Analysis of signal accumulation of avalanche transceivers during multiple burial scenarios

Study by Markus Eck, Rudi Sackl, Michael Schober, Summer 2006

More and more avalanche transceivers are becoming highly sophisticated signal processing units - not least due to the challenge of solving multiple burial scenarios. This study analyses the behavior of different transmitting strategies during mixed brand burial situations for the first time ever. Results of studies by SLF Davos (made in 2000) shows us:

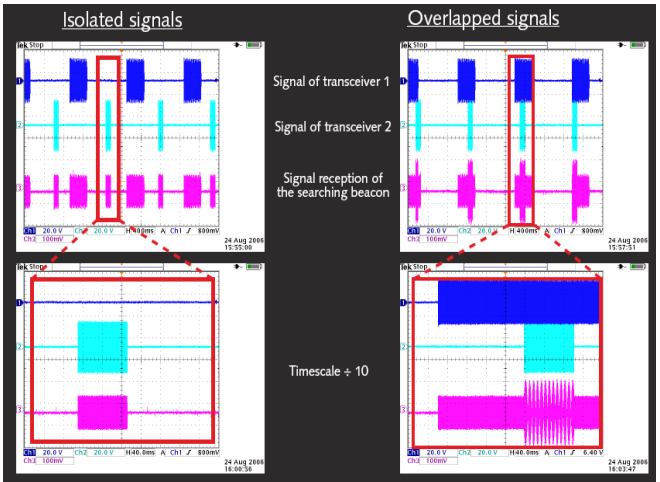
- **Over 50% of those buried are the victims of multiple burials**
- **Burials where 2 victims are in close proximity are the big problem!**
- **In cases with more than 2 victims we can assume that most of these cases will most likely resemble either a step by step single or a double burial search!**
- **Signal overlapping happens during transceiving of beacons with different periodic time and/or different impulse duration.**

How the tests were made:

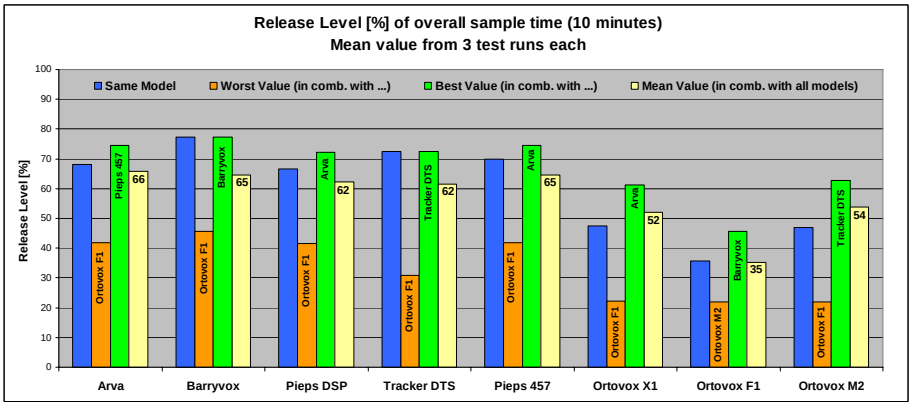
A simple direct receiver / amplifier with an approx. 10 cm receiving range was built to record transmitting impulses. This signal source was connected to an oscilloscope with storage capabilities (Tektronix TDS3014B) and to a simple digital data logger (sample rate 10ms) connected to a PC via USB. Each test run had a duration of 10 minutes. 3 independent test series each with the same constellation and made in sequence were regarded as representing random start-up configurations. The recorded data were then put through a tiny PC-program to calculate the phases of signal collisions. Once the drifting signals start to overlap, the "superposition" phase starts and not until the signals are fully separated again does this calculated stage end. The opposit of this result is passed to the final calculation of the release-level of the two signals which determines the accumulated time share, where both signals are isolated and clear, referring to the overall test time.

Which transceivers have been tested?

A representative selection of those beacons with a significant market share has been chosen with 3 samples random selected from each beacon brand. All the beacons were first measured up and their transmitting parameters determined. All the tests were carried out using full batteries and at room temperature.



The overlapping of signals is the major source of problems during close multiple burial situations. The transmitting strategy chosen by the beacon manufacturer is an issue of fundamental importance here, due to the fact that an overlapped signal can no longer be isolated, not even with digital signal processing.



Strategy 1: a very short impulse with a period duration as long and constant as possible

A good impulse/pause ratio results in purely mathematical terms in short impulses and a longer period duration – also bringing a positive result thanks to a higher signal release level. In the case of a two device constellation with approximately the same period duration, there are very long phases without overlap but also long overlapping phases!

Strategy 2: short impulses with period durations that are as long and varied as possible

This strategy would appear to be the standard for modern digital devices. A period duration of different lengths is specified - whether this is from manufacturing dispersion or by means of a random generator on switching on. This has the handicap that overlaps occur very frequently, but on the other hand has the decisive advantage that these brief overlaps are always of short duration only.

Strategy 3: short period duration

This worsens the impulse/pause ratio and a higher overlapping level must be reckoned with. But at least it brings the advantage that a somewhat faster alarm can go out with the search devices.

Strategy 4: long impulse, long period duration

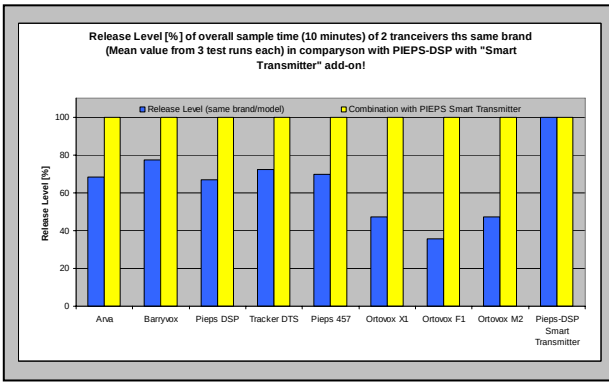
This strategy was clearly selected without taking multiple burials into account. In addition to the potential advantages of a greater reach, significant disadvantages also arise – as a result of the poor impulse/pause ratio.

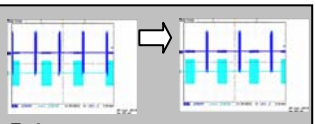
Conclusion:

Each manufacturer is in principle free to choose the form in which his signal is transmitted – provided it is within the limits specified by the standard. The results indicate that several basic strategies are being followed by the manufacturers which also have significant influence on the overlap or release level. In the final analysis the main factor of influence is the impulse/pause ratio.

Summary:

"Whether an old analog device or a modern digital one is used – both transmit equally well!" This notion is a myth that is clearly disproved by this study. The all-important issue for the buried person is how her/his device transmits – that it uses the correct frequency and the right strategy. **The essential point is that the signals of the different transmitter can clearly be distinguished from each other!** When the signal can be heard clearly and without interference by the searchers, this has a significant influence on the person being found more easily and faster – independent of what search technology the rescuers are equipped with!





Future:

A completely new and revolutionary approach - the "Smart Transmitter" is being introduced by PIEPS. The transceiver uses all DSP receive capabilities also in standard transmit (SEND) mode making use of built-in high-tech power. On reception of a neighbor signal, the Smart Transmitter adjusts and moves its signal to a position where overlapping no longer occurs! A real advantage for the buried victim!

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