

Pinpointing on a line: A modern technique for solving deep burials

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Abstract: Deep burials can provide a vexing challenge to even the most experienced of transceiver users. "Null" and "misleading maximum" signals surrounding the victim often result in excess bracketing, probing, and excavation. By pinpointing on a line using dual-antenna, digital technology, advanced users can reduce the pinpoint area from a plane to a line, minimizing their exposure to these pitfalls and maximizing their chances of making a live recovery.

Keywords: Avalanche rescue, pinpoint search, null, spike, misleading maximum, misleading minimum

Nulls and the Vertical Field

Most avalanche professionals will tell you that during a beacon search, signal strength is highly dependent on the orientation of the receiving beacon's antenna with respect to the field of the transmitting beacon. Maximum signal strength occurs at any given point when the receiving beacon's antenna is in line or parallel to the field of the transmitting beacon. When the receiver is rotated away from that orientation, however, the signal becomes weaker, and will approach zero if perfectly perpendicular. This directional sensitivity is the basis of performing an induction line search; while performing a fine search on the horizontal plane, the searcher periodically re-orientates the receiver to maintain a parallel orientation with the field of the transmitter.

Many people don't realize, however, that the same phenomenon occurs in the vertical plane, which is the realm of the pinpoint search. Within approximately three meters of a transmitting beacon—more as the depth of burial increases—the flux pattern starts curving sharply in the vertical plane, into the snow. Since most searchers aren't trained to adjust their orientation vertically, they typically lose their alignment with the field. At some point their searching beacon, which is horizontal, becomes perpendicular to the field, which is now vertical, and the signal strength approaches zero. This point is commonly called the "null" for analog/audible-based beacons because the sound fades sharply. It's called the "spike" for digital/visual-based beacons because the distance reading on a digital

display "spikes" to a higher number. In addition, the lights will go off center and the distance display might temporarily go blank.

"Misleading" Maximums and Minimums

Nulls and spikes are a concern because they can create what are sometimes called "misleading maximum" or "misleading minimum" signals. A misleading maximum refers to the relatively loud signal an analog/audible-based beacon receives right before the searcher hits the null. Novices and experts alike often hear this null, then bracket around the loud signal they heard right before it. As they bracket to the sides and reach other fade points in the horizontal plane, a "misleading maximum" is created. These other fade points occur because as the field curves, the searching beacon loses alignment with it. And in such close proximity to the transmitter, the field curves very sharply.

With a digital, visual-based beacon, "misleading maximums" are called "misleading minimums" because the distance reading is relatively low when compared to the anomalous high distance reading at the spike. As explained below, a "misleading minimum" using a digital, dual-antenna beacon is only a point along a line, rather than a square created by bracketing on a plane. In either case, if the burial is deep, these misleading signals can be offset from the victim's actual location by as much as the burial depth. For instance, in a horizontal burial two meters deep, a searcher could unknowingly start probing or digging nearly two meters away from the true maximum/minimum under which the victim is located.

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The problem of nulls and misleading maximums is exacerbated by the limitations of single-antenna technology. With a single antenna beacon, which has

very little directional precision, it is very unlikely that your fine/induction line search will bring you directly over the top of the transmitter, where you would most often find your only true maximum reading. Instead, you are more likely to pinpoint around a misleading maximum. This problem occurs because with a single-antenna beacon, the pinpoint search is performed by bracketing within an area surrounding the transmitter, not along a line. And within this pinpoint area, there can be up to six misleading maximum signals that could be mistaken as the victim's location (Figure 1).

In a deep burial, this area of misleading maximums can be very large. All beacon manufacturers recommend starting the pinpoint search at least three meters out; if bracketing, this corresponds to an area of 36 square meters. However, pinpointing on a line with a dual antenna reduces this area from a large plane with up to six misleading readings to a line just six meters long, with a maximum of only two misleading readings.

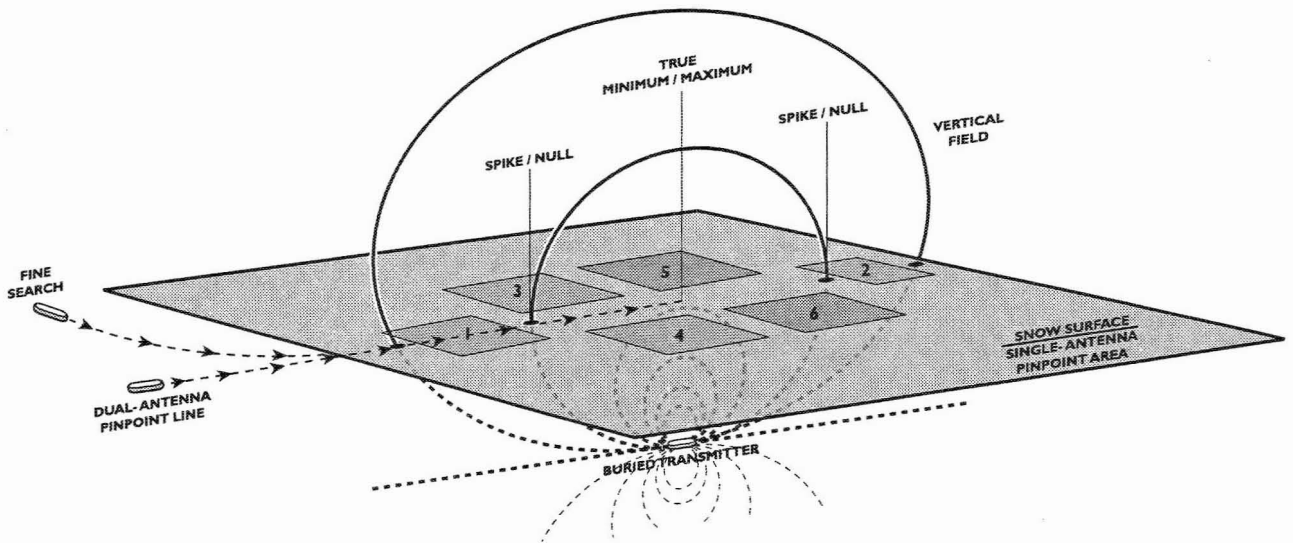


Figure 1

Misleading Maximums/Horizontal Burial: When bracketing with an analog, single-antenna beacon, the pinpoint area can be a large plane containing up to six misleading maximum signals. Misleading maximums #1 and #2 will be encountered when bracketing with the searching beacon approximately parallel to the transmitter. Misleading maximums #3-6 will be encountered when bracketing with the searching beacon roughly perpendicular to the transmitter. When pinpointing on a line with a digital, dual-antenna beacon, the search is reduced from a plane to a line, and the searcher avoids misleading maximums #3-6.

Vertical Burials

Pinpointing can get even more interesting in scenarios where the transmitting antenna is buried approximately vertical. In this case, the null or spike will be located directly on top of the transmitting beacon and there will be a box of maximums surrounding it (Figure 2). This phenomenon is sometimes called the "shadow box." Searchers bracketing with a single-antenna beacon will often probe the entire box to locate the victim. By pinpointing on a line with a dual-antenna beacon, this box of maximums is reduced to two minimum distance readings along the pinpoint line, with one on either side of the spike.

It should be noted that vertical transceiver burials are quite common. Statistics have shown that the majority of completely buried victims are found in a horizontal position. Since many beacons are worn on the side of the body, the antenna would be roughly vertical.

If the transmitting antenna is buried at an approximate 45-degree angle, the field will show characteristics similar to that of a horizontal burial, only the true

maximum will be closer to one misleading maximum than the other. For the "shadow box" phenomenon to occur, the transmitting antenna must be very close to vertical.

For clarity, misleading readings in figures 1 and 2 are only shown where they occur above the snow surface. Misleading readings also occur below the snow surface, but would only affect the searcher if the slope were extremely steep.

Existing Techniques

Several techniques currently in use address the issue of misleading maximums. One solution is to push through all fade signals in the pinpoint search to see if there is a true maximum reading on the other side. With enough practice, this method can be effective for both analog and digital beacons, although it requires extensive and time-consuming bracketing. Another solution is to pinpoint with the beacon oriented vertically, which can reduce the number of misleading signals. Whether the searcher is holding the beacon horizontally or vertically, however, he or she must

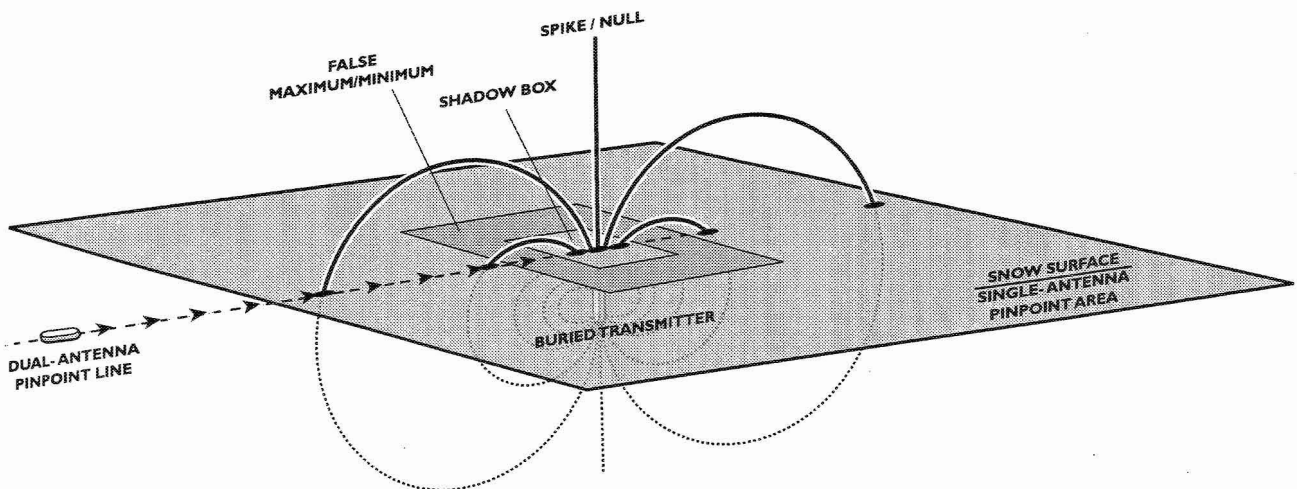


Figure 2

Misleading Maximums/Vertical Burial: If the transmitter is oriented vertically, there will be a "shadow" directly over the victim, surrounded by a "box" of maximum readings, using a single-antenna, analog beacon. By pinpointing on a line rather than bracketing, this box is eliminated.

always continue to extend his or her brackets to test for more misleading maximums.

Using a more recent technique, called "pinpointing in a circle" (Genswein, 2001), the searcher holds the beacon vertically. Once a first maximum is bracketed, the searcher backs off until the signal disappears, then walks in a circle to search for a second maximum. If a second maximum is detected and bracketed, the searcher then turns his or her beacon horizontally and walks in a straight line between the two. A true maximum reading should then be encountered somewhere on this line. If no second maximum is detected, the searcher returns to the first maximum, which is then determined to be the "true" maximum in a vertical burial. This technique is mainly applicable to single-antenna, analog beacons as an aid for establishing a straight "pinpoint line" in the absence of a dual antenna.

Pinpointing on a Line

Do the techniques above seem somewhat convoluted? If so, that's because they address the symptoms, not the problem. The cure is to avoid these nulls and misleading maximums as much as possible by reducing your pinpoint search from a plane to a line: the axis of the transmitting antenna. The only way to do this is to pinpoint on a line, which can only be done with a modern dual-antenna, digital transceiver. Single-antenna, analog beacons do not have the directional precision required to establish a precise pinpoint line without first walking in a circle. And by pinpointing on a line, the searching beacon can be held horizontally. This is the easiest orientation for reading distance and directional information while performing an induction search with any beacon.

The key to pinpointing on a line is to establish a straight line before the pinpoint search, or at the spike reading(s). In most cases, this task is very straightforward. If you have picked up the signal from its maximum distance, you will most likely be travelling in a straight line before reaching the spike. However, if your search path is still curved when you reach the first spike, back up and approach the transmitter from another angle (Figure 1). After one or two different approaches, you will be able to extrapolate a straight line that will closely correspond to the axis of the transmitting antenna. At this point, it is helpful to lay a long object, such as a ski or probe pole, down on the snow surface in the direction you have established. You can then limit your search to

this line, avoiding all but two of the six potential misleading readings.

Once you have narrowed the search to this line, ignore all directional arrows and simply look for the lowest distance reading along the line. When you detect a minimum reading, extend past it, along the line, to see if there is another one. If there is only one minimum reading and two spikes, probe at the single minimum reading, because the transmitter is buried approximately horizontal. If there are two minimum readings and one spike between them, probe at the single spike, because the transmitter is buried approximately vertical. If the number of spikes is unclear, probe at lowest reading.

Before probing, it is helpful to confirm the minimum reading(s) by bracketing once perpendicular to the line. This step will add more precision in case the line wasn't established properly. In a horizontal burial, keep the searching beacon horizontal and bracket at the lowest reading. In a vertical burial, orient the searching beacon vertically at the spike and bracket. In both cases, ignore directional readings and pay attention only to the numeric distance display. With enough practice, an expert searcher should never have to probe more than once.

Bracket searching is a valid and reliable pinpoint search technique using both analog and digital avalanche beacons, especially for novices in shallow burials and for experts in close-proximity multiple burials. For most professionals, however, pinpointing on a line promises a much-needed cure for the deep-burial blues.

References

Genswein, M., 2001. Pinpointing in a Circle. *The Avalanche Review*. 19, 3.

For complete instructions on teaching this and other transceiver search techniques, see the new Tracker DTS Instruction Guide and Advanced Tutorial. These are available from Backcountry Access at (303)417-1345 and can be downloaded at <http://www.bcaccess.com>.

S.A.F.E.

Avalanche control work has long been a dangerous part of daily Ski Patrol life. During times of extreme stress recalling protocols and standard operating procedures can be a difficult task. At the Breckenridge Ski Area we have developed an acronym to assist patrollers in recalling a flow chart for effective partner rescue procedures. This poster addresses the need for an organized strategy in partner rescue and recovery. Think **S.A.F.E.**

SNOW SAFETY PARTNER RESCUE

RESCUER SAFETY IS PRIORITY # 1

S = SIGNAL

STAY CALM!
CALL PATROL DISPATCHER
"10-100, 10-100, 10-100"
OF PATROLLERS BURIED & LOCATION
DISPATCH DO YOU COPY?
(REPEAT IF NO RESPONSE)

A = ANALYZE

SCENE SAFE? → ADDITIONAL HAZARD
CHARGES IN ON
ADJACENT ROUTES
TRANSCIVER
SEARCH PLAN → ONE RESCUER
TWO RESCUERS

F = FIND

FOCUS ON TRANSCIVER SEARCH
FIND YOUR PARTNER FAST!!!!!!
RADIO OFF!

E = EVACUATE

OUR GOAL IS A SAFE EVACUATION!
EVERY SECOND COUNTS!

REMEMBER, YOUR PARTNER'S BEST CHANCE FOR SURVIVAL IS
YOU!