

Introduction

Signal and image processing are fundamental areas of study in the field of electrical engineering and computer science. These disciplines involve the analysis, manipulation, and interpretation of digital signals and images, with applications ranging from communication systems to medical imaging. (Singh et al., 2021) In recent years, there has been a growing interest in incorporating research experiences into the undergraduate curriculum in signal and image processing, with the

Background and Motivation

The increasing complexity and volume of data in modern signal and image processing applications have posed significant challenges for educators (Seltzer & Zhang, 2009). Implementing interactive and visual models of real-world signal processing systems can help students better understand the underlying concepts and their relevance to practical applications. (Modi et al., 2009) One approach to address this challenge is to engage undergraduate students in research projects, which can provide them with hands-on experience in problem-solving, critical thinking, and independent learning.

Existing research has demonstrated the benefits of incorporating research experiences into the undergraduate curriculum. Specifically, in the field of signal and image processing, several studies have explored the use of audio and visual exercises to reinforce key concepts and enhance student learning. (Pierre et al., 1999) Additionally, research has explored the design of effective course projects that align with current industry needs and academic research directions. (Du, 2002)

For example, one study describes the use of audio signal processing homework exercises in a MATLAB-based environment to reinforce fundamental concepts of digital signal processing (Pierre et al., 1999). Another study highlights the development of a research-focused laboratory course in digital signal processing, where students were given a well-defined problem to solve and were encouraged to explore alternative solutions and extensions. (Bhattacharya, 2006)

Proposed Research

The proposed research aims to investigate the design and implementation of a research-based curriculum in signal and image processing for undergraduate students. The key objectives of this research are:

1. To develop interactive and visual models of real-world signal processing systems using tools such as Simulink, and to integrate these models into the lecture and laboratory components of a digital signal processing course.
2. To design and implement a research-focused course project that allows students to apply their knowledge of signal and image processing to solve a practical problem, with opportunities for independent exploration and innovation.

References

1. Bhattacharya, S. (2006, April 6). Research Experience with Undergraduate Students and its Effect on Development of Academic Laboratory., F1F-19. <https://doi.org/10.1109/fie.2005.1612023>.
2. Du, W Y. (2002, December 1). Design of Proper Course Projects for Effective Student Learning. Elsevier BV, 35(2), 639-644. [https://doi.org/10.1016/s1474-6670\(17\)34011-9](https://doi.org/10.1016/s1474-6670(17)34011-9)
3. Modi, K N., Hong, E., & Bhattacharya, B. (2009, January 1). Interactive models for teaching digital signal processing., 2, 238-243. <https://doi.org/10.1109/dsp.2009.4785928>.
4. Pierre, J W., Kubichek, R F., & Hamann, J. (1999, January 1). Reinforcing the understanding of signal processing concepts using audio exercises., 3577-3580 vol.6. <https://doi.org/10.1109/icassp.1999.757616>.
5. Seltzer, M L., & Zhang, L. (2009, April 1). The data deluge: Challenges and opportunities of unlimited data in statistical signal processing.,1,3701-3704. <https://doi.org/10.1109/icassp.2009.4960430>.
6. Singh, P., Singhal, A., Fatimah, B., Gupta, A., & Joshi, S D. (2021, June 11). Proper Definitions and Demonstration of Dirichlet Conditions. <https://doi.org/10.36227/techrxiv.14761539.v1>.