KU CENTER FOR REMOTE SENSING OF ICE SHEETS
The University of Kansas

Special Temporary Authority to Test Radar Instrumentation

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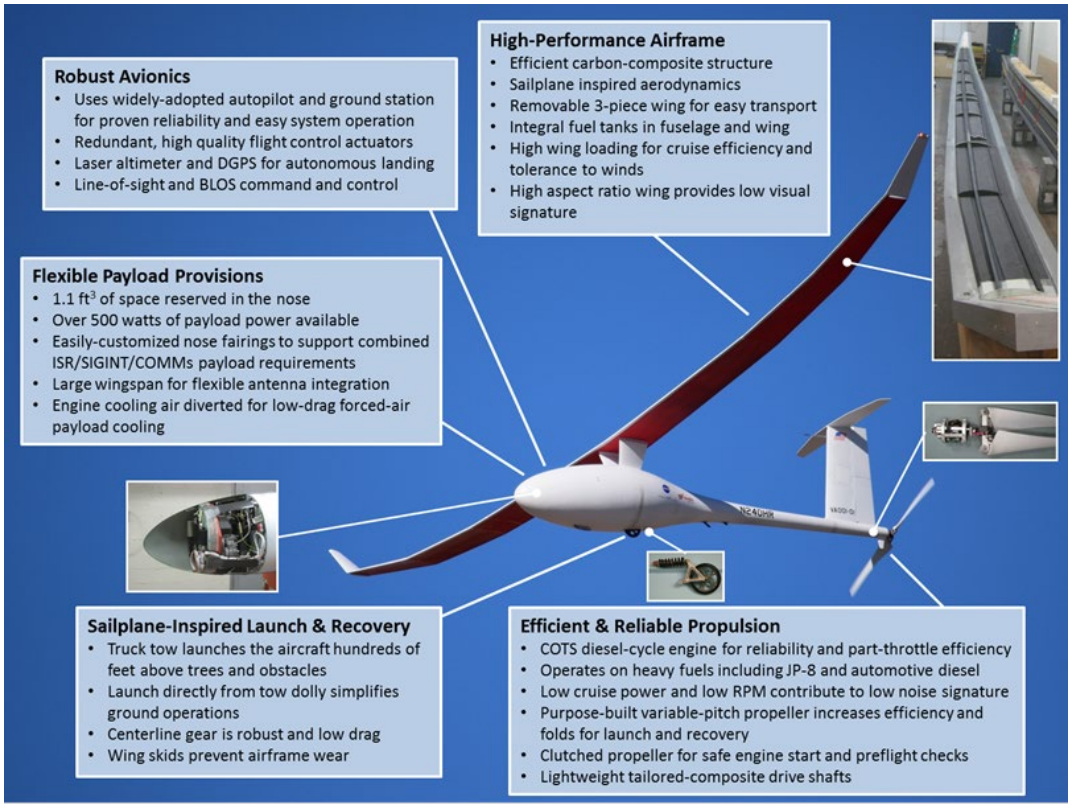
A. Purpose of Operation and Need for License

The purpose of this experiment is to test the performance of an ultra-wideband radar system for sounding sea ice when operated on board the Vanilla Unmanned VA001 aircraft (https://vanillaunmanned.com/). The radar system will transmit a waveform in the S and C bands, with its antennas looking towards the nadir direction. This work is funded through a grant from NASA to study sea ice in the Artic. Platform Aerospace has obtained permission for test flights of the aircraft at Edwards.



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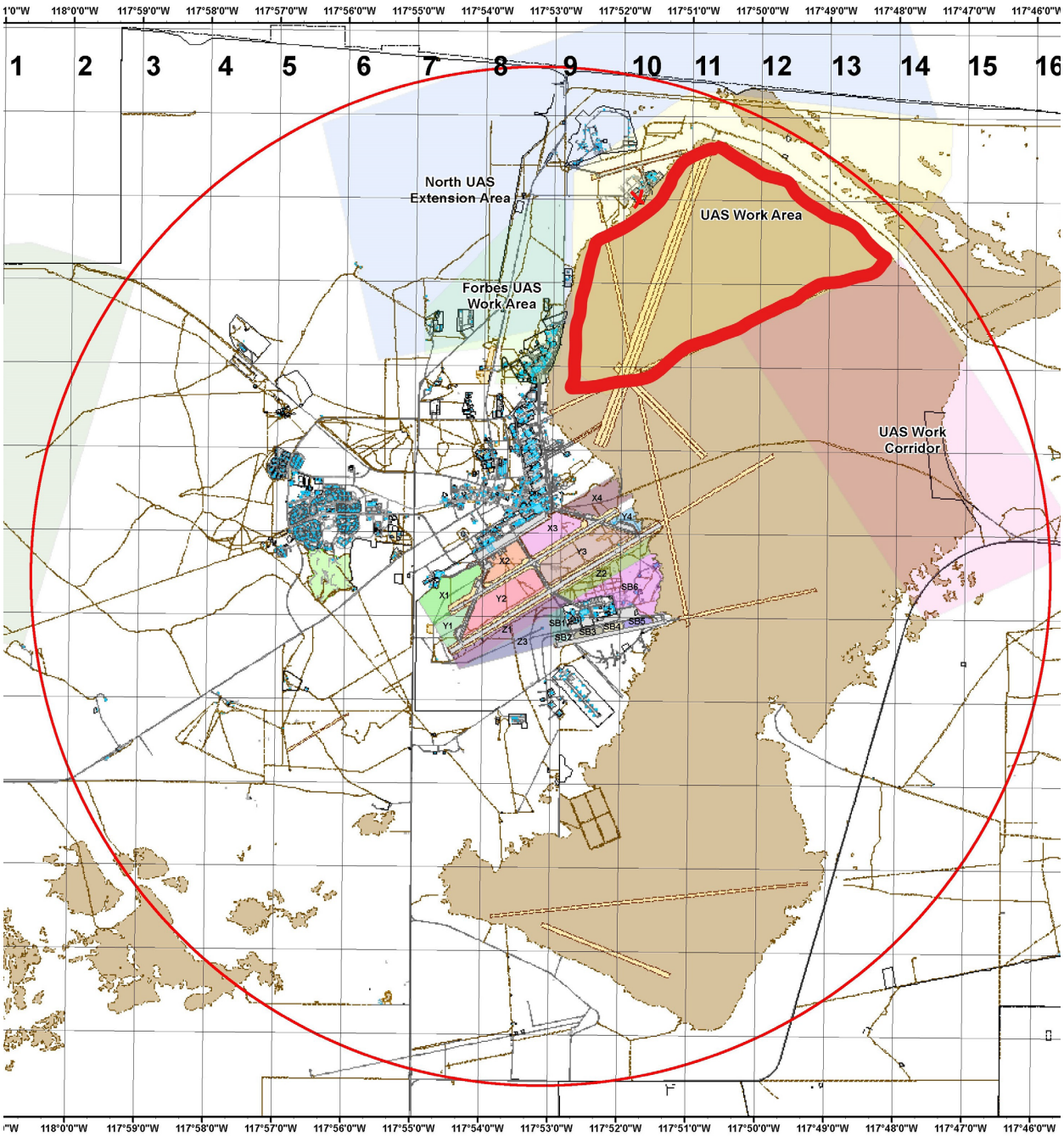
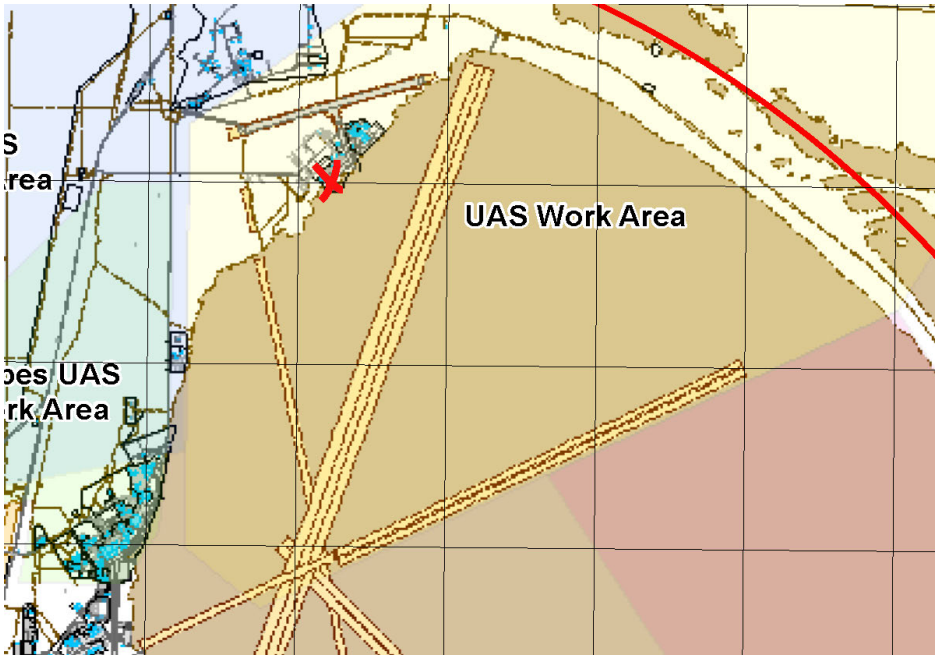
B. Locations of Proposed Operation

Proposed Locations: Measurements will be conducted at Edwards Air Force Base in Edwards, California. Flights will be conducted within the Red box outlined in the image below. This is within the Edwards base in their UAS work Area.





Dates: We are requesting a window from Feb 1 to March 31, 2021. Test flights are currently planned for the week of February 8th or 15th , 2021.

Contact Information for Edwards:

We are coordinating with the Frequency and Airspace management at the base.

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C. Technical Specifications

1. Frequency of Operation

CReSIS requests authorization to operate in the 2-8 GHz bands.

Snow Radar Parameters

Parameter	Value
Lower Frequency	2 GHz
Upper Frequency	8 GHz
Transmit Power (Max)	0.63 W (28 dBm)
EIRP	7.1W ; 8.5 dBw
ERP	4.3W ; 6.4 dBw
Frequency Tolerance	2 MHz
Waveform	Chirp

2. Effective Radiated Power (ERP)

The effective radiated power (ERP) will not exceed 10 W (ERP in Watts units); 10 dBw (ERP in dBw units), and will be always directed at nadir directly below the aircraft. The ERP at angles near the horizon (90 degrees off nadir) will not exceed 100mW.

3. Modulation Signal Description and Emissions

The system is a frequency modulated continuous wave radar that emits a 2-8 GHz chirp. The chirp duration is 200 µs and the pulse repetition frequency is 5 kHz. The primary emission designator is 6G00G3N.

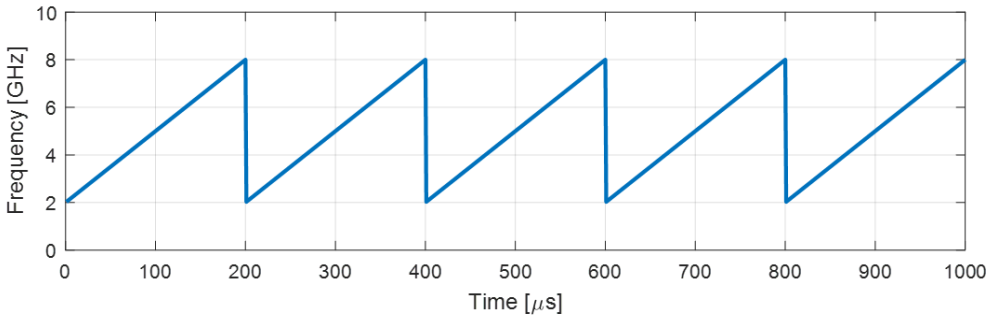

Fig. 1 – Modulation Signal (Ramp) for the Snow Radar

The FMCW Radar sweeps +/- 3GHz from the Carrier (5 GHz). The sweep duration is 200 microseconds. The repetition rate is 5 kHz. B_d = 3 GHz B_n = 2 B_d = 6 GHz

4. Antenna Information

The antenna used are directive horn antennas Model 3115 by ETS- Lindgren and mounted on the wings of the UAV with a gain of 20 dBi. The Antennas are nadir pointing with a beamwidth (along track and cross track) of 50 degrees and 50 degrees.

Antenna Parameters

Parameter	Value
Antenna Manufacturer	A-Info
Model / Part Number	LB-20180-NF [1]
Average Gain	10.5 dBi
Average Beamwidth (Along Track)	48.9 deg
Average Beamwidth (Along Track)	51.6 deg

Antenna Gain

The Snow Radar uses the two double-ridge horn antennas, part number LB-20180-NF. One horn antenna is used to transmit the radar signal, and the other horn antenna is used to receive the reflected signal. The antenna gain of the Snow Radar varies from 7 to 14 dBi. The average gain of the antenna over this band is 10.5dBi. Figure 1 shows the antenna gain measured at the CReSIS anechoic chamber. Figure 2 shows the antenna gain provided in the datasheet of the antenna.

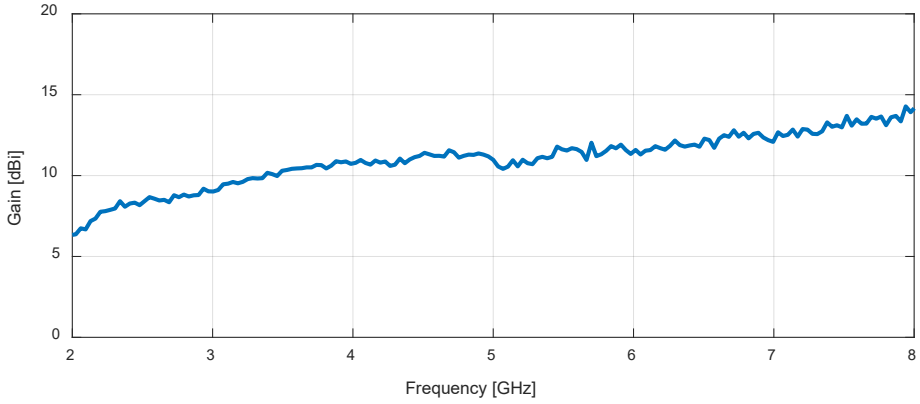

Figure 1 - Measured Antenna Gain at CReSIS Anechoic Chamber

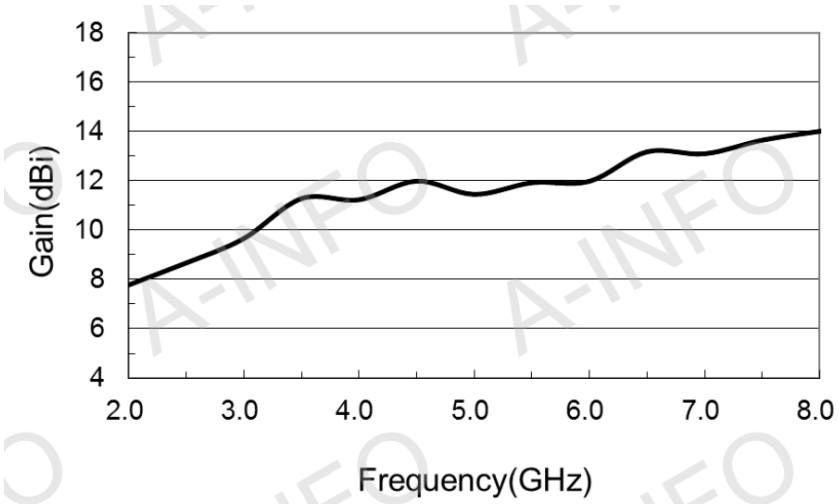

Figure 2 - Antenna Gain from datasheet [1]

Antenna Beamwidth

The beamwidth of the Snow Radar antenna varies as a function of frequency. The beamwidth is given by the datasheet of the antenna. The E-plane of the antenna is aligned to the along-track of the moving platform. The H-plane of the antenna is align to the cross-track of the moving platform. Figure 3 shows the 3dB Beamwidth of the antenna as a function of frequency, given by the antenna datasheet. The average 3dB beamwidth of the antenna is 48.9 degrees in the along-track, and 51.6 degrees in the cross-track.

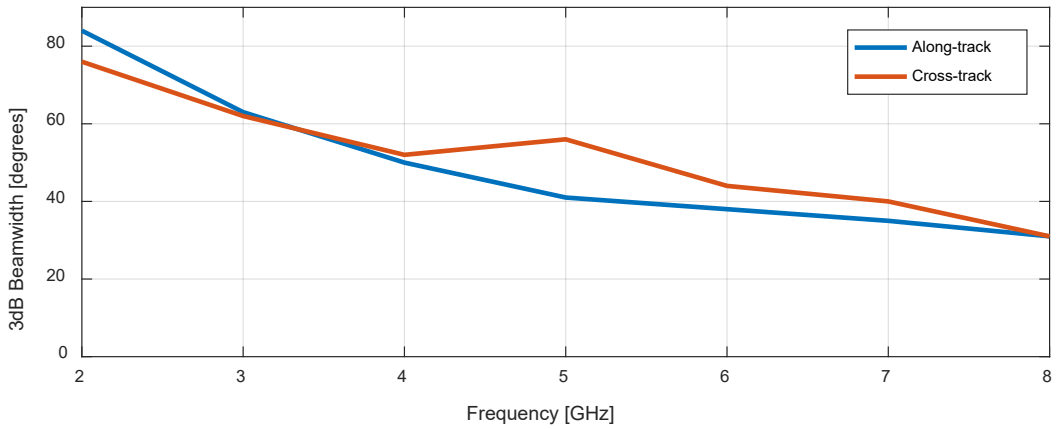

Figure 3 - Antenna Beamwidth [1]

5. Equipment Utilized

The Radar equipment used for this system is custom built at the Center for Remote Sensing of Ice Sheets at the University of Kansas.

6. Station Class

This station will be Aeronautical Mobile in the area described in section B with a nominal altitude of 1500-4500 feet AGL.

E. Contact Information

For questions about this application or in the unlikely event interference concerns should arise, please contact:

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