

**A SPACE-BASED SOLUTION TO IMPROVE ROADWAY SAFETY AND
EFFICIENCY IN VIRGINIA: REAL-TIME WINTER WEATHER DATA FOR
NAVIGATION**

USING INDUCED TORPOR AS A METHOD TO REACH MARS

An Undergraduate Thesis Portfolio
Presented to the Faculty of the
School of Engineering and Applied Science
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Mechanical and Aerospace Engineering

By

Khamal-Karim Saunders

May 6, 2021

SOCIOTECHNICAL SYNTHESIS

Space technologies are present and relevant everywhere in our lives. The technical report and the STS research paper are about two different aspects of space-based engineering. Although the projects may be different, they are related in that all spacecraft have to be similar to deal with the unique problems of space. The technical report looks at getting real-time weather data to drivers to increase road safety. The STS paper researches the use of induced torpor in getting astronauts to Mars. Long distance space travel will be a focus in the near future and the STS research will see how realistic it is.

One of the biggest causes of car accidents on the road is poor weather. Sudden storms or unpredictable changes in the weather can lead to dangerous road conditions, and when drivers are unaware of these conditions the risk of accidents increases. In order to solve this problem, the Virginia Department of Transportation tasked the spacecraft design class with creating a solution to get real-time weather data to drivers. If drivers were to get timely information on the current weather, they would be aware of the dangers and could make more educated decisions, leading to increased safety. To design a solution, the class spoke with several subject matter experts and split up into different functional teams to handle each aspect of the mission.

The final design of the solution is a series of satellites that passes over a point of interest about once every hour. This series of satellites contains twenty-four 6U CubeSats, which are small satellites about 6,800 cubic centimeters in size. The twenty-four satellites are offset so one will be able to see the road of interest at the wanted one-hour interval. There are specific sensors inside the satellites that will be able to record the weather conditions and identify rain or ice on the road. Each unit will communicate with a ground station in Charlottesville, Virginia, where

the data will be collected and distributed. This solution was determined to be the best way to get real time weather data to drivers while staying within the given budget of \$50 million.

The STS paper was researched because a mission to Mars comes with many difficulties, so new technology will need to be implemented. One of the biggest issues stems from the conditions astronauts will experience in the nearly year-long journey. The research topic was to see if there is a way to make the trip to Mars more bearable for the participants. Induced torpor, the process of inducing sleep, was researched as the solution to this problem. Scientific journals, the company SpaceWorks' proposal to the National Aeronautics and Space Administration, and the STS framework of Diffusion of Innovation by Everett Rogers were the main sources used for the analysis.

The science, ethics, and readiness of induced torpor were examined in this research paper. Inducing sleep in humans may be possible through hypothermia or hibernation, and promising developments in these methods have been made. The ethical concerns are mainly testing and prototyping issues, as this is a new technology that will need to be evaluated before being used. Diffusion of Innovation shows that this technology is still in its early stages of being diffused into society, with tests and trials needing to occur. The study has shown induced torpor to be a viable option in reaching Mars, but further research and testing are needed before it is certain this technology can be used.

Spacecraft have a variety of uses. The two topics described help increase road safety, and may get us to a new planet. This variety and usefulness are why space-based technologies are becoming more popular in this advanced technological age.

TABLE OF CONTENTS

SOCIOTECHNICAL SYNTHESIS

A SPACE-BASED SOLUTION TO IMPROVE ROADWAY SAFETY AND EFFICIENCY IN VIRGINIA: REAL-TIME WINTER WEATHER DATA FOR NAVIGATION

with Arianna Asquini, Isaac Burkhalter, Xavier Castillo-Vieria, Mici Cummings, Andrew Curtin, Andrianna Daniels, Ian Davis, Luke Dennis, Cooper Dzema, Kyle Ebanks, Shane Eilers, Graham Fitzgerald, Kevin Fletcher, Rikia Freeman, Raeann Giannattasio, Brandon Ghany, Jalen Granville, Alex Griffin, Allen Lang, Dorothea LeBeau, Dominic Pinnisi, Colin Purcell, Bailey Roe, Anisha Sharma, Jimmy Smith, Pranav Sridhar, Elias Topp, Nana-Ayana Tyree, Anish Vegesna, Ethan Vicario, Avery Walker, Ian Wnorowski, and Victor Yang
Technical advisor: Christopher Goyne, Department of Mechanical and Aerospace Engineering

USING INDUCED TORPOR AS A METHOD TO REACH MARS

STS advisor: Catherine D. Baritaud, Department of Engineering and Society

PROSPECTUS

Technical advisor: Christopher Goyne, Department of Mechanical and Aerospace Engineering;
STS advisor: Catherine D. Baritaud, Department of Engineering and Society