2020 Richard J. Fasenmyer Engineering Design Conference

Hall Thruster Visualization and Animation

PennState Behrend

Introduction

There has been a rise in serious consideration for long range missions into space due to environmental concerns, resource depletion, and exploration purposes. The need for an efficient, fast, and sustainable propulsion for these missions has led to the development of many different types of thrusters. The NASA Psyche mission will use solar-electric propulsion. This will be the first user of Hall-Effect Thrusters beyond lunar orbit [1].

Most of the public's knowledge about space travel however is about chemical rockets systems. There does not currently exist a visual and interactive means for people to learn about or gain a deeper understanding of Hall-Effect Thrusters. The need for education on the benefits and operation of Hall thrusters is the basis for this project.

The goal will be to provide the best way for any program using this type of thruster to gather interest in the spacecraft through a friendly interface. It will provide those interested in aerospace the opportunity to learn, explore, and understand this modern style of thrusters. The tool will allow the user to navigate through the system and learn about the different parts of the Hall thruster and understand the steps involved in its operation.

Objectives

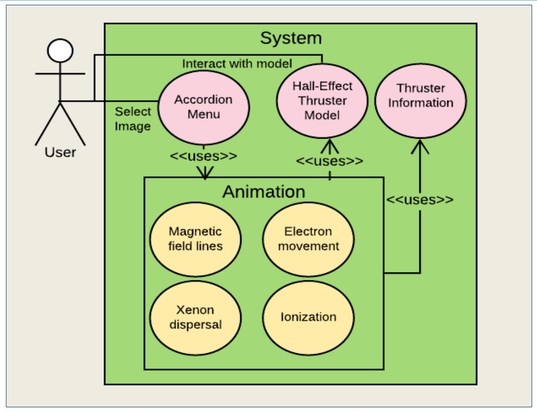

Figure 1: User Interaction with System

Build an interactive animation to educate users about the processes and benefits of Hall-Effect Thrusters

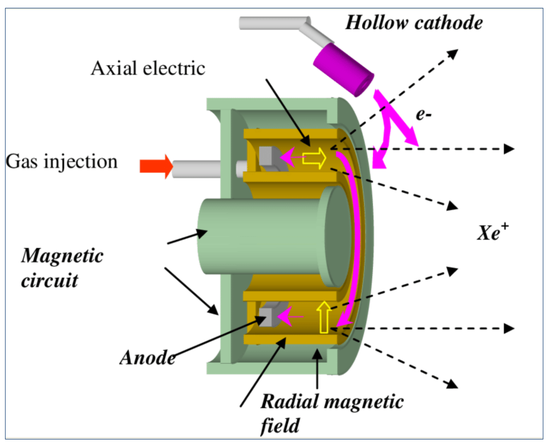

Figure 2: Hall-Effect Thruster Process Diagram [2]

Author & Abstract

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Sponsored By: NASA Psyche

Abstract

The Hall Thruster Visualization Tool will provide those interested in aerospace the ability to learn, explore, and understand this modern style of thrusters The goal will be to provide the best way for any program using this type of thruster to gather interest in spacecraft topics through a friendly interface. Currently, education regarding Hall Thrusters is limited to sources which can be challenging to distribute to the general public, as well as to those within the field. This new accessible means of education will have impacts in many facets of the world. Not only will the general public have the opportunity to learn about modern aerospace technologies, but also the way information is distributed within aerospace companies can be improved and made more friendly for employees unfamiliar with the specific technology

Results

The tool implemented with Unity can be exported as a video to be used within a website. A user on the website can interact with the animation using their mouse. The animation will provide buttons within an accordion menu for each stage of the Hall-Effect Thruster process, as well as allowing users to hover to view information about different parts of the Thruster

Below: Screenshot of information displayed regarding parts of Thrusters to users

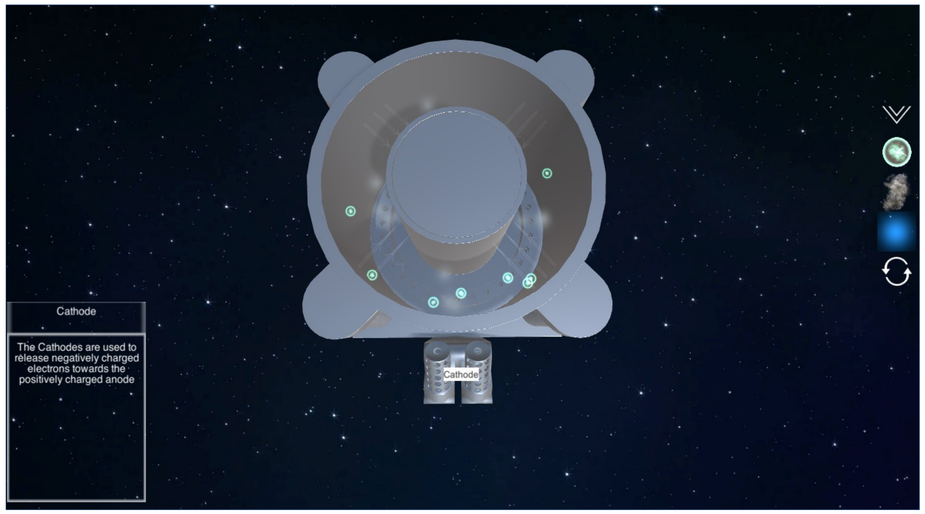

Figure 3: Entire System During Animation

Figure 4: Screenshot of Part information Display

Top: Screenshot of the entire system when the user has begun animations

Right: Screenshot of information about the current process as well as facts about the Thruster displayed to the user when that process of the animation has begun

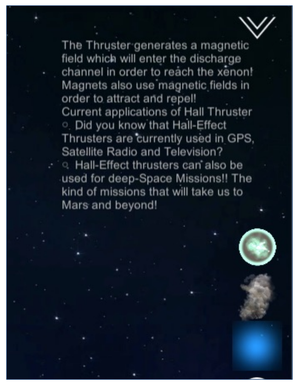

Figure 5: Screenshot of Process Information Display

Practical Application

One of the ways in which this system can be useful is by utilizing the tool to educate the general public at Psyche's informational events. Currently, there does not exist a visual and interactive means for those in attendance at such events to learn about or gain a deeper understanding of Hall thrusters. The audience at such events could range from curious young children to professionals in the field of aerospace. Therefore, this tool aims at creating a single way of communicating the information and the importance of Hall Thrusters. The system includes technical knowledge for an audience familiar with the vocabulary of the mission as well as non-technical way of communicating for an audience unfamiliar with the field and technical specifications. Moreover, the interactive aspect of the visualization tool will allow the audience to engage with the system and make the whole experience of learning about the Hall Thrusters more captivating. Creating the tool with Unity software allows it to be easily exportable to various systems and can be used at informational events that have systems with a simple user interface.

Another way the Hall Thruster Visualization tool can be used is for internal/ formal presentations for the Psyche team. The Psyche team currently disseminates information using blog posts and PowerPoint presentations. This system can diversify the way the Psyche team communicates information about Hall Thrusters internally. A video recording of the animation can be incorporated into formal presentations. The detailed three-dimensional Hall Thruster model can be used when talking about the intricacies of the model. The ability of the system to incorporate technical knowledge about Hall Thrusters makes it compatible with professional meetings. Overall, it will prove to be a better experience when discussing Hall Thrusters within the Psyche mission's organization. The system overall will enable a higher education of Hall Thrusters.

Third-Party Software

- Unity
- Blender
- Visual Studio Code
- Github

References

1) "A Mission to a Metal World," *Psyche Mission*. [Online]. Available: https://psyche.asu.edu/. [Accessed: 08-Apr-2020].
2) Doveil, F. & Arcis, N & Zurbach, S. (2012). Plasma propulsion for geostationary satellites for telecommunication and interplanetary missions. Iop Conference Series: Materials Science and Engineering. 29. 10.1088/1757-899X/29/1/012010. Materials