisely adjusting parameters to improve circuit performance. The various concepts acquired during this session include:

- The importance of precision in configuring components and control signals.
- The need for thorough analysis to align practical results with theoretical predictions.

3.2.10 Lab 10: Practical Experimentation with Boost Converters

In the previous lab sessions, we studied different DC-DC converters, Boost and Buck, focusing on how they reacted based on the duty cycle and input voltage. To manage the duty cycle, we used a function generator for its precision and to avoid overcomplicating the labs. Now that the concepts are mastered, we can generate our own PWM using the Texas Instruments TF28335 board. In fact, we learned how to do this in lab sessions 3 and 4. This session serves as a synthesis of all the previous labs, aimed at evaluating the performance of the Boost converter using the Texas Instruments TF28335 board to generate PWM signals. The objective is to demonstrate the board's ability to precisely modulate the PWM signal and analyze its impact on the output voltage of the Boost circuit.

Activities Performed

- **Circuit Setup**: Installation and configuration of the TI board to replace a traditional function generator.
- **Practical Experimentation**: Using MATLAB and Simulink to program the TI board, generate PWM signals, and dynamically control the duty cycle via a potentiometer.

Results Achieved

During this lab, participants conducted two phases of testing. The first phase involved taking measurements with fixed PWM parameters, justifying possible discrepancies between practice and theory. The second phase involved taking measurements again, but this time with dynamic PWM, meaning it was controlled via a potentiometer. Students first had to determine the corresponding duty cycle using an oscilloscope, and then take output voltage measurements. The results clearly show that adjustments to the duty cycle directly influence the output voltage.

Analysis of Results

- **Measurements and Observations**: Compilation of data on variations in the output voltage in response to changes in PWM parameters.
- **Dynamic Control**: Testing with a potentiometer to adjust the duty cycle in real-time, measuring the immediate effect on the output voltage.

Through various measurements, whether under fixed or dynamic control, participants verified the output voltage equation for the Boost circuit:

$$V_{\text{out}} = \frac{V_{\text{in}}}{1 - D} \tag{24}$$

where D is the duty cycle, selected through MATLAB or precisely measured using an oscilloscope. Participants were able to identify solutions for their measurement errors and explain the discrepancies between theory and practice.

Lessons Learned and Future Application

This lab session confirmed that the concepts learned in all previous sessions are well understood, and participants can now validate the functionality and precision of the TI TF28335 board in controlling Boost converters. Students gained more than just a skill; they are now capable of combining the various knowledge they acquired. From programming to circuit assembly, participants successfully created a working Boost circuit to carry out the study. Furthermore, this lab required them to explain their errors and discrepancies, which strengthened their critical thinking regarding their work.

3.2.11 Lab 11: Practical Experimentation with Buck Converters

After mastering the control of the Boost converter in the previous lab session, this session focuses on applying the same principles of Pulse Width Modulation (PWM) to a Buck circuit. The objective is to leverage the Texas Instruments TF28335 board to finely adjust the Buck circuit, enhancing students' skills in managing PWM for DC-DC converters.

Activities Performed

- **Buck Circuit Setup**: Installation and configuration of the Buck circuit using the TI board, similar to the procedures of the previous lab but adapted to the specifics of the Buck circuit.
- **Experimentation with Dynamic Control**: Use of advanced PWM control techniques to modulate the output voltage of the Buck circuit, focusing on precision and system responsiveness.

Results Achieved

In this session, as in the previous one, participants had to manage their PWM signal in two ways. The first involved fixed control of the signal, and once validated, they moved on to dynamic control. Participants conducted measurements using both methods of generating the PWM signal. However, they had to determine the duty cycle value using the oscilloscope.

Analysis of Results

- **Fixed Control and Measurements**: Participants were required to set a value for the duty cycle and record the output voltage of the Buck circuit.
- **Dynamic Control and Measurements**: Participants first had to determine the duty cycle value while recording the output voltage of the Buck circuit.

With the various measurements taken, participants were able to validate the output voltage equation for a Buck circuit:

$$V_{\text{out}} = D \times V_{\text{in}} \tag{25}$$

where D is the duty cycle, chosen through MATLAB or precisely measured using an oscilloscope.

Although participants noted discrepancies between theory and practice, they provided a detailed justification for these differences.

Lessons Learned and Future Application

This session brought together all the skills participants had acquired during the previous lab sessions. Indeed, in this session, they had to use the TI TF28335 board by programming it, while also assembling a Buck circuit to understand the behavior of this DC-DC converter. This allowed them to consolidate all the skills they had previously acquired while learning new ones. Participants had to constantly question their measurements, either by explaining their errors or justifying the discrepancies. Notably, one of the expected justifications in this session concerned the accuracy of the equipment used, such as the capacitor. Participants had to consult its datasheet to justify their discrepancy, for example. With these last two lab sessions, students now know how to handle both the Boost and Buck circuits in any manner. They know how to use them effectively, and they can also generate their own PWM signal using the TI TF28335 board. These skills are crucial for the development of integrated energy solutions, enabling precise regulation in various industrial and commercial contexts.

3.3 Development of Lab Materials

3.3.1 Creation of the Lab Exercises

The creation of lab practicals for students, or even for others, was an essential component of my internship, integrating both technical skills and, new to me, pedagogical skills. The process for developing these practicals followed a fairly consistent logic. I started by clarifying the objectives with my supervisor, who defined the tasks and expected outcomes for each lab session. Then, I followed these steps:

- **TP Design**: Once the guidelines were received, I designed a practical session that integrated theoretical concepts along with one or more practical applications. In this process of creating the practical, I tested the study myself to ensure its feasibility and alignment with the educational objectives.
- **Theoretical and Practical Validation**: I designed each lab session to validate the theory through practical experiments. I asked students to understand and explain the discrepancies between theory and practice in the lab. This allowed me to ensure that the concepts covered were well understood.
- **Bilingual Writing**: I initially wrote the lab sessions in French to ensure good writing quality and to properly organize the logic of the study. Since I was in Thailand, the materials were then translated into English. This dual-language writing ensured the clarity and accessibility of the guides both for my supervisor and for an international audience.

3.3.2 Feedback and Revisions

The feedback process was crucial in the continuous improvement of the lab guides. My supervisor, after reading the practicals, provided regular feedback, allowing for consistent revisions of the TP versions.

- **Feedback Cycle**: Feedback was generally given one or two weeks after the creation of a lab session. This feedback mainly focused on the relevance of the content and its clarity.
- **Adjustments Based on Feedback**: The revisions could include simplifying certain theoretical sections or, conversely, deepening them, as well as adjusting the educational objectives to better target the needs of the lab students.
- **Translation and Validation**: After being revised in French, the guides were translated into English once again, allowing for an additional layer of revision and adaptation, ensuring that the translations faithfully reflected the instructions and technical information.

These efforts in creating and revising the lab guides were not only beneficial for the lab by improving the quality of teaching and learning, but they also strengthened my technical skills and developed new abilities as a pedagogical content developer. I was able to respond dynamically to the educational and cultural requirements of an international environment.

3.4 Courses Delivered

3.4.1 Development and Delivery

During my internship, I had the opportunity to lead mini-classes for a small group of four Thai students, who were under the supervision of my internship mentor. We shared the same room at times, and this daily proximity greatly facilitated our interactions.

Course Context: The classes took place in a room where it was just our small group. This configuration of a small group in our own space created a relaxed atmosphere. Additionally, the relationship was not one of teacher-student but rather a friendly dynamic conducive to exchanges. This encouraged the students to ask me questions freely and work without concerns.

Figure 28: Course delivered at Thai French Innovation Institute (TFII) on Boost and Buck converters.

Course Content: The course content was essentially the lab guides I had developed. The students had the document and could work independently. I was available to help them solve any technical problems or explain theoretical points that were unclear. I also taught another type of course, which was more theoretical, where I stood at the board and led a class for an hour. The course mainly focused on the concepts covered during the practical work.

3.4.2 Impact and Reception

The number of these course sessions, whether theoretical or practical, was limited due to my progress on my work and the writing of the various lab guides, as well as the students' commitments to other activities, notably their final year projects. However, this did not prevent a significant impact.

Indeed, the number of sessions was limited to 2-3 due to the students' commitments to other activities, particularly their final year projects, but this did not stop them from having a meaningful impact.

Participant Feedback: There is nothing more rewarding than seeing the lab guides I had developed already being used and running smoothly. I could attest to the logical flow I intended to convey, and that technical knowledge was transmitted effectively. It was truly a pleasure to see the students successfully manage the TI TF28335 board.

Communication in English: Since the students were Thai, their questions and my explanations were conducted in English. Conducting a class in English for an hour was a new experience for me in every way. I had never given even a speech or a lesson for an hour, let alone in English. This allowed me to improve my language skills and better understand cultural differences.

3.5 Meeting with Mr. Matthieu Peyraud and the Ministry of Foreign Affairs Delegation

3.5.1 Presentation of Work to the Minister

On May 29, 2024, the Thai French Innovation Institute (TFII) had the honor of hosting a delegation from the French Ministry of Foreign Affairs. Professor Dr. Somrerk Chandra-ambhorn, Vice President for Research and Development of Information Technology, and Asst. Prof. Dr. Pornsak Srisungsitthisunti, Director of TFII, welcomed Mr. Matthieu Peyraud, Director of Cultural, Educational, Scientific, and Higher Education Diplomacy, who led the delegation.

Figure 29: Meeting between Professor Dr. Somrerk Chandra-ambhorn, Mr. Matthieu Peyraud, and the delegation from the French Ministry of Foreign Affairs at TFII.

During the visit, the delegation was able to see all the infrastructures presented in the previous sections, such as the TFII-Schneider Electric Center of Excellence in electrical, electronic, and automation systems.

During this visit, I had the opportunity to present my work on the board and transducers in front of Mr. Peyraud and the members of the delegation. Although I had only been at TFII for a month, this meeting was a valuable opportunity to showcase the beginning of my research and to explain my role within the institute. During my presentation, I detailed the various objectives of my projects, particularly my work on the TI TF28335 board. The discussion also covered my background, motivations, and vision for the future.

3.5.2 Impact of the Meeting

In addition to my presentation, I had the opportunity to speak directly with Mr. Peyraud. This discussion was particularly enriching, covering not only the technical aspects of my work but also the cultural and institutional differences between France and Thailand in the field of research. We observed how, here in Thailand, research is oriented toward direct applications in industry, a point that contrasts with some academic approaches in France. This focus allows them to attract direct investors who see immediate benefits.

This conversation highlighted the unique opportunities offered by TFII, as well as the importance of my presence as an engineering student in a research environment focused on practical application. Speaking with such a high-ranking individual allowed me to understand the strategic significance of my work and, through the valuable advice given, to reflect on how I can consider my future contributions as an engineer.

3.6 Optimization of Energy Management for Solar-Powered Electric Vehicles

3.6.1 Energy Management Issues in Solar Power

Electric vehicles equipped with solar panels face a major problem: the variation in energy produced by the solar panels, which is linked to weather conditions. Indeed, the weather influences the panels, and a clear sky or a cloudy sky will not produce the same electrical power. This significant fluctuation in the voltage generated by the solar panels thus creates a problem. How can we efficiently manage these energy fluctuations in the electric

vehicle?

The electrical system that connects the solar panels to the rest of the vehicle's electrical equipment operates as follows: a bus serves as an intermediary between the solar panels, the electric motor, and the car's battery. This electrical component, called the bus, is a set of conductors (lines or wires) that carry electrical signals between different parts of a circuit, enabling the exchange of power between electronic components. To function properly, the bus needs to consistently receive 300V. The voltage delivered by the solar panels varies between 50V and 150V, which is not enough for the bus. A Boost circuit connects the solar panels to the bus. The presence of this Boost circuit meets the bus's voltage requirements. Additionally, a battery of about 100V is connected to the bus via a Buck/Boost circuit, which can adopt the properties of either a Buck or a Boost.

To ensure proper monitoring and maintain precise regulation of this voltage, transducers are placed to accurately measure the voltage produced by the solar panels. With this precise measurement, it is then possible to dynamically adjust the voltage, as seen in the various lab sessions, using a potentiometer that allows for the modification of the duty cycle of the Buck and Boost circuits. Naturally, in a system such as a car, the modulation of the potentiometer is done automatically via a program.

3.6.2 Solutions Developed During the Internship

The dynamic adjustment of the duty cycle in Boost and Buck circuits plays a key role in managing energy. This control optimizes the output voltage based on varying sunlight conditions while also meeting the vehicle's requirements.

- **In Low Energy Conditions:** In conditions of low sunlight, the voltage delivered by the solar panels is increased by the Boost circuit. However, this voltage increase is not sufficient to meet the vehicle's needs. Therefore, the car's battery is used to supplement the remaining energy. This battery, which has a voltage of 100V, must be adapted by reducing the voltage via the Buck circuit. As a result, the bus is properly powered and can transmit electrical energy to the car's motor.
- **In High Energy Conditions:** Under ideal conditions with strong sunlight, the solar panels produce at their maximum capacity, and the Boost circuit further increases their power. Thus, the bus and motor are properly powered, but there may be an excess of energy. It would be advantageous not to waste this excess energy and instead redirect it to the battery. This excess energy passes through a Boost circuit to increase its voltage, allowing the battery to be charged.

3.6.3 Implications and Future Applications

For future studies, it would be interesting to further explore how to concretely implement the system in an actual car. During my internship, I was tasked with studying all the components and circuits, and learning how to handle the TI TF28335 board, which I successfully did by providing high-quality technical documents. To continue this work and go further, the next steps would be to consider how to implement the entire system and to examine more closely the functioning of the bus.

3.7 Technical Challenges and Solutions

3.7.1 Problems Encountered

During my internship, I frequently encountered technical challenges that required an in-depth understanding and a methodical approach to resolve. The main technical problems I faced were:

- **Calibration of LV 25-P and LA 55-P Transducers**: The various application phases with these transducers in precise voltage and current measurements presented difficulties. These transducers are quite sensitive and require exact calibration to obtain reliable results.
- **Programming the TI F28335 Board**: Configuring and programming the TI TF28335 board to generate PWM signals was not easy. It required a detailed understanding of the board's architecture as well as the use and compatibility of the software.
- **Stability of DC-DC Converters**: The Boost and Buck converters required heightened vigilance during their assembly, as many stability issues, especially with variable loads, affected the reliability of the experiments conducted.
- **System Integration**: The integration of various electronic components into a system sometimes led to interference and compatibility issues, requiring thorough verification.

- **Intercultural Communication**: The internship took place in an international context, and certain instructions and technical documentation had to be clearly translated and adapted for a non-French-speaking audience, in this case into English, which posed additional challenges in terms of clarity and accuracy.

3.7.2 Problem Resolution

Faced with the technical challenges encountered during my internship, various strategies were adopted to find effective solutions and continuously improve project processes and outcomes. Here's how each problem was addressed and resolved:

- **Calibration of LV 25-P and LA 55-P Transducers**:
  - **Use of Precision Measurement Equipment**: I employed voltmeters and ammeters during measurements to perform double checks and correctly calibrate the transducers.
  - **Consultation of Technical Documentation**: Manufacturer data was thoroughly reviewed to fully understand the operation and calibration requirements of the transducers.
- **Programming the TI F28335 Board**:
  - **Specific Training on the TI Board**: Dedicated training sessions on TI microcontroller programming were followed to master the technical aspects of the board.
  - **Use of the Correct Version**: For various tasks on the board, we used MATLAB, but only versions prior to 2022 were compatible.
- **Stability of DC-DC Converters**:
  - **Meticulous Assembly**: Special attention was required when assembling the circuit to avoid any source of error.
  - **Repeated Testing**: Numerous tests were conducted several times, testing not the entire circuit but specific parts to ensure proper operation and to more easily identify potential errors.
- **System Integration**:
  - **Technical Review with Supervisor**: Collaboration with the supervisor to review designs and make adjustments based on his recommendations.
- **Intercultural Communication**:
  - **Translation and Validation**: The lab guides were translated into English. Translating certain technical terms could be challenging, but the supervisor's review ensured accuracy and clarity.

These technical challenges not only allowed me to push my technical skills but also enriched my overall experience, enhancing my problem-solving ability and improving my relational skills when discussing potential solutions from external sources.

4 Skills Acquired

4.1 Technical Skills

During my internship, I acquired and refined technical skills, which allowed me to gain a deeper understanding of complex electronic systems.

4.1.1 Programming in MATLAB and Simulink

I was able to strengthen this skill during my internship. It is a skill that I developed during my engineering studies, particularly at SeaTech. Here at TFII, I was able to further enhance this expertise by using tools such as MATLAB and Simulink to program on the Texas Instruments TF28335 board. I notably developed models and scripts to optimize or even automate certain tasks on the board.

4.1.2 Handling Transducers

A completely new concept for me, I gained practical experience with the LV 25-P and LA 55-P transducers. My understanding of these electronic tools came through learning how to configure and use them for precise measurements in various applications. I was then able to fully grasp their specificities and technical functioning.

4.1.3 Using Buck and Boost Converters

Buck and Boost circuits were unfamiliar to me before. I knew the various components that make up these circuits, but I had never used them. This new concept allowed me to effectively leverage my knowledge in electronics. Indeed, to gain a complete understanding of these circuits, I had to use fundamental electronics formulas and solve differential equations to grasp the underlying theory. Subsequently, I was able to apply all this theory in practice to fully understand the principles of energy conversion efficiently. This skill is essential in the field of power electronics.

4.1.4 Controlling Potentiometer via Microcontroller

It is essential to know how to make a system automatic but also to make it accessible to the user. Adjusting parameters in real-time through an application that serves as a user interface is a key skill. Here, the user interface involved controlling a PWM signal via the potentiometer through the TI board. During my internship, I developed this skill, which is a practical and essential ability for precise real-time parameter adjustment.

4.1.5 Technical Problem Diagnosis and Resolution

My ability to diagnose and resolve technical issues was strengthened during my internship. To achieve this, I used tools such as oscilloscopes and multimeters to measure and analyze potential sources of error.

4.1.6 Creation and Interpretation of Electronic Schematics

During my internship, I was able to improve my skills in both reading and creating electronic diagrams, essential competencies in my engineering curriculum at Seatech in the SYSMER program. Notably, all the illustrations were created by myself using software such as Lucidchart for electronic schematics, and even Python for generating graphs.

4.1.7 Handling High-Tech Equipment

I had the opportunity, during my internship, to handle high-tech instruments that I was not familiar with, such as a function generator and gate drivers like the TPL250, for testing and validating circuits. These new instruments allowed me to acquire new skills in the field of electronics.

4.2 Organizational Skills

Apart from technical and organizational skills, which are undoubtedly essential foundations for professional life, other more personal skills are just as useful. During my internship, I was able to strengthen my interpersonal skills on a daily basis.

4.2.1 Writing Technical Materials

One of the main tasks assigned to me was writing technical documentation for practical work. This task allowed me to develop my skills in writing technical documents, a valuable skill in the professional world where we constantly need to produce reports to demonstrate the quality of our work. This skill is a real asset for me, as I was able to develop no fewer than eleven technical documents, each consisting of at least ten pages.

4.2.2 Research and Documentation

To ensure the accuracy of the materials and courses, it was often necessary for me to consult datasheets from various manufacturers. The ability to analyze and search for information in a technical document is crucial for an engineer, as it also helps demonstrate the validity of the results obtained.

4.2.3 Adaptability to Feedback

During the preparation of the technical materials, it was common for me to receive feedback requesting modifications to certain sections. I learned to be receptive and adaptable to criticism and suggestions. It is important to take a step back from one's work and respond appropriately to the requested requirements. In this way, I could ensure that the practical exercises met the expectations of the Institute.

4.2.4 Course Planning and Execution

I was able to develop a brand-new skill: planning and executing educational sessions. I had to organize one-hour classes from start to finish. This included preparing the content, structuring the presentation and slides, managing time, and adapting the sessions based on the needs of the participants.

4.2.5 Managing Lab Exercises

During my internship, I was responsible for organizing practical lab sessions. This required careful planning to ensure that all the necessary equipment for the lab was available. In addition, I had to facilitate the sessions and answer the various questions that arose from the students.

4.3 Interpersonal Skills

Apart from technical and organizational skills, which are undoubtedly essential foundations for professional life, other more personal skills are just as useful. During my internship, I was able to strengthen my interpersonal skills on a daily basis.

4.3.1 Multicultural Communication

I had the opportunity to work at the Thai French Innovation Institute in a multicultural environment. This experience allowed me to strengthen my communication skills, both basic and intercultural. The daily interactions in English with my Thai colleagues and students refined my ability to communicate clearly and effectively in a second language while taking cultural nuances into account.

4.3.2 Collaboration and Teamwork

I developed strong working relationships with students, colleagues, and supervisors. Collaborating on various projects and activities taught me to value everyone's contributions, resolve conflicts constructively, and work effectively within a team.

4.3.3 Adaptability and Flexibility

Adapting to a new work environment, new routines, and different working methods was essential. I learned to be flexible in my methods and approaches, quickly adjusting my strategies in response to unexpected changes or challenges.

4.3.4 Active Listening and Empathy

Understanding and responding to the needs of students and colleagues was crucial. I cultivated active listening to better understand others' perspectives, which improved interactions and increased the team's productivity.

4.3.5 Respect and Courtesy

Throughout my internship, I made it a priority to maintain a high level of respect and courtesy, a crucial point in the professional world, and even more so in Thailand, where respect is essential. Despite the language barrier and different cultures, I developed friendly and respectful relationships with my colleagues, something they often highlighted. This approach not only facilitated collaboration but also greatly enriched my intercultural experience.

5 Assessment and Prospects

5.1 Personal Assessment

My internship at the *Thai French Innovation Institute* was a period of great success for me. On a personal level, it was an extremely enriching experience where I was able to acquire new skills and deepen my knowledge in electronics and programming.

One of the most rewarding experiences was writing practical work materials and teaching. Although it was entirely new for me, I could see my work being useful to others, and in turn, I was able to share my knowledge directly. This positive experience was made possible thanks to the kindness of my internship supervisor, as well as the 4-5 attentive and curious students during the internship. The moments spent with them were enjoyable and allowed me to build more personal relationships and have meaningful discussions about work, but also about everyday life.

This kindness encouraged me to do my job well, and I was able to acquire new technical skills, as I mentioned, but I also had the opportunity to improve my English proficiency. Working on tasks and having discussions in English was extremely beneficial for me.

I deeply appreciated my internship, which benefited me on many levels. I met incredible people and gained skills that strengthened my desire to continue in this field.

5.2 Professional Assessment

On a professional level, the internship was a complete success. Indeed, after discussing with my supervisor, all the objectives set at the beginning of the internship were successfully achieved.

- **Milestone Validation** : I successfully developed practical work materials with a dual purpose. The first was to demonstrate my progress in learning how to use the board for the project, and the second was to serve the Institute for future students or professionals following a similar path.
- **Contribution to the Institute's Project** : My work during the internship aligned with the many projects undertaken by the institute on electric vehicles and energy management. I was able to make significant progress on the energy management project for an electric vehicle using the Texas Instruments TF28335 board. The project was crowned with success, leading to full control over the energy management. The next step is to integrate the components into the vehicle, paving the way for future studies.

Figure 30: Certificate of completion presented by the director of the institute, Mr. Pornsak, in the presence of my supervisor Burin Yodwong and two other colleagues from the institute.

Moreover, at the end of the internship, to acknowledge my good work and successful research, I had the honor of receiving a certificate of completion from the hands of the institute's director, Mr. Pornsak. This recognition was a significant testament to my contributions and dedication (see figure 30).

5.3 Future Prospects

This internship allowed me to discover many new aspects that have significantly changed my career perspectives and professional aspirations.

- **Increased Interest in Electronics and Programming** : During the internship, I realized how rewarding it is to code in electronics because it has a direct real-world application. This has profoundly strengthened my interest in this field.
- **International Aspirations** : My time abroad opened my eyes to the benefits of an international experience, both linguistically, technically, and personally. In fact, I had rarely traveled in my life, and during this internship, it was my first time flying. I had not anticipated all the advantages this international experience would bring me. It encourages me to consider my future professional life abroad and, why not, to do my final-year internship in another country.

- **Reflection on a Teaching Career** : This experience was entirely new for me, and I greatly appreciated the opportunity offered by the institute. I believe it brought me a lot, and although the experience went wonderfully, I do not wish to pursue a teaching career in the future.

6 Conclusion

The present internship report explored the various aspects of my experience at the Thai French Innovation Institute. We reviewed the work environment, the projects carried out during this internship, the skills acquired, as well as the challenges faced and future perspectives.

Contributions and Learning:
During my internship, I developed a series of practical work guides intended for a student audience, which also allowed me to strengthen my technical skills in electronics and programming. I was also able to develop pedagogical skills, new to me. The technical challenges I faced enriched my learning, pushing me to ask the right questions and find appropriate solutions. I developed systematic approaches to diagnose and solve complex problems.

Institute Environment:
A detailed presentation of the institute was reviewed in this report, highlighting its key role in education in Thailand, as well as its ambitious objectives in terms of innovation and international collaboration. The infrastructures available at the institute were described, illustrating its commitment to promoting education and research in engineering.

Practical Experiences:
The projects carried out during this internship were highlighted in the report, showcasing my work on different components, such as transducers and converters, and emphasizing my involvement in the project. The main project focused on managing the electric power supplied by solar panels in an electric vehicle using the Texas Instruments TF28335 control board. These projects demonstrate my progress in the project while also serving as practical work guides for the institute's students.

Personal and Professional Development:
The personal and professional development aspect was addressed in the report, highlighting a positive experience marked by the acquisition of numerous skills. I appreciated the interactions with a small group of students, as well as the teaching sessions I conducted. These experiences were not only positive but also helped me improve my communication skills in a multicultural environment.

Future Perspectives:
The skills acquired during this internship encourage me to continue pursuing my path in the field of electronics, where I feel at home and have begun to develop valuable expertise for my future career as an engineer. The international context of the internship has also opened up new opportunities for international work, offering many professional and personal benefits.

In conclusion, this internship was a real opportunity for me to confirm my interest in the field of electronics, as well as a defining step in my academic and professional journey. It enriched my experience, broadened my horizons by confirming my desires, and created new ones. I am convinced that the skills acquired during this internship will serve me well in my future career as an engineer.

7 Annexes

7.1 Liste des supports de Travaux Pratiques

7.1.1 Lab 1

Cliquez ici pour télécharger le PDF du Lab 1

7.1.2 Lab 2

Cliquez ici pour télécharger le PDF du Lab 2

7.1.3 Lab 3

Cliquez ici pour télécharger le PDF du Lab 3

7.1.4 Lab 4

Cliquez ici pour télécharger le PDF du Lab 4

7.1.5 Lab 5

Cliquez ici pour télécharger le PDF du Lab 5

7.1.6 Lab 6

Cliquez ici pour télécharger le PDF du Lab 6

7.1.7 Lab 7

Cliquez ici pour télécharger le PDF du Lab 7

7.1.8 Lab 8

Cliquez ici pour télécharger le PDF du Lab 8

7.1.9 Lab 9

Cliquez ici pour télécharger le PDF du Lab 9

7.1.10 Lab 10

Cliquez ici pour télécharger le PDF du Lab 10

7.1.11 Lab 11

Cliquez ici pour télécharger le PDF du Lab 11

7.2 Fiche tuteur entreprise et Fiche d'évaluation étudiant

SEATECH TOULON

Fiche d'évaluation du tuteur entreprise 2023-24

Cette fiche est à remplir par le tuteur entreprise et doit être retournée avant le 19 aout à sre@seatech.fr

Organisme d'accueil : Thai-French Innovation Institute, KMUTNB
Etudiant : Mr. Enzo Cherif
Sujet du stage : Programming for Modern Microcontrollers

Evaluation : développement des compétences

La grille d'évaluation est en cohérence avec le référentiel de compétences de la formation. Les 6 compétences se développent au cours des trois années de la formation. Merci d'évaluer le stagiaire selon les différents critères.

Références pour la cotation

(A) Excellent	Au-delà des attentes (au-delà des étudiants du même niveau)
(B) Adéquat	Répond aux attentes (dans la norme des étudiants du même niveau)
(C) Insuffisant	Ne répond pas aux attentes (en deçà des étudiants du même niveau)
(N) Non applicable	Critère non évaluable dans le contexte du stage

Compétence	Critère	Eval	Commentaire
Concevoir des solutions d'ingénierie	Analyser le besoin	A	The intern identified and analyzed the specifications of microcontroller board (TI F28335).
	Répondre au besoin	A	The intern successfully responded to the project's requirement.
	Utiliser les outils appropriés	A	The intern used Matlab program, which is appropriate for development program.
	Documenter ses choix et ses sources	A	The document on this intern is suitable and support their programming
Mettre en œuvre des solutions	Analyser et améliorer une solution existante	A	The intern identified areas for analyze to optimization of the systems.
	Proposer une solution nouvelle	A	The intern proposed new programming solution that addressed specific challenges.
	Utiliser les principes de l'amélioration continue	A	—
	Rédiger un document scientifique et technique d'appui	A	—
Développer une démarche R&D	Réaliser une veille technologique / un état de l'art	A	The intern conducted thorough up-to-date with the latest advancements in microcontroller programming
	Formuler des hypothèses	A	The intern formulated hypotheses related to optimizing microcontroller performance.
	Proposer une démarche expérimentale, un protocole ou un modèle	A	The intern proposed a well-structured experimental approach and protocol
	Adopter une démarche d'innovation	A	The intern adopted an innovative approach by exploring unconventional programming methods.

NB : Dans le but d'alléger la lecture du document, le genre masculin est utilisé sans discrimination pour le genre masculin et féminin.

SEATECH TOULON

Fiche d'évaluation du tuteur entreprise 2023-24

Piloter des projets d'ingénierie	S'insérer dans ou conduire une ou plusieurs étapes d'un projet	A	The intern demonstrated leadership in managing critical tasks of the microcontroller programming.
	Prendre en compte la gestion globale des organisations ou les règles de fonctionnement, économiques ou juridiques	A	—
	Utiliser les outils de gestion de projet et outils collaboratifs	A	—
	Identifier ou mobiliser les ressources appropriées	A	—
Encadrer une équipe	S'insérer et collaborer	A	Mr. Enzo cherif worked together with Thai student very well.
	Travailler en équipe pluridisciplinaire et/ou internationale	A	—
	Assurer une responsabilité d'animation	A	—
	Communiquer (écrit et oral) de manière adaptée	A	Mr. Enzo cherif communicated in English very well with Thai team, as well as excellent report.
Agir en professionnel responsable	Prendre en compte les enjeux éthiques et sociétaux (RSE, DD, RGPD, ...)	A	—
	Assumer la responsabilité de ses actes et décision	A	—
	Porter un regard critique sur le sens de l'activité conduite	A	—
	Être dans une dynamique d'apprentissage	A	—

Appréciation globale du stagiaire et recommandations en vue d'occuper un poste d'ingénieur ***(il est recommandé de discuter de cette évaluation avec le stagiaire)***

Si vous avez détecté des qualités personnelles chez le stagiaire telles que sa capacité à surmonter des difficultés, à accepter les critiques, à exprimer des points de vue de manière argumentée, ou tout autre aspect vous pouvez le noter ici dans son intérêt.

This intern is focusing on programming for mordern microcontrollers specifically the Texas Instrument TI 28335 board, which will be useful in the power electronic field in the near future. Mr. Enzo cherif shown exceptional dedication and skill throughout the internship, particularly in the areas of problem-solving and adaptability. I strongly believe that this internship will provide great value to Mr. Enzo cherif in term of initiative, technical proficiency and a strong commitment to continous learning.

Date, cachet de l'entreprise, nom et signature du tuteur de l'organisme d'accueil

16/8/2024 Buringodn

KMUTNB

NB : Dans le but d'alléger la lecture du document, le genre masculin est utilisé sans discrimination pour le genre masculin et féminin.

Fiche d'évaluation étudiant

Ce document est à insérer dans le rapport. Le rapport est à fournir pour le 19 aout dernier délai.

Organisme d'accueil :TFII
Sujet du stage : Programmation pour microcontrôleurs modernes

Evaluation qualitative du stage	I	S	B	E	N	Commentaires
Qualité de l'entreprise						L'Institut a offert un cadre propice au développement de compétences en ingénierie, bien qu'elle ne connaissait pas spécifiquement mon école auparavant. J'ai dû fournir des détails sur mon école, mais ils savaient qu'elle faisait partie des INP. Tous les moyens nécessaires, y compris des ressources techniques et documentaires, étaient à ma disposition, permettant une réalisation efficace de mes missions de stage.
L'entreprise offre-t-elle un contexte propice à une carrière d'ingénieur ?				E		
L'entreprise connaissait elle l'école (accueil de stagiaire, embauche, relations autres…) ?			B			
L'entreprise a-t-elle mis à votre dispositions les moyens nécessaires pour réaliser votre mission (documents, éléments d'information, matériels) ?				E		
Qualité de la missions						Mes missions étaient directement en rapport avec ma formation en ingénierie, alignées sur les objectifs initialement définis. J'ai pu appliquer et approfondir mes connaissances techniques tout au long du stage, réalisant les tâches prévues dans la description de mon poste.
Vos missions étaient-elles en rapport avec votre formation ?				E		
Les missions effectuées étaient-elles bien celles définies au départ ?				E		
Qualité de l'encadrement						Mon tuteur au sein de l'organisme d'accueil a pris le temps de me présenter en détail le fonctionnement de la structure et l'équipe, facilitant mon intégration et ma compréhension des processus internes. Il a également été très disponible pour m'aider et me conseiller tout au long du stage, répondant efficacement à mes besoins et questions. De même, mon enseignant référent a suivi mon stage.
Votre tuteur organisme d'accueil a-t-il pris le temps de vous présenter le fonctionnement de la structure et l'équipe ?				E		
Votre tuteur organisme d'accueil vous a-t-il aidé et conseillé quand cela était nécessaire ?				E		
Votre enseignant référent vous a-t-il aidé et conseillé lorsque cela était nécessaire ?				E		

Explication des cotations	
I	(I) Insuffisant
S	(S) Suffisant
B	(B) Bien
E	(E) Excellent
N	(N) Non applicable

NB : Dans le but d'alléger la lecture du document, le genre masculin est utilisé sans discrimination pour le genre masculin et féminin.

Fiche d'évaluation étudiant

Autoévaluation : développement des compétences et trajectoire professionnelle En prenant un peu de recul sur votre activité durant le stage pensez-vous avoir travaillé / développé certaines des compétences du référentiel de la formation Seatech ? Lesquelles ? Pourquoi et comment ? D'autres compétences ?		
Compétence	**Critère**	**Commentaire**
Concevoir des solutions d'ingénierie	Analyser le besoin	Durant le stage, j'ai analysé les besoins techniques spécifiques pour la gestion de l'énergie avec la carte TI TF28335
	Répondre au besoin	J'ai participé à l'élaboration de solutions de gestion de l'énergie en utilisant des convertisseurs Buck et Boost, répondant directement aux besoins identifiés.
	Utiliser les outils appropriés	J'ai utilisé MATLAB et Simulink pour programmer le microcontrôleur, des outils essentiels pour le développement et la simulation de nos solutions techniques, ainsi que pour l'utilisation d'appareils de mesure tels que des oscilloscopes et des multimètres.
	Documenter ses choix et ses sources	J'ai rédigé des documents techniques et des supports de formation qui expliquent en détail les choix technologiques réalisés, les configurations des circuits, et les résultats des tests effectués.
Mettre en œuvre des solutions	Analyser et améliorer une solution existante	J'ai amélioré les configurations de circuit pour les convertisseurs Buck et Boost, augmentant ainsi leur efficacité et leur fiabilité.
	Proposer une solution nouvelle	J'ai développé de nouvelles méthodes de mesure et de contrôle utilisant des techniques PWM avancées pour une gestion plus précise de la puissance.
	Utiliser les principes de l'amélioration continue	Les feedbacks des tests et des utilisations en situation réelle ont permis d'affiner continuellement les solutions proposées.
	Rédiger un document scientifique et technique d'appui	Les supports de TP que j'ai créés servent de documentation scientifique et technique, facilitant la compréhension et la réplication des solutions par d'autres ingénieurs et étudiants.
Développer une démarche R&D	Réaliser une veille technologique / un état de l'art	
	Formuler des hypothèses	
	Proposer une démarche expérimentale, un protocole ou un modèle	J'ai élaboré des protocoles expérimentaux pour les tests des solutions développées, permettant une évaluation systématique de leur efficacité.
	Adopter une démarche d'innovation	L'approche adoptée pour intégrer des solutions de gestion de l'énergie innovantes dans les véhicules électriques solaires est un exemple de démarche d'innovation.

Fiche d'évaluation étudiant

Piloter des projets d'ingénierie	S'insérer dans ou conduire une ou plusieurs étapes d'un projet	J'ai activement participé à la conduite du projet.
	Prendre en compte la gestion globale des organisations ou les règles de fonctionnement, économiques ou juridiques	
	Utiliser les outils de gestion de projet et outils collaboratifs	j'ai utilisé des outils collaboratifs modernes pour faciliter la communication et la gestion des projets comme Gmail et WhatsApp
	Identifier ou mobiliser les ressources appropriées	L'identification des ressources matérielles nécessaires pour atteindre les objectifs du projet a été une part essentielle de mes responsabilités, assurant que les projets disposaient des ressources adéquates pour leur réussite.
Encadrer une équipe	S'insérer et collaborer	J'ai travaillé en étroite collaboration avec des chercheurs et des étudiants, partageant des connaissances et des compétences dans un environnement respectueux et productif.
	Assurer une responsabilité d'animation	En dirigeant des sessions de formation technique, j'ai assumé un rôle d'animateur, guidant les étudiants à travers des expériences pratiques et théoriques.
	Travailler en équipe pluridisciplinaire et/ou internationale	Le stage a été réalisé dans un contexte international, nécessitant une adaptation et une collaboration efficace avec des personnes de diverses disciplines et cultures.
	Communiquer (écrit et oral) de manière adaptée	J'ai développé et affiné mes compétences en communication, en présentant des rapports et en menant des discussions techniques en anglais, assurant que toutes les parties prenantes étaient bien informées des progrès et des résultats.
Agir en professionnel responsable	Prendre en compte les enjeux éthiques et sociétaux (RSE, DD, RGPD, …)	J'ai été conscient des implications éthiques des technologies développées, en particulier leur impact environnemental et sociétal, aligné sur les objectifs de développement durable.
	Assumer la responsabilité de ses actes et décision	J'ai pris des décisions techniques et méthodologiques en toute connaissance de cause, prêt à en assumer les conséquences et à justifier mes choix.
	Porter un regard critique sur le sens de l'activité conduite	J'ai régulièrement réfléchi à l'impact de mon travail, tant sur le plan personnel que professionnel, évaluant comment mes contributions s'alignaient avec les objectifs plus larges de l'institut et de ma carrière.
	Être dans une dynamique d'apprentissage	Tout au long du stage, j'ai maintenu une attitude d'apprentissage continu, cherchant à acquérir de nouvelles connaissances et à améliorer mes compétences, prêt à recevoir et à intégrer les feedbacks pour mon développement personnel et professionnel.

Trajectoire professionnelle

A la suite de votre stage, avez-vous confirmé ou affiné votre projet professionnel d'être ingénieur (métier plus précis, secteur, contexte ou type d'entreprise, …) ? Si oui, quelles actions pensez-vous devoir entreprendre pour y arriver (renforcer certaines connaissances, développer certaines compétences, lesquelles)?

16/08/2024

Date et signature de l'étudiant :

References

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[2] King Mongkut's University of Technology North Bangkok, *Institutional Information and Academic Programs*, documentation institutionnelle sur les objectifs et la mission de KMUTNB, disponible en ligne: https://www.kmutnb.ac.th/?lang=en-gb

[3] King Mongkut's University of Technology North Bangkok, "Top 10 Universities in Thailand," 2024. Disponible en ligne: https://kmutnb.ac.th/news/university-news/%E0%B8%A1%E0%B8%88%E0%B8%9E-%E0%B8%95%E0%B8%94-Top-10-%E0%B8%AD%E0%B8%99%E0%B8%94%E0%B8%9A%E0%B8%A1%E0%B8%AB%E0%B8%B2%E0%B8%A7%E0%B8%97%E0%B8%A2%E0%B8%B2%E0%B8%A5%E0%B8%A2%E0%B9%84%E0%B8%97%E0%B8%A2-%E0%B8%88%E0%B8%94%E0%B8%AD%E0%B8%99%E0%B8%94%E0%B8%9A%E0%B9%82%E0%B8%94%E0%B8%A2-T.aspx

[4] Thai-French Innovation Institute, "TFII-Schneider Electric Centre of Excellence," documentation en ligne sur le Centre d'Excellence, disponible en ligne: https://tfii.kmutnb.ac.th/training/en/?page_id=3821

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[7] MATLAB and Simulink, *MATLAB and Simulink for Technical Computing*, MathWorks. Disponible en ligne: https://www.mathworks.com