13th Wernher von Braun Memorial Symposium
October 26 – 28, 2020

An Examination of Ignition Systems for the Tartarus 800lb Nitrous Oxide-Ethane Engine

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Introduction

The Tartarus project needed a more professional, safe, and effective method of creating the ignition for the Tartarus Liquid Bipropellant rocket project. To achieve these goals, the team created a spark gap ignition system.

The system includes an ignition coil to boost voltage and allow the current to jump the gap. This creates a spark to ignite the rocket propellants.

The system will also include a connection to the DAQ running the whole of the Tartarus project systems and a MOSFET to use as a switch for remotely turning the system on and off.

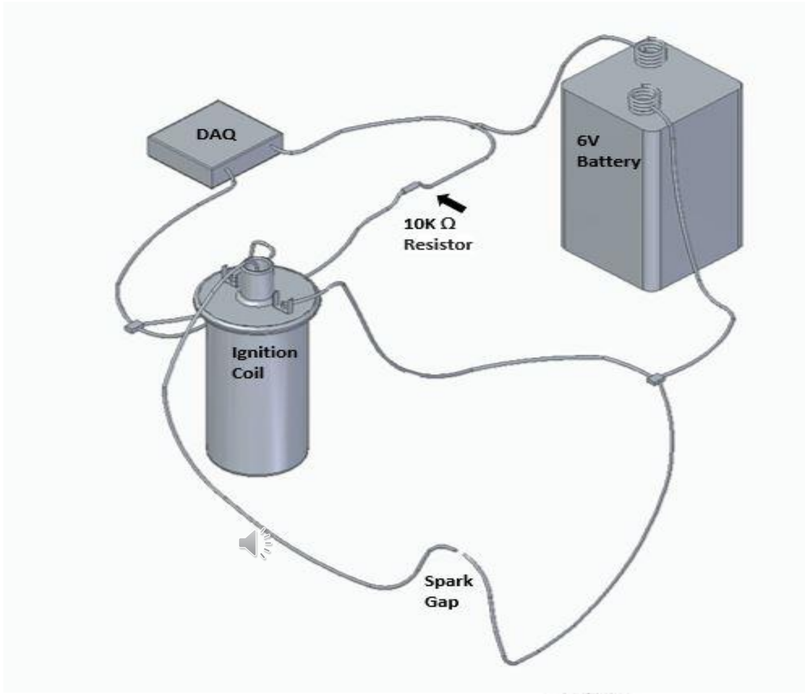
Dielectric of Air(V/mm)	3000.00	Desired Gap Size (mm)	5.00	Coil Ratios 100:1
System Voltage	Output (V)	Required Output (V)	Headroom (V)	Headroom (mm)
6V	20000	15000	5000	1.67
12V	40000	15000	25000	8.33

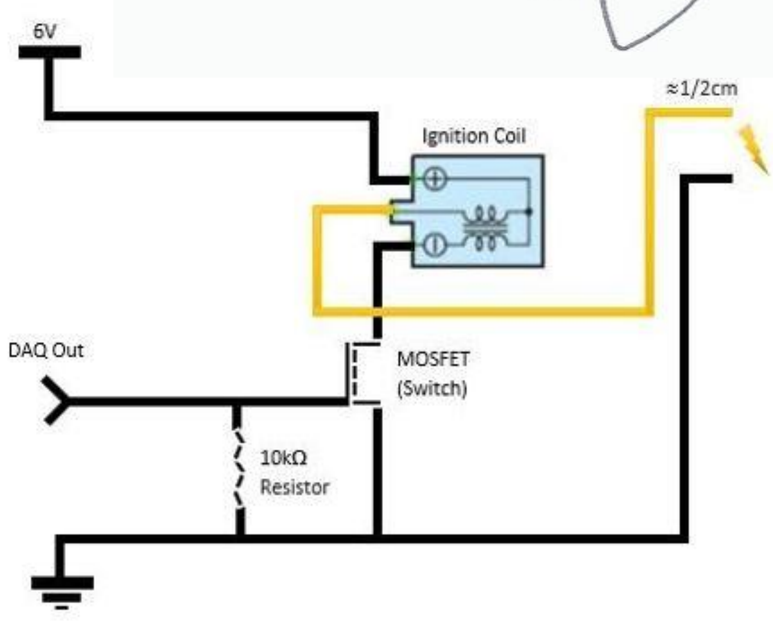
Conceptual Framework

Pyrotechnics, the current method of ignition, is unreliable and unable to be controlled remotely from a safe distance.

Proposed new ignition method is able to:

- Create a spark inside the rocket engine
- Ignite ionized propellant gasses
- Be remotely controlled from distance
- Be easily repeatable by replacing the spark wires
- Avoid inhibiting other parts of the rocket or creating extra weight
- Be cost efficient and reliable





Considerations and Decisions

Initially, the main considerations were how to ignite the ionized gasses in the nozzle of the rocket engine. The methods of ignition considered included:

- Spark ignition
- Pyrotechnics
- Torch ignition

Spark ignition proved to be the best solution because of its low cost, easy integration, remote capabilities, repeatability, and safety. Torch ignition requires extra propellants/fluids and pyrotechnics are often unsafe, among other problems.

Specific components for the spark gap needed to be decided including:

- Spark gap length
- Battery and voltage
- Method of increasing voltage output

Went with 6V battery and ignition coil with a .5cm spark gap. Requires 15,000V to surpass 3000V/mm dielectric of air. 6V Ignition coils provide ~20,000V giving us around 5,000V or headroom to guarantee reliability.

Conclusions

Final solution uses a 6V battery and ignition coil to generate large amounts of voltage. Ignition coil allows current to:

1. Exceed the dielectric of air making the air a conductor. The current is then able to
2. Jump the spark gap and ignite the ionized gasses within the combustion chamber of the rocket.

Overall, we are happy with our solution. The spark gap is a safe, reliable, and cost-effective way to ignite our rocket. Plans have been made to implement the ability to control the ignition system through the DAQ used for other Tartarus systems in the future so that we can make the ignition process completely remote.

Acknowledgements

We would like to give a sincere thank you to the mentors that have helped us through the design process. Our mentors include Dr. Richard Tantaris and Dr. Gang Wang of the UAH Mechanical and Aerospace Engineering Department as well as Dr. Themistoklis Chronis of the UAH Physics Department.