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NAVIGATING THE NEW FRONTIER: AI-DRIVEN EDUCATION IN ASTRODYNAMICS AND
SPACE MISSION DESIGN

Abstract

This paper outlines the pedagogical benefits and strategies associated with integrating Generative Artificial Intelligence (GenAI) as a transformative tool to facilitate learning specifically in astrodynamics and space mission design, and its potential to serve the aerospace industry. In 2023, US technology firms allocated over \$200 billion towards GenAI advancements, with 94% of engineering companies acknowledging its potential to elevate productivity. Despite only 37% currently leveraging GenAI, 77% plan to do so within the next five years. Aerospace engineering education faces challenges towards implementing GenAI as less than 10% of academic institutions have adopted formal GenAI training, even though over half of the students use GenAI for assignments and exams. As a result of these trends, it is crucial for educators to equip future graduates with GenAI skills for professional application.

The program discussed in this paper, “Advanced Space Technologies and Research Opportunities: Artificial Intelligence in Design and Education” (ASTRO-AIDE), has two objectives: 1) teach students how to implement GenAI in research and writing; and 2) provide students with a GenAI-powered course assistant. The first is accomplished through lectures and assignments on priming and prompting Large Language Models (LLMs), such as the popular ChatGPT. The second is a custom-made OpenAI Generative Pre-trained Transformer (GPT) named “Journey to Understanding and Learning Interplanetary Astrodynamics” (JULIA). Students can interact with JULIA 24/7 via text, voice commands, and file uploads to ask questions regarding course information, material, and assignments.

ASTRO-AIDE has required students to use GenAI for certain assignments. From January 2023 to February 2024, a series of surveys involving 151 students were conducted, highlighting GenAI’s critical role in education and student future careers. Initially, 53% of students had no experience with GenAI, and 92% rated their knowledge at 3 or below on a 5-point scale. Mid-semester, 73% felt already more knowledgeable about GenAI, and an end-of-the-semester survey showed that 64% attributed their enhanced understanding of the course material to ASTRO-AIDE’s GenAI implementation. When asked about LLM preference, students favored a combination of OpenAI’s ChatGPT (90%), Google Bard/Gemini (42%), and Microsoft Copilot (27%). 93% advocate for wider GenAI adoption in university courses and 83% acknowledge GenAI’s importance for their future aerospace engineering careers, reinforcing the importance of GenAI in today’s education.

Implementing GenAI can dramatically transform and elevate the efforts of educators and learners. This equips students and young professionals with a competitive advantage in academia and industry, significantly boosting their marketability.