Semester - Long Internship Report

On

Enhancement of Scilab Toolbox and Xcos Functionality through Various Case Study Projects

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July 5, 2024

Acknowledgment

I would like to express my heartfelt gratitude to the FOSSEE team at IIT Bombay for providing me with the opportunity to undertake my Semester-Long Internship. Their unwavering support and guidance were instrumental in shaping my projects on Scilab toolbox development and Xcos Parameterization through various Case Studies. I am especially grateful to Mrs. Rashmi Patankar and Mr. Sunil Shetye for their invaluable mentorship and encouragement throughout the internship. Their expertise and willingness to share knowledge greatly enhanced my learning experience and contributed significantly to the success of my projects.

Furthermore, I extend my sincere thanks to every member of the FOSSEE Team who assisted and supported me during my tenure. Their collective efforts in providing resources, feedback, and a conducive working environment were pivotal in overcoming challenges and achieving milestones during the internship. The collaborative spirit and dedication of the team fostered an enriching learning environment, enabling me to broaden my technical skills and deepen my understanding of computational tools.

I am also deeply appreciative of the support extended to me by my college, St. Xavier's Catholic College of Engineering, Nagercoil. Their encouragement and academic guidance played a crucial role in complementing the practical experiences gained at IIT Bombay. The academic foundation and resources provided by SXCCE facilitated seamless integration of theoretical knowledge with hands-on application, thereby enriching my overall educational journey.

In conclusion, I am grateful to all individuals and institutions who contributed to my growth and learning during this internship period. Their support has been invaluable in shaping my professional development and preparing me for future endeavors in the field of computational sciences.

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Chapter 1

Introduction: Objectives of FOSSEE Project

- FOSSEE promotes open-source software in STEM education.
- Focuses on SciPy, Python, OpenFOAM, Scilab, and eSim for Indian education.
- Led by IIT Bombay faculty with developers maintaining software tools.
- Organizes workshops, training, and educational materials for open-source tools.
- Enhances education through collaboration, innovation, and community engagement.

1.1 Overview: Scilab Toolbox Functionality

1. **Enhanced Capabilities:** Extends Scilab's numerical computation features.
2. **Specialized Applications:** Toolboxes for control systems, signal processing etc.
3. **Customization:** Tailors Scilab to specific user needs.
4. **Community Driven:** Developed and maintained by a global community.
5. **Continuous Evolution:** Regular updates keep Scilab cutting-edge.

1.2 Xcos: Graphical Modeling in Scilab

1. **Graphical Editor:** Xcos is a graphical editor for hybrid dynamic systems.
2. **Integration:** Integrated with Scilab for numerical computation.
3. **Interactive Modeling:** Enables interactive block diagram modeling & simulation.
4. **Broad Application:** Used in control systems, signal processing, and engineering.
5. **Real-time Visualization:** Visualizes real-time system behavior during simulation.

Chapter 2

Advanced Case Study Projects

- Versatile tools for various engineering fields.
- Enable precise modeling and simulation.
- User-friendly interfaces and extensive libraries.
- Foster innovation and accelerate development.
- Support education in computational modeling.

2.1 Comprehensive Case Studies Using Scilab

During my internship, I had the opportunity to delve into two significant case studies using Scilab, a powerful open-source numerical computation software. These studies focused on exploring and optimizing critical aspects of environmental and energy sectors through advanced data analysis and modeling techniques.

1. **Rainfall Distribution Analysis and Prediction Using Scilab:**

- Analyzed historical rainfall data for future predictions.
- Used Scilab for statistical analysis and modeling.

2. **Integrated Analysis of Wind Power Opportunity Costs and Turbine Performance:**

- Integrated economic analysis with wind turbine performance in Scilab.
- Evaluated financial impacts of turbine efficiencies and strategies.

During my involvement, I gained experience in two impactful Scilab case studies. I predicted future rainfall from historical data and optimized renewable energy strategies through economic analyses. These projects demonstrated my skills in numerical computation, statistical modeling, and addressing challenges in environmental sustainability and renewable energy sectors.

2.1.1 Rainfall Distribution Analysis and Prediction Using Scilab

In my study "Rainfall Analysis and Prediction using Scilab," I used Scilab's capabilities to improve rainfall predictions crucial for agriculture and disaster preparedness. Analyzing a five-month dataset with advanced algorithms, I categorized rainfall aspects like intensity and temperature. Scilab enabled precise predictions and visualized data through graphs, aiding in weather interpretation and predicting sunrise and sunset times. This research underscores Scilab's role in environmental studies, emphasizing collaboration between computational and environmental experts for reproducible climate modeling and accurate predictions.

Usefulness:

1. Enhances accuracy of rainfall predictions for agriculture and disaster preparedness.
2. Analyzes rainfall intensity, duration, and atmospheric conditions.
3. Visualizes data for atmospheric interpretation and sunrise/sunset forecasting.
4. Shows collaboration between computational experts and environmental scientists.
5. Provides tools for easy data interpretation and climate modeling.

Impact After Usage:

1. Improves agricultural planning and disaster preparedness.
2. Advances climate modeling and environmental studies.
3. Educational resource in environmental science & computational modeling.
4. Demonstrates practical application of Scilab in environmental research.
5. Paves the way for innovations in climate prediction and sustainability.

Benefits:

1. Precision in rainfall and weather predictions.
2. Supports data-driven decision-making in agriculture and disaster management.
3. Cost-effective solutions through computational analysis.
4. Promotes sustainable practices and environmental understanding.
5. Improves resilience and supports sustainable development.

Results and Findings along with Graphical Insights:

In my project, I developed a user-friendly interface to collect location-specific data for rainfall prediction. Over five months, I gathered crucial information such as rainfall intensity, humidity levels, temperature variations, rainfall duration, and sunrise/sunset times. Each month's data was meticulously recorded and processed using Scilab's computational capabilities to predict various outcomes based on these inputs.

```
Predicted Climate Zone: Tropical
There will be rainfall.
Predicted Rainfall: 22.489651 mm/hr
Predicted Duration: 5.056825 hours
Predicted Humidity: 73.919077%
Predicted Temperature: 33.546107°C
Rainfall category: MODERATE RAIN
ALERT: Moderate rain predicted. Please stay indoors if possible.
Predicted weather condition: Windy
Predicted Average Air Density: 1.151062 kg/m^3
Average Sunrise time predicted for month 1: 6:13 AM (approx)
Average Sunset time predicted for month 1: 6:31 PM (approx)
Average Sunrise time predicted for month 2: 6:02 AM (approx)
Average Sunset time predicted for month 2: 6:23 PM (approx)
Average Sunrise time predicted for month 3: 6:13 AM (approx)
Average Sunset time predicted for month 3: 6:06 PM (approx)
Average Sunrise time predicted for month 4: 6:05 AM (approx)
Average Sunset time predicted for month 4: 6:34 PM (approx)
Average Sunrise time predicted for month 5: 6:41 AM (approx)
Average Sunset time predicted for month 5: 6:20 PM (approx)
Predicted weather condition for past month 1: Cloudy
Predicted weather condition for past month 2: Moist
Predicted weather condition for past month 3: Moist
Predicted weather condition for past month 4: Moist
Predicted weather condition for past month 5: Moist
Predicted Dew Point: 27.802422°C
Predicted Heat Index: 28.841669
Predicted Average Hail Probability: 0.022767
Predicted UV Index: 2.198172 (Low (Minimal risk))
Predicted Average Soil Moisture: 0.079005 m^3/m^3
Predicted Air Quality Index: 191.034465 (Moderate [Air Quality is Acceptable;
Predicted Average Wind Chill: 32.423803°C
Predicted Average Barometric Pressure: 1017.986733 hPa
```

Fig.1.1. Predicting Output Values based on the Model's Learning

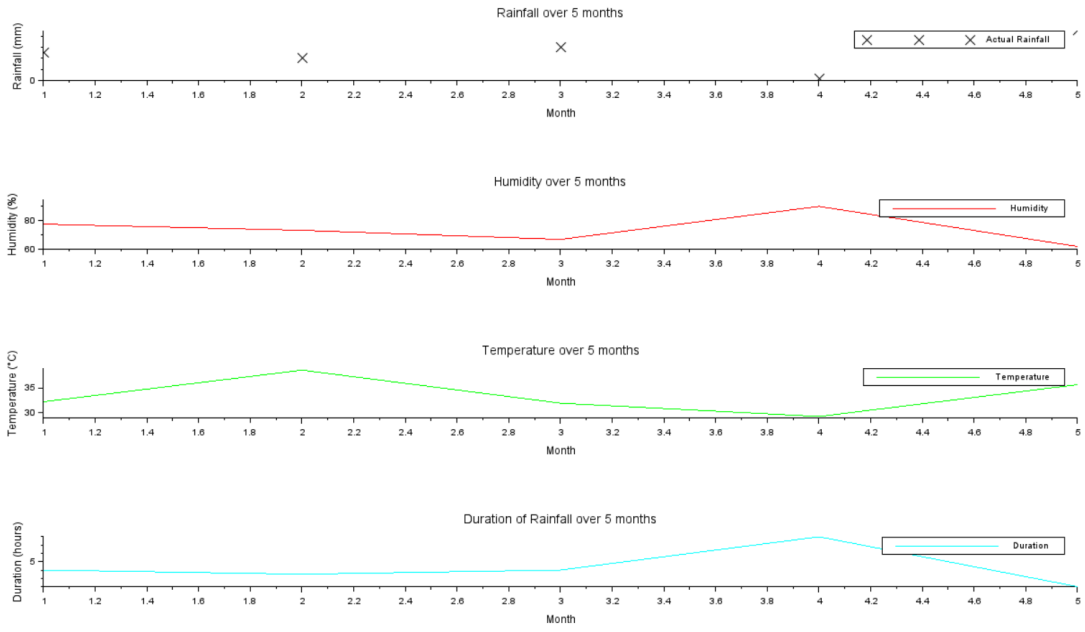

Fig.1.2. Graphical Representation for the Output Parameters

2.1.2 Integrated Analysis of Wind Power Opportunity Costs and Turbine Performance

In my project, "Integrated Analysis of Wind Power Opportunity Costs and Turbine Performance," I optimized wind power systems for cost efficiency and environmental sustainability. Using advanced modeling and algorithms, I adjusted power output dynamically, balancing supply and demand while considering factors like spinning reserve and environmental impact. The study evaluated system efficiency, load factors, and capacity to achieve optimal operation. Insights from the Wind Turbine Performance Calculator guided power generation estimates and environmental benefits, documented for future wind energy research and strategic turbine deployment.

Usefulness:

1. Optimizes wind power generation and minimizes costs.
2. Ensures environmental sustainability in energy systems.
3. Utilizes advanced modeling for performance enhancement.
4. Provides insights into turbine efficiency and environmental impact.
5. Supports strategic decision-making in renewable energy deployment.

Impact After Usage:

1. Improves energy efficiency and cost-effectiveness.
2. Reduces environmental footprint through optimized operations.
3. Enhances grid stability and reliability.
4. Advances research in wind energy technology.
5. Facilitates sustainable development goals through renewable energy.

Benefits:

1. Enhances turbine performance and operational efficiency.
2. Minimizes carbon emissions and environmental impact.
3. Optimizes power generation in diverse environmental conditions.
4. Provides comprehensive data for informed decision-making.
5. Promotes sustainable energy practices and innovation in wind power.

Results and Findings along with Graphical Insights:

I analyzed wind-generated electricity, optimizing real-time adjustments for cost-efficiency and environmental impact. Using Scilab, I evaluated system efficiency, performed economic dispatches, and fine-tuned power generation with Optimal Power Flow. The Wind Turbine Performance Calculator provided crucial data on power generation and emissions. These studies showcased my proficiency in numerical computation, statistical modeling, and system optimization for sustainable energy solutions.

	A	B	C
1	Pschedule	750	
2	KL	0.25	
3	KH	0.1	
4	PWF	709.59575	
5	EPWF_shortage	588.38301	
6	EPWF_surplus	1281.032	
7	Pr_shortage	0.6607587	
8	Pr_surplus	0.3392413	
9	CL	26.697457	
10	CH	18.014802	
11	Ctotal	44.712259	
12	Efficiency	94.612767	
13	Power Factor	0.9	
14	Load Factor	0.9461277	
15	Capacity Factor	0.039422	
16	Energy Yield	17030.298	
17	Emission Factor	0.11	
18	Energy Loss	40.404248	

Fig.2.1. Comprehensive Analysis of Wind Power Generation Efficiency and Costs

	A	B	C	D
1	Input Values			
2	Number of Units	3		
3	Cost Coefficient a	Cost Coefficient b	Cost Coefficient c	
4	0.05	23.5	700	
5	0.2	20	850	
6	0.09	18	960	
7	Minimum Power	Maximum Power		
8	40	150		
9	40	150		
10	40	150		
11	Total Demand	275		
12				
13	Optimum Schedule			
14	130.538462			
15	41.384615			
16	103.076923			

Fig.2.2. Economic Dispatch Including and Excluding Losses

	A	B	C
1	Number of Units	3	
2	Transmission Loss	0.003675	
3	Incremental Loss	0.0043	
4	Incremental Loss	0.00135	
5	Incremental Loss	0.0056	

Fig.2.3. Incremental and Transmission Losses

	A	B	C	D	E	F
1	Bus Type	Real Power Demand (Pd)	Reactive Power Demand (Qd)	Voltage Magnitude (V)		
2	1	123	456	1.05		
3	From Bus	To Bus	Resistance (R)	Reactance (X)	Line Capacity	
4	1	2	123	45	1.225	
5	Optimal Power Generation					
6	1.05					
7	Minimum Cost					
8	1.313825					

Fig.2.4. Optimal Power Generation and Network Parameters Analysis

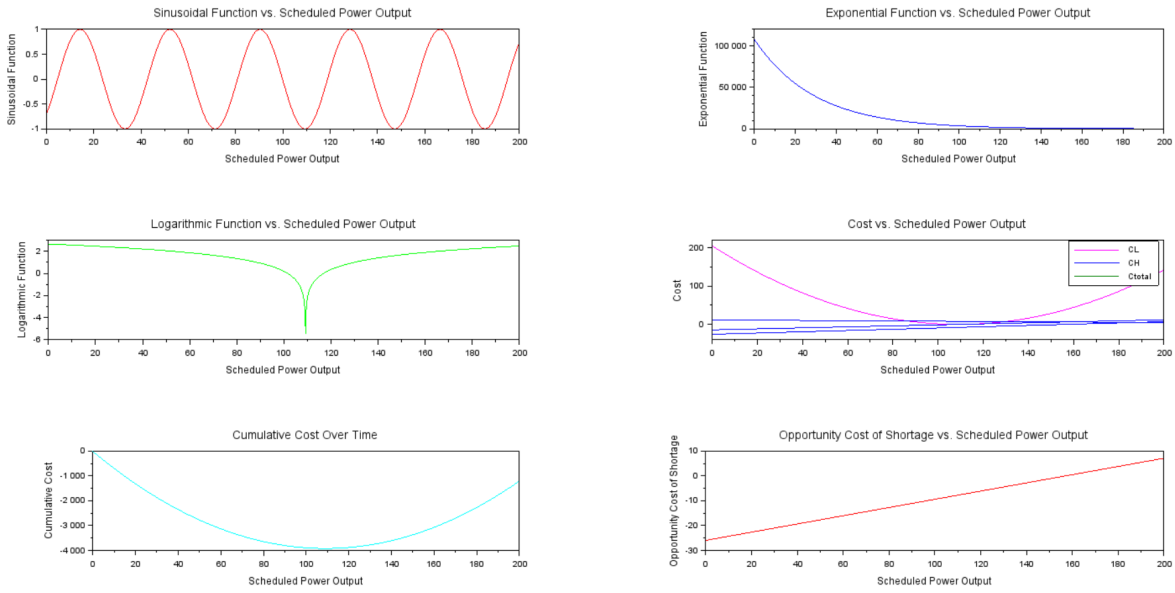

Fig.2.5. Graphical Representation of Variations in Output Parameters

2.2 Xcos Case Study: Dynamic Systems Modeling and Simulation

Using Xcos, my study focuses on optimizing a Two-Area Load Frequency Control System with Tie-Line Bias Control. This simulation-based project explores strategies to enhance grid stability by modeling interactions between interconnected areas and analyzing the impact of tie-line bias on system dynamics and response to disturbances.

2.2.1 Two-Area Load Frequency Control System with Tie-Line Biased Control:

I conducted a study on the Two-Area Load Frequency Control System with Tie-Line Bias Control using Xcos. This project aimed to optimize grid stability by simulating interactions between interconnected areas and analyzing the effects of tie-line bias on system dynamics and disturbance response. The study sought to enhance understanding of control strategies and their impact on maintaining frequency stability in power systems.

Usefulness:

1. Optimizes grid stability by simulating interconnected power system dynamics.
2. Analyzes tie-line bias effects on frequency stability and power flow optimization.
3. Enhances understanding of control strategies in power system frequency regulation.
4. Facilitates real-time decision-making in grid management for stability optimization.
5. Supports advanced research in modern power grid stability and management.

Impact After Usage:

1. Improves predictive capabilities for frequency stability in interconnected grids.
2. Enables proactive adjustment of tie-line bias to mitigate frequency deviations.
3. Enhances operational efficiency and reliability during grid disturbances.
4. Advances knowledge in optimal control strategies for power system stability.
5. Empowers engineers with tools to optimize energy transfer and grid resilience.

Benefits:

1. Increases reliability and resilience of power networks under varying conditions.
2. Optimizes energy transfer efficiency between interconnected power areas.
3. Reduces operational costs associated with frequency regulation and grid stability.
4. Supports sustainable energy practices through enhanced grid management.
5. Promotes innovation in power system dynamics and control strategies.

Results and Findings along with Graphical Insights:

I used Xcos to model the Two-Area Load Frequency Control System with Tie-Line Bias Control, simulating interactions between power areas, generators, loads, and tie-lines with bias control. Xcos enabled detailed simulations and frequency domain analysis, visualizing system responses and optimizing power flow between areas, as shown in the figures.

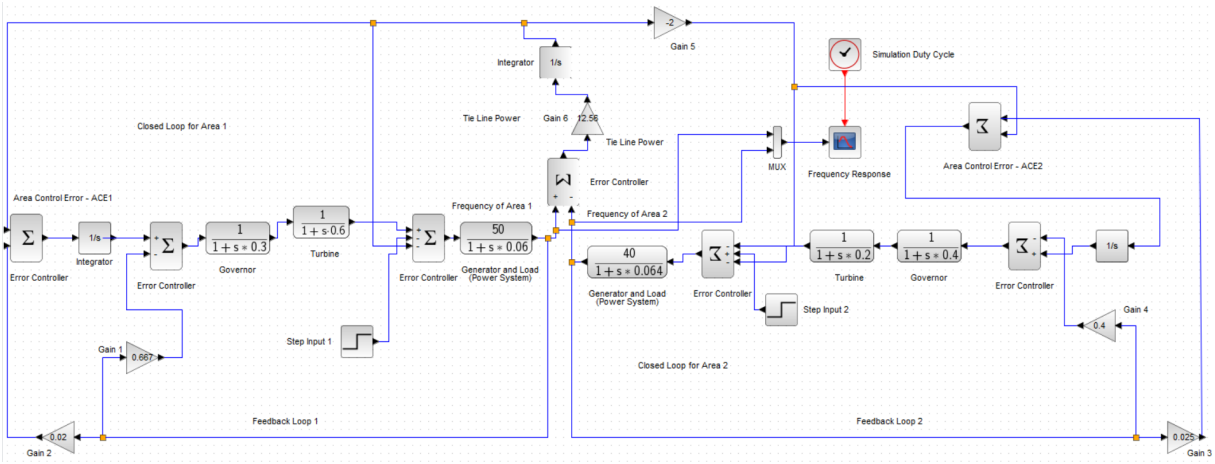

Fig.3.1. Schematic Diagram for Two-Area LFC with Tie-Line Bias Control

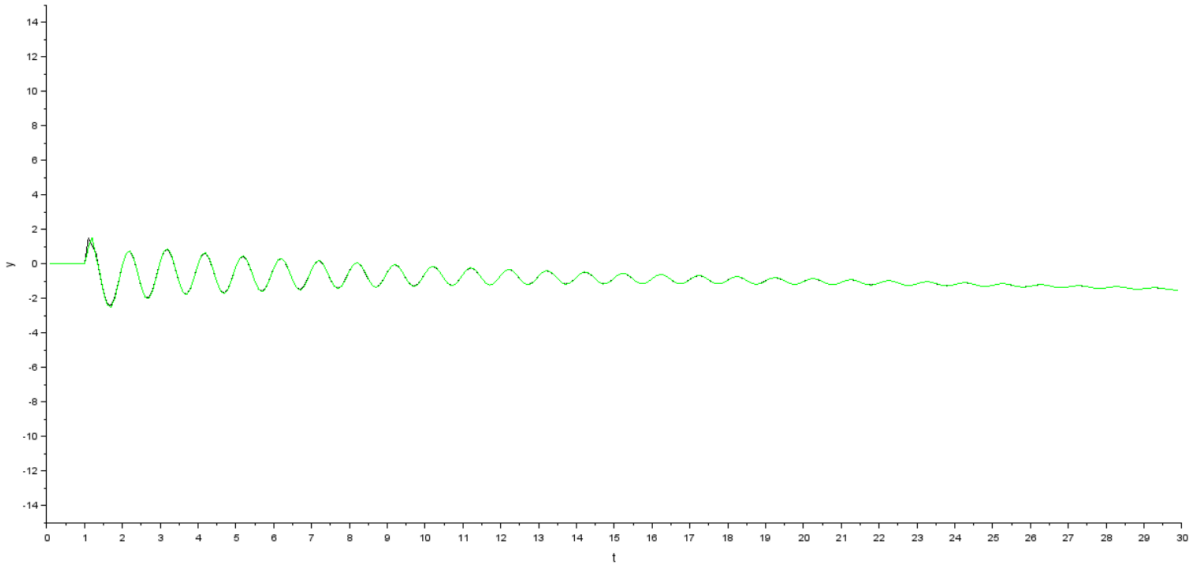

Fig.3.2. Frequency Response for Two-Area LFC with Tie-Line Bias Control

In conclusion, using Xcos to model the Two-Area Load Frequency Control System with Tie-Line Bias Control has deepened my understanding of power system dynamics and control strategies. It has enabled precise simulations and insightful frequency domain analysis, highlighting Xcos' role in advancing grid stability and efficiency in power engineering applications.

Chapter 3

Scilab Toolbox Development for Control Systems

During this internship, I undertook the task of developing Scilab functions that mirror the functionality of existing control system functions in Octave. This involved translating Octave code into Scilab to ensure compatibility and functionality across platforms, enabling seamless integration and usability in Scilab environments. Each function was meticulously crafted to maintain consistency with its Octave counterpart while leveraging Scilab's capabilities for enhanced performance and reliability in control system simulations and analyses.

3.1 List of Developed Functions

1. **BMWengine:** Function for modeling BMW engine dynamics.
2. **WestlandLynx:** Simulation function for the Westland Lynx helicopter.
3. **ctrb:** Computes the controllability matrix for a given system.
4. **dsort:** Sorts elements of a matrix in descending order.
5. **esort:** Sorts eigenvalues of a matrix in ascending order.
6. **gensig:** Generates test input signals for system simulation.
7. **isct:** Checks if a system is controllable.
8. **isctrb:** Checks controllability of a system using its controllability matrix.
9. **isdti:** Checks if a system is discrete-time.
10. **isobsv:** Checks observability of a system using its observability matrix.
11. **obsv:** Computes the observability matrix for a given system.
12. **pid:** Implements a PID controller function.
13. **series:** Computes series combination of two systems.
14. **step:** Generates step response of a system.

Chapter 4

Parameterizing the Working Examples of Xcos

In addition to developing Scilab functions, I parameterized examples in Xcos, systematically varying inputs to simulate control systems from books by A. Nagoor Kani and K. M. Moudgalya. This hands-on approach deepened my theoretical understanding and practical skills in control theory and digital control systems. By documenting system responses and optimizing parameters through Xcos simulations, I gained comprehensive insights into system dynamics and enhanced my proficiency in applying advanced control methodologies.

4.1 Control Systems - A. Nagoor Kani

1. Parameterizing Control Systems in Xcos improved my time response analysis skills.
2. I gained practical insights into state space representation through these simulations.
3. Applying theory in Xcos improved my understanding of control system dynamics.
4. Xcos experience strengthened my control system configuration and analysis skills.
5. Overall, this process solidified my theoretical foundation in control theory.

4.2 Digital Control - K. M. Moudgalya

1. Parameterizing Digital Control in Xcos deepened my grasp of digital algorithms.
2. Simulations provided practical insights into stability and performance enhancement.
3. Implementing Xcos control strategies enhanced my closed-loop analysis skills.
4. Optimizing controller parameters in Xcos helped achieve precise system behavior.
5. This process enhanced my understanding of real-world digital control applications.

4.3 Summary of Parameterizing Xcos Examples

I parameterized Xcos examples from "Control Systems" by A. Nagoor Kani and "Digital Control" by K. M. Moudgalya, focusing on key topics like time response and pole placement controllers. This practical approach deepened my understanding of control theory principles and equipped me to apply advanced strategies in engineering contexts.

4.4 Verification of Xcos Textbook Companion

During my internship, I verified the Xcos Textbook Companion by comparing example solutions in Xcos with Scilab code. This ensured alignment between the platforms. Discrepancies were documented in a Google Sheets repository, enhancing reliability and usability.

Comprehensive Verification of Textbook Examples in Xcos:

1. **Concepts Of Physics (Volume 2):** Validated 22 examples.
2. **Fluid Mechanics:** Validated 20 examples.
3. **Heat And Mass Transfer - A Practical Approach:** Validated 20 examples.
4. **Mechanics of Materials:** Validated 20 examples.
5. **Thermodynamics an Engineering Approach:** Validated 21 examples.
6. **Integrated Electronics - A/D Circuits and Systems:** Validated 20 examples.
7. **Semiconductor Physics and Devices:** Validated 22 examples.
8. **Signals and Systems:** Validated 20 examples.
9. **Principles of Electronic Communication Systems:** Validated 20 examples.
10. **Quantum Physics of Atoms and Particles:** Validated 20 examples.

Benefits of Verifying Textbook Examples in Xcos:

1. **Enhanced Accuracy:** Aligned Xcos solutions precisely with Scilab code.
2. **Quality Assurance:** Ensured educational material reliability.
3. **Error Identification:** Noted and addressed discrepancies promptly.
4. **Educational Effectiveness:** Improved learning with accurate textbook examples.
5. **Contributed to Development:** Refined Xcos textbook materials with feedback.

I verified Xcos textbook examples to align with Scilab code across disciplines like fluid mechanics, heat transfer, and quantum physics, promptly addressing discrepancies to improve learning outcomes.

Chapter 5

Mastering Document Creation with LaTeX

During my internship, I honed my skills in LaTeX, a robust typesetting system renowned for its application in technical and scientific documentation. This experience enabled me to proficiently create reports and presentations, leveraging LaTeX's advanced features for formatting mathematical equations, tables, and references. Its ability to handle intricate document structures with precision and consistency makes it indispensable for academic papers and professional publications, ensuring outputs meet rigorous standards and are suitable for collaborative projects and diverse academic disciplines.

5.1 Elevating Skills in LaTeX during the Internship

1. Enhanced technical writing skills through educational videos on LaTeX.
2. Mastered LaTeX syntax and commands for creating professional documents.
3. Efficiently produced complex mathematical equations, figures, and tables.
4. Contributed effectively to project documentation requirements.
5. Prepared for future professional endeavors requiring precise documentation skills.

5.2 Harnessing Overleaf for Document Preparation

1. Enhanced technical writing skills with Overleaf's LaTeX platform.
2. Mastered structured document creation using LaTeX.
3. Integrated mathematical equations, figures, and tables seamlessly.
4. Efficiently managed and collaborated on documents with Overleaf's features.
5. Improved productivity and cross-device collaboration during the internship.

Chapter 6

Skill Set Acquired During Internship

Here's an expanded list summarizing the breadth of experiences and skills acquired during my internship:

1. **Case Studies in Scilab and Xcos:**
    - Advanced modeling and analysis for diverse applications.
    - Expertise in complex system simulations.
2. **Toolbox Development:**
    - Creation of specialized software tools.
    - Developing custom functions as Octave.
3. **Parameterization Work:**
    - Configuring and simulating simulations.
    - Implementing and validating examples.
4. **LaTeX Proficiency:**
    - Document formatting proficiency using LaTeX.
    - Advanced technical writing skills honed through LaTeX.
5. **Overleaf Usage:**
    - Efficient document creation using Overleaf.
    - Collaborative writing facilitated by Overleaf's features.

Through Scilab and Xcos case studies, I developed advanced modeling and analysis skills for complex systems in environmental and engineering applications. I also gained expertise in developing customized toolboxes. Additionally, my proficiency in LaTeX and Overleaf improved my ability to create professional documents and presentations efficiently.

Chapter 7

Enhancement of Learning and Development

During my internship, I gained essential skills in control systems engineering and software development, including control theory analysis, Scilab toolbox development, Xcos simulation, LaTeX documentation, Overleaf project management, and MATLAB/Simulink applications. These experiences built a strong theoretical and practical foundation in control systems and software engineering.

1. **Advanced Control System Analysis:** Enhanced understanding and application of advanced concepts in control system analysis through practical implementations and simulations.

2. **Software Development Skills:** Developed proficiency in software tools like Scilab for toolbox development and Xcos for parameterization, supporting automation and optimization in control system design.

3. **Technical Documentation Abilities:** Improved technical writing and documentation skills using LaTeX for precise mathematical notation and professional report formatting.

4. **Collaborative Project Management:** Gained experience in collaborative project management and version control using Overleaf, facilitating efficient team workflows and document tracking.

5. **Research and Practical Applications:** Applied theoretical knowledge to real-world case studies and research projects in control theory, contributing to practical solutions and innovations.

These experiences enhanced my skills in control systems analysis, software development, technical writing, and collaborative research, preparing me for engineering and academic roles. They equipped me to contribute to innovative projects and advance control systems through research. Additionally, they fostered an appreciation for interdisciplinary collaboration and practical application of theoretical concepts.

Chapter 8

Overcoming Challenges and Building Skills

During my internship, I encountered diverse technical challenges that significantly contributed to my professional growth.

1. Overcame complex coding challenges in Scilab and Xcos.
2. Mastered mathematical models and algorithms.
3. Developed efficient code for scientific computations.
4. Navigated the learning curve in LaTeX for technical writing.
5. Enhanced teamwork and communication skills in interdisciplinary projects.
6. Overcame steep learning curve of LaTeX syntax and structure.
7. Developed proficiency in LaTeX through dedicated effort and guidance.
8. Improved technical writing skills and created professional-quality documents.
9. Managed bibliography, equations, and figures with meticulous attention to detail.
10. Enhanced ability to present complex information clearly and concisely.
11. Collaborated with diverse team members, enhancing communication skills.
12. Integrated different perspectives into cohesive solutions.
13. Developed teamwork and project management skills.
14. Learned the importance of communication, planning, and coordination.
15. Broadened perspective on control theory's diverse applications.

Chapter 9

Appreciation and Gratitude

I extend my heartfelt gratitude to the FOSSEE team at IIT Bombay for granting me the opportunity to embark on my Semester-Long Internship journey. Their unwavering support and expert guidance were pivotal in shaping my projects on Scilab toolbox development and Xcos Parameterization through engaging Case Studies. A special thank you to Mrs. Rashmi Patankar and Mr. Sunil Shetye for their invaluable mentorship and encouragement, which fueled my learning and project success.

I am deeply appreciative of every member of the FOSSEE Team whose assistance and camaraderie made my tenure enriching and productive. Their collective efforts in providing resources, constructive feedback, and fostering a conducive work environment were instrumental in overcoming challenges and achieving significant milestones during my internship.

Furthermore, I express my sincere gratitude to St. Xavier's Catholic College of Engineering, Nagercoil, for their unwavering support and academic guidance, complementing the practical experiences gained at IIT Bombay. The strong academic foundation and resources provided by SXCCE facilitated the seamless integration of theoretical knowledge with hands-on application, enhancing my overall educational journey.

In conclusion, I am thankful to all individuals and institutions who contributed to my growth and learning during this internship period. Their support has been invaluable in shaping my professional development and preparing me for future endeavors in the dynamic field of computational sciences.

Chapter 10

Comprehensive Internship Conclusion

My semester-long internship has been an enriching journey filled with diverse learning experiences and significant achievements. From delving into advanced topics in control theory to developing practical skills in Scilab toolbox development and Xcos parameterization, each project has contributed immensely to my growth as an engineer. Navigating through challenges in LaTeX documentation and collaborating on interdisciplinary projects broadened my perspective, emphasizing the importance of adaptive problem-solving and teamwork in engineering and research. I am grateful to the FOSSEE team at IIT Bombay for their unwavering support, mentorship, and encouragement throughout this journey. Special thanks to Mrs. Rashmi Patankar and Mrs. Vineeta Ghavri for their invaluable guidance and expertise, which played a pivotal role in shaping my projects and enhancing my technical skills.

In conclusion, this internship has not only deepened my understanding of computational tools and control systems but also prepared me for future endeavors in engineering and academia. I am thankful for the opportunities, mentorship, and knowledge gained, which have significantly contributed to my professional development. I look forward to applying these skills and insights as I continue to pursue excellence in my career.

Appendix A

Research Works Supporting the Projects

1. Comparative Analysis of Rainfall Prediction Models Using Machine Learning in Islands with Complex Orography: Tenerife Island, by Ricardo Aguasca-Colomo, Dagoberto Castellanos-Nieves and Máximo Méndez, https://doi.org/10.3390/app9224931, 16 November 2019

2. Rainfall Prediction Using Machine Learning Models: Literature Survey, January 2022, DOI:10.1007/978-3-030-92245-0_4, In book: Artificial Intelligence for Data Science in Theory and Practice (pp.75-108), by Eslam A. Hussein, Mehrdad Ghaziasgar, Christopher Thron, Mattia Vaccari, Yahlieel Jafta

3. Optimal Power Flow Solution Incorporating Wind Power, Libao Shi, Senior Member, IEEE, Chen Wang, Liangzhong Yao, Yixin Ni, Senior Member, IEEE, and Masoud Bazargan, IEEE SYSTEMS JOURNAL, VOL. 6, NO. 2, JUNE 2012.

4. SYNTHESIS AND REVIEW - Environmental Impact of Wind Energy, J Mann and J Teilmann, Department of Wind Energy, Technical University of Denmark, Frederiksborgvej 399, DK - 4000 Roskilde, Denmark - Department of Bioscience, Aarhus University, Frederiksborgvej 399, DK- 4000 Roskilde, Denmark.

5. Structure of PID Controller and Its Performance in Multi-Area Power System Network, Arun Kumar Maurya and Hera Khan, Department of Electrical and Electronics Engineering, Ajay Kumar Garg Engineering College, 27 Km Stone, Delhi – Meerut Expressway, Adhyatmik Nagar, Ghaziabad 201009 UP India (Dr. A. P. J. Abdul Kalam Technical University)

6. Tie line power control of Two Area System using Tie-line bias Controller, Suganthi N., Research Scholar, Dayananda Sagar College of Engineering, Bangalore, Karnataka, International Journal of Advances in Engineering and Management (IJAEM) Volume 2, Issue 6, pp: 630-633 www.ijaem.net ISSN: 2395-5252.

Appendix B

References

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2. **Scilab Case Study Projects:**
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5. **Parameterizing the Working Examples of Xcos:**
   https://rb.gy/yvvwje
6. **LaTeX Tutorial Series by Overleaf:**
   https://t.ly/r_VFl
7. **Michelle Krummel LaTeX Tutorials:**
   https://t.ly/4KW1T
8. **Downloadable Tex File - Michelle Krummel:**
   https://rb.gy/ijhric
9. **Link to Overleaf:**
   https://t.ly/pAy6Y
10. **FOSSEE LinkedIn Profile:**
    https://t.ly/dqSo_

Thank You