ATTACHMENT TO VEXCEL STA APPLICATION

This STA is requested to demonstrate a novel specialized short range, low power radar system that illuminates a rock wall next to a highway and maps the surface profile in detail. Vexcel believe that this technique can be used to detect potential dangerous rockfalls that could damage vehicles and travelers on the adjacent highway.

The application request authority at Vexcel's Boulder, CO location and 3 remote locations of interest because of differing types of rock walls present. The actual system, as shown below, is a trailer that contains a radar antenna that instead of rotating moves in 2-dimensions to scan the rock surface.

JUSTIFICATION OF NEED

In October 2007 Vexcel made a presentation to the Department of Transportation's, Federal Highway Administration (FHA) office proposing the use of Synthetic Aperture Radar (SAR) technology for the detection and monitoring of rock fall and landslides on steep slopes that border busy transportation corridors. Vexcel had previously demonstrated through software simulation that integrating the interferometric SAR data processing technique into a ground-based system would enable the measurement of surface displacements on the order of a millimeter at stand-off distances of up to several hundred meters. Since surface displacements are a precursor to rock wall failure, the ability to measure surface displacement over time yields a capability to predict wall failures. This predictive capability would enable transportation authorities to schedule mitigation activities during low traffic periods thereby minimizing the risk to life and limb of rock wall failures and significantly reducing their negative economic impacts.

Following the recommendation of the FHA officials, Vexcel presented this concept to the Colorado Department of Transportation's (CDOT) Rockfall program office. CDOT engineers agreed that this technology had great potential and it was agreed that the next step was to validate the performance through field testing. Several representative test sites were identified during a site survey with CDOT's engineers conducted on April 9, 2008. To validate the system concept, Vexcel needs to run a series of experiments at these or similar sites.

OPERATIONAL SCENARIO

To properly verify the system operation, Vexcel needs to measure several different types of rock formations. To do this, the system will be installed on a trailer which can be towed to each experimental site. A drawing depicting the trailer system is shown in Figure 1. Directional horn antennas are used to transmit and receive the radar's radio frequency signal. The antennas are mounted on a linear rail system and are moved horizontally and vertically along the rails. The motion is such that the antenna pointing direction is not changed during operation. The horizontal rail allows for 5 meters of motion. The vertical rail allows for 1.6 meter of motion. The antenna's highest position above the ground during operation is 2.6 meters.

A drawing showing the operation of the system near a rock wall is shown in Figure 2. The main radiation lobes of the antennas will always be pointed at the rock wall during operation at a 25 deg skyward-looking angle. The distance from the base of the rock wall to the trailer will never be more than 50 meters.

Each experiment is composed of multiple scans along the rails and will take approximately 8 hours. The trailer remains stationary during the operational period and will always be attended by at least one operator.

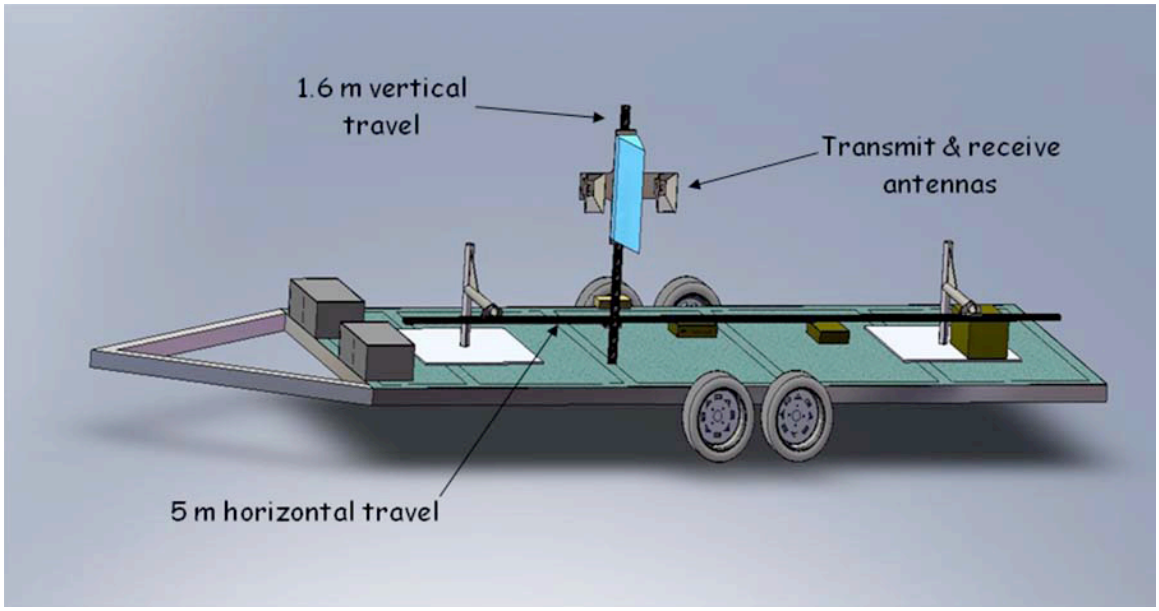


Figure 1. Trailer mounted system.

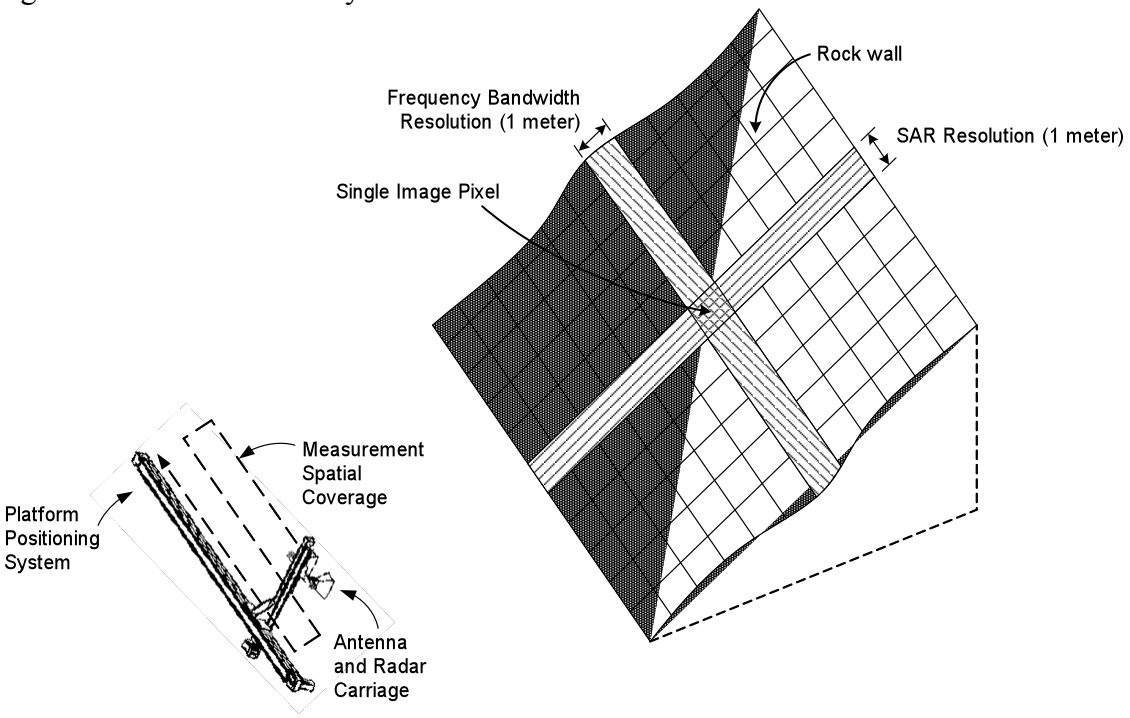


Figure 2. Operational scenario showing system measuring a rock wall.

SYSTEM PARAMETERS (CHANGES DUE TO SHIFT IN FREQUENCY BAND)

The gain of the antennas is ≤15.0 dB (varies with frequency of operation and antenna unit) and the transmit power is 60 mW. Therefore the effective isotropic radiated power (EIRP) is 2 W.

The center frequency is 10.95 GHz. The necessary bandwidth of the system is 500 MHz so that the frequency band is 10.7 to 11.2 GHz.

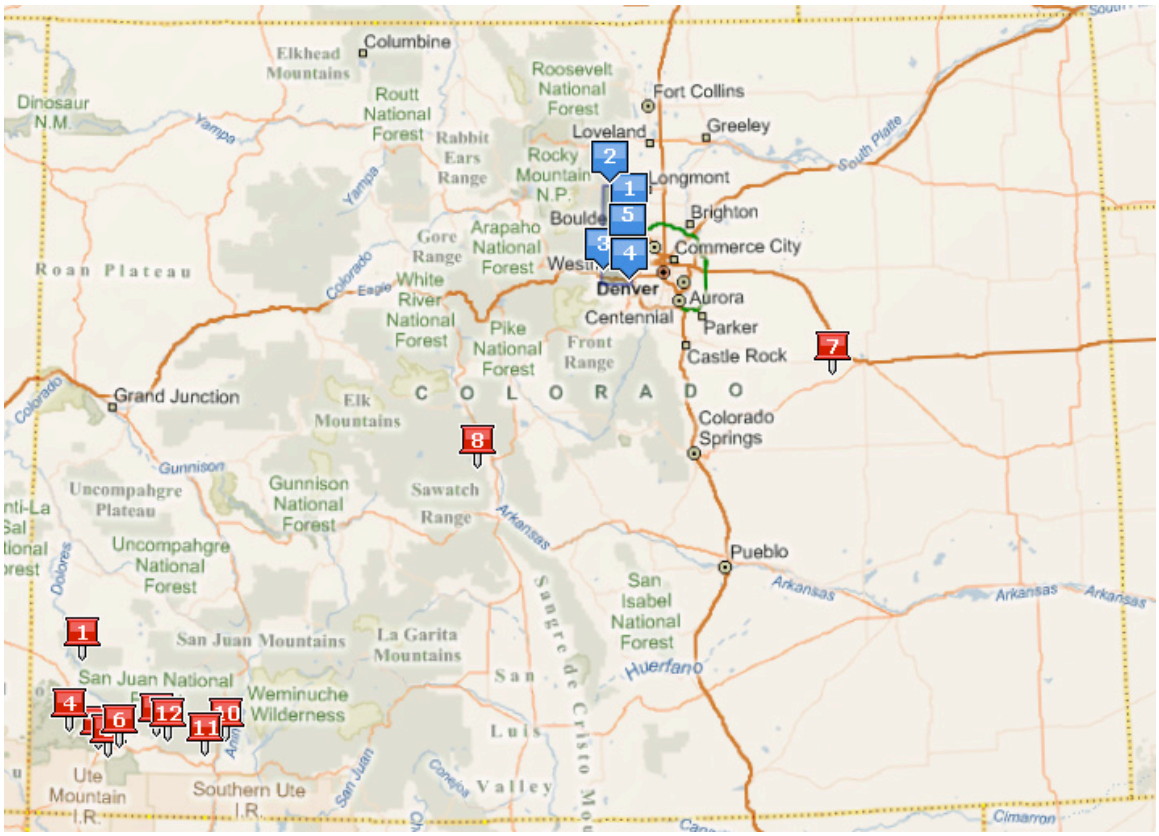
The transmitted signal is a linear frequency sweep from 10.7 to 11.2 GHz with a sweep rate of 333 milliseconds.

JUSTIFICATION OF THE SELECTION OF RADIO PARAMETERS

The system that we are designing is a side looking synthetic aperture radar. The system produces radar imagery with a resolution set by the bandwidth of the system. Based on the 1 meter imagery resolution requirement set by the CDOT rock fall group, we have chosen a bandwidth of 500 MHz. Using interferometric processing, two images taken at different times are compared to create a surface displacement map. The resolution of the displacement map is determined by the signal to noise ratio of the data and the center frequency of the system. Based on the 1 millimeter displacement resolution requirement set by CDOT we chose an X-band center frequency. For the field test validation phase of this work, we determined that an effective isotropic radiated power of 2 W at X-band would satisfy the displacement resolution requirement.

INTERFERENCE POTENTIAL TO COCHANNEL LICENSEES

Vexcel understands that the terms of §5.85(c) its use of the proposed frequency band is secondary to all licensed users. A recent search of ULS shows that the only licensee in Colorado in this band is Qwest Corp. which holds licenses: KAN79, KAS72, KBD20, KBD28. The sites in these licenses are shown below as red squares numbered 1-8. The proposed Vexcel sites are shown in blue as 1-5. (Note that site 5 is not actually applied for in this application.) The closest site is more than 60 miles away in mountainous terrain and there is no interference risk.



Sites applied (blue) for and Qwest cochannel licenses (red) in Colorado

The closest site in this application to the Table Mountain Radio Receiving Zone is 10 km. away. Under the terms of §1.924(b)(2) consultation is not necessary. However, out of an abundance of caution and to be a good neighbor in Boulder, Vexcel is notifying ITS of this application.