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Open Source Avalanche Rescue Imaging System (OS-ARIS)

An Initiative of the IEEE HIC-Ottawa SIGHT Affinity Group

Main objective:

To improve and adapt the low-cost frequency-modulation continuous-wave (FMCW) radar imaging system from MIT Open Course Ware (OCW) to function as a compact, real-time, radar imaging system for snow avalanche search and rescue operations. The resulting design will be made available as an open source design, in accordance with the Creative Commons License requirements of the MIT OCW.

Background:

Utilizing the MIT Open Course Ware (OCW) program, accessible at <http://ocw.mit.edu/>, a new open source hardware project was first proposed in January 2013, as part of the IEEE HIC-Ottawa SIGHT Affinity Group activity. After about 10 months of planning and revisions, the proposal was accepted. Presently, this project is fully endorsed by the IEEE HIC-Ottawa SIGHT Affinity Group, the IEEE SIGHT Canada, and the IEEE Ottawa Section (see the IEEE HIC Canada official web site at <http://hic.ieee.ca/> for further details).

The intent of this project is to improve and adapt a low-cost radar imaging system from the OCW to serve as a radar imaging system for snow avalanche search and rescue operations. In addition, as a type of ground penetrating radar, it may also be further adapted for use in other buried-victim search and rescue operations, especially, in landslide and collapsed-building emergencies.

As a humanitarian technology initiative, this radar imaging project certainly falls within the scope of utilizing technology in support of relief assistance during a natural or man-made disaster. This initiative is inline with the scope regardless of whether the stricken area is impoverished or wealthy, for as long as one or more human lives are at stake because of the disaster.

Although it still requires much refinement, the radar technology itself is relatively mature, and is currently also quite expensive. However, the intellectual property rights of the OCW system are all protected by the popular Creative Commons License, which will





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hopefully foster a positive and inexpensive development of this new radar system through the open source community.

Development steps:

1. For the purpose of initial analysis and testing, build a low-cost FMCW radar imaging system based on the MIT OCW implementation (<http://ocw.mit.edu/resources/res-ll-003-build-a-small-radar-system-capable-of-sensing-range-doppler-and-synthetic-aperture-radar-imaging-january-iap-2011/>). Note that this is an S-band radar system of which its frequencies of operation fall within both Industry Canada and ITU-R designated frequency bands for industrial, scientific and medical applications. The middle C-band can also be considered if necessary. Improve on the design if parts are unavailable. Characterize the radar imaging system through analysis and measurements.
2. A suitable data acquisition system for the synthetic aperture radar (SAR) operation mode needs to be designed, built, and integrated into the radar imaging system for the purpose of snow avalanche search and rescue missions.
3. Study the electromagnetic propagation and scattering properties of snow avalanche debris and buried human body, basing on the MIT OCW implementation. Start from reviewing Modroo's Master's thesis (<http://www.Modroo.com/Downloads.html>).
4. Determine the hardware and software requirements for adapting the low-cost radar imaging system to function as a radar imaging system for avalanche search and rescue operations. As a start, design the system to operate at temperatures down to about 4 degrees below freezing (Celsius).
5. Perform an itemized cost analysis of the completed radar imaging system.

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