Title: SALVS-01 Specify Animals Location Via Sound

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Organization: UNISEC-THAILAND

Need

  We need area within dense equatorial jungles or forests and need an animal sound reference. Instead of a tracking device that needs to be equipped on to the animals directly. This type of tracking is very time-consuming, but SALVS-01 offers a simpler, but more effective way. By leaving "TerraTrack Alert" to intercept any animal that made noise and specify its location.

Mission Objectives

  SALVS-01 focuses on detecting and observing 4 types of endangered animals even in the most remote areas. Our test location is in Huai Kha Khaeng Wildlife Sanctuaries. Our method of detecting is to use multiples of our "TerraTrack Alert" to record the ambient sound in the area and use the differences in the sound intensity in each of our devices to designate the animal's position.

The animals we're looking for are:

1. Malayan Tapir (Tapirus indicus)

2. Wild water buffalo (Bubalusarnee)

3. Eld's deer (Rucervus eldii)

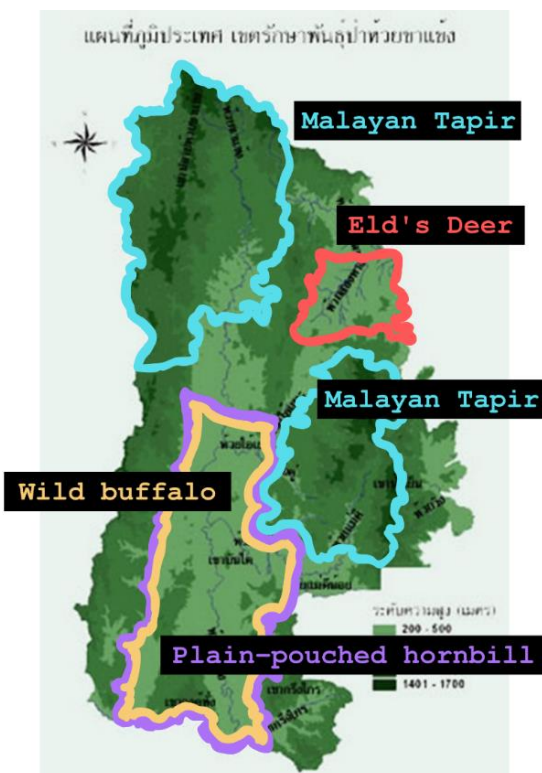4. The plain-pouched hornbill (Rhyticeros subruficollis)

Figure 1: displays the possible area that contained our targets

Concept of Operations

Ground segment:

TerraTrack Alert is a device that records ambient sound, examines the frequency of the sound to specify the animal types and the distance from our device, and transmits the data to our TerraTrack Hub.

TerraTrack Hub are used for keeping, accumulating, and further transmitting our compiled data to our 3U satellites

Space segment:

Our satellite constellation "TerraTrack Sat" will consist 8 of 3U CubeSat in Very Leo Earth Orbit The TerraTrack Sat is capable of communicating with TerraTrack Hub to update animals' locations every 92 minutes then publicize our data to The government or private organizations who's in permitted and need of our data.

Key Performance Parameters

The animals must be in range of 1 km from our TerraTrack Alert. We make use of doppler effect to determine the animal's distance from our devices to designate its location, and our algorithm would use our reference sound to specify the types of animals based on the sound that they produce.

The animals must produce a distinctive sound that can then be compared with our reference to specify the animal's type. Although different species of eld's deer produce very similar sound, there are certain characteristics.

After TerraTrack Alert specify the type of animals. It will send data to TerraTrack Hub and prepare the data uplink to satellite. Which has a communication period of 9 to 10 for overall communication.

The TerraTrack Alert must be installed at the height of at least 3 meters of the ground, because we've experienced a solar panel in the area that was broken by the wild animals.

Our TerraTrack Alert only has enough power to work at full capacity for at least 6 months.

Space Segment Description

Subsystem	Component	Part description	Mass (g)	Average Power Consumption (W)	COTS/ Custom
COMM	S-Band ANTENNA	Antenna Information	115	~4	COTS
OBC	Onboard Computer	Constellation Single Board	225	~15	COTS
EPS	Solar cell	Solar Arrays	508	-	COTS
	Power module	EPS & Battery Module	200	0.15	COTS
	Battery				Custom
ADCS	ADCS's Actuator	Close loop ADCS	1,300	2.3	COTS
	Sun Sensor			0.335	
	Star Tracker				
	Magnetometer				
	GPS	NEO-6 u-blox 6 GPS Modules	12	0.335	COTS
Payload	Experimental APRS & UHF Antenna	Experiment antenna for more resolution and	3000	~10	Custom
Structure	3U Sat	Aluminum 6028	340	-	COTS
Total			5700	31.785	

Table.1 Satellite sub-system mass and power budget of satellite

Orbit/Constellation/Description

From our objectives about detecting and observing endangered animals our area of interest is in Huai Kha Khaeng Wildlife Sanctuaries and other equatorial forest or jungle within 23.5°N and 23.5°S, so we would use a 3U satellite in Very Low Earth Orbit (VLEO) Semimajor Axis 6758 km (400km above earth surface) with an inclination of 25° which would took about 01:32:33.63 (hh:mm:ss) per loop of orbit. Our constellation will have eight of our satellites, and we will be able to communicate with our satellites every period it gone by.

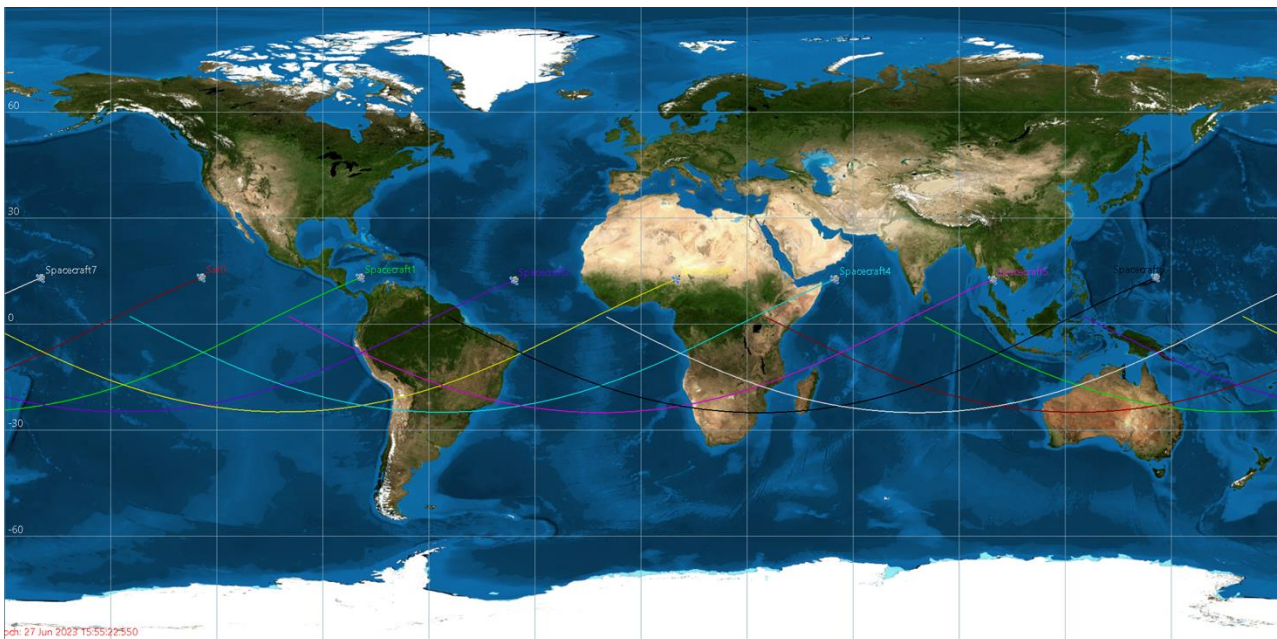| TerraTrack Sat	01	02	03	04	05	06	07	08
Semimajor (km)	6758	6758	6758	6758	6758	6758	6758	6758
Eccentricity (e)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Inclination (°)	25	25	25	25	25	25	25	25
Argument of periapsis(°)	75	75	75	75	75	75	75	75
RAAN(°)	0	45	90	135	180	225	270	315
Mean anomaly(°)	100	100	100	100	100	100	100	100

Table 2 Orbiton elements

Figure 2 Satellite orbital

Implementation Plan

The SALVS-01 is a mission idea by a team from UNISEC THAILAND. In our teams were composed of high school and university students from various university in Thailand. Therefore, we can discuss widely with many professors and access many tools from varied institutes. The mission was planned to develop for 3 and a half years, separated into 1 and a half years for development and 2 years for mission operations. While the manufacture phase is ongoing, we have a plan to pass on knowledge about satellites to younger students. Since the mission was created by students, the risk and problem that might occur in real situation can be predicted in 5 topics.

1. The human resources for project to be fully work. Because the general study schedule and semester periods are different.
2. Financials for development, manufacture and operation of a constellation mission.
3. The lack of hands-on experiences and knowledge.
4. An unapproved request to perform an experiment in a real area.
5. Regarding the topic of launching, we are quite confident that we can successfully launch and deploy satellites. Our research has shown that an American satellite called 'GLAST' was successfully launched into orbit 550 km above the Earth's surface in 2008 using the Delta 7920H launch vehicle. However, with the increasing number of low-orbit satellites like Starlink being launched, we are now unsure if any complications might arise.

Phase	2023	2024	2025	2026	2027
ANALYSIS					
Mission Definition	1–2				
Mission Definition Review (MDR)	3				
Space requirement	4				
Ground requirement	4–5				
Design,Development					
Ground communication system	5–8				
Ground Power system	5–8				
Preliminary Design Review (PDR)	6				
Ground Device (TerraTrack Alert)	7–12				
Ground Device (TerraTrack Hub)	7–12				
Space Device (TerraTrack Sat)	6–11				
Engineering Model (EM)	10				
Critical Design Review (CDR)	9				
Flight Model (FM)		1			
TEST					
Ground communication range	8–11				
Ground power generation rate	8–11				
Ground environment	8–11				
satellite space environment	11–12	1			
LAUNCH					
Permits and Licenses		1–6			
Flight Model Revission (FMR)		2–8			
Launch Rreadness Review (LRR)		3–8			
Start of Mission			ongoing	ongoing	ongoing
End of Mission					12

Table 3 Project Schedule

References

[1] Christine Erbe Jeanette A. Thomas Editors Exploring Animals Behavior Through Sound: Volume1 methods 2021

[2] Wiley J. Larson,James R. Wertz Space Mission Analysis and Design Third Edition

[3] Launch https://space.skyrocket.de/doc_sdat/glast.htm

[4] orbital parameters https://www.space-track.org