Name of research institute or organization:

ETH Zürich and Uepaa AG

Title of project:

Avalanche Rescue Beacon with Smartphones

Part of this programme:

Part of a Master thesis at ETH Zürich

Project leader and team:

Prof. Dr. Bernhard Plattner, project leader
Mathias Haussmann, project co-leader
Dr. Franck Legendre
Matthias Mock

Project description:

The work carried out at the premises of the HFSJG was part of a Master thesis jointly supervised by ETH Zürich and Uepaa AG.

In this thesis, an off-the-shelf smartphone was used to develop an avalanche beacon system (ABS/LVS) application. The goal was to rely solely on sensors and signals available on a stock phone. Available radio technologies were first analysed and characterized with respect to output power and receiver sensitivity. A simulator incorporating a 3D propagation model was implemented allowing the modeling of signal propagation in an avalanche use case. Besides modelling the influence of snow type, burial depth and sloped terrain, both the effect of ground reflection and influence of the body attenuation of searcher and victim were included. Extensive field tests took place for calibrating the propagation model and simulations allowed for the evaluation of various configurations (victim relative position, snow conditions, slope, etc.). For the proposed search procedures, various localization schemes, such as angle of arrival (AoA), time of arrival (ToA), time difference of arrival (TDoA) and received signal strength indicator (RSSI) based methods were evaluated. It was shown that standard localization schemes cannot be expected to produce accurate results in an avalanche environment and instead a procedure of obtaining the AoA using RSSI measurements was proposed. It was assessed whether a relative localization approach, such as simultaneous localization and mapping (SLAM) or parallel tracking and mapping (PTAM), and the collaboration of multiple searcher phones could be beneficial compared to a single searcher case. Extensive field tests proved that the developed prototype is on par accuracy-wise with top of the range commercial ABS/LVS. The application achieved a mean localization error of 0.1 m (versus 0.11 m) and a standard deviation of 0.11 m (versus 0.08 m). Search time-wise on average only 122 seconds were needed (16 % relative increase compared to high-end ABS/LVS). Furthermore, a unique way of obtaining AoA information from RSSI measurements was presented. The orientiation accuracy was below 3 degrees up to 30 m away from the buried victim.

Extensive measurement campaigns were carried out in August, 2014 at the High Altitude Research Station Jungfraujoch. The goal was to validate the developped search algorithm in real-world conditions.

Key words:

ABS, ARVA, LVS, Smartphone

Collaborating partners/networks:

ETH Zürich and Uepaa AG

Scientific publications and public outreach 2014:

Theses

Mock, M., Avalanche Rescue Beacon with Smartphones, Master Thesis, MA-2014-05, ETH Zürich, 2014.

Address:

Prof. Dr. Bernhard Plattner
ETH Zürich
Computer Engineering and Networks Laboratory
Communication Systems Group
ETH Zentrum
Gloriastrasse 35
CH- 8092 Zürich

Contacts:

Dr. Franck Legendre
Tel.: +41 44 809 60 00
e-mail: mathias.haussmann@uepaa.ch
URL: http://www.uepaa.ch