TELONICS QUARTERLY™

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Which Way Did He Go?

Special Sensors Help To Quantify Activity Data

In addition to providing a means for biologists to locate animals, radio telemetry can be used to convey in- formation regarding animal activity. Historically, activity information has been inferred from changes in received signal amplitude or frequency. With this approach, it is assumed that a con-stant signal indicates an inactive animal and variations in amplitude or frequency indicate activity. While this approach to activity monitoring provides insight into activity patterns, it is difficult to quantify. In addition, users differ in their ability to distinguish small amplitude or frequency changes. Fluctuations in noise levels may hide amplitude variations, and the received signal amplitude is influenced by the movement of objects (e.g. vegetation, other animals) in the signal path between the transmitting and receiving antennas. A common solution is to incorporate special sensors into the transmitting subsystem to indicate changes in activity through changes in pulse rate. There are two basic approaches to monitoring activity and both provide a more accurate and quantitative evaluation of activity than is possible with amplitude or frequency variations alone.

The first approach involves "real-time sensors." In this case, changes id activity are instantaneously reflected by changes in pulse rate. The most frequently used type involves a tip-switch which provides specific pulse rates depending on the orientation of the switch. Such sensors can be used to indicate positioning at a given time (e.g. head up versus head down, perched versus flying). If the changes in position are rapid, an intermediate pulse rate results. The number of pulse rate changes during a specific time interval can be quantified to index activity.

A second type of real-time sensor, the Relative Activity Sensor, provides an increase in pulse rate as activity increases. The pulse rate varies continuously within specified limits (e.g. 50 to 100 bpm). Establishing how much activity is taking place or what behaviors result in a particular pulse rate requires extensive visual calibration.

"Time-delay sensors" form the second approach to monitoring activity. In this case, a counter is used in conjunction with a switch. If the switch has not been triggered within a specified period of time, the pulse rate of the transmitter is changed. Thus, time-delay sensors provide "active" and "inactive" pulse rates. Delay times can vary from several seconds to many hours, and pulse rates can either increase or decrease after the time delay is exceeded.

The most common use of time-delay sensors has been in mortality studies. Delay times are usually set at several hours and once the delay time is exceeded, the pulse rate increases to act as an alarm. Short delay times (e.g. 1 or 2 hours) are used when it is important to know about a mortality quickly. Longer delays (e.g. 4 to 11 hours) are used to avoid "false triggers" that may occur when an animal is bedded for extended periods.

Time-delay sensors may also provide a slower or decreased pulse rate after the delay period is exceeded. This capability is often used with bears to indicate a period of hibemation.

Short delay times (seconds, minutes, 1 to 2 hours) may be used to monitor various kinds of motion or activity. If a time-delay sensor is pulsing in the inactive rate, the active rate is immediately resumed once motion occurs and the switch is triggered. The delay time must again be exceeded for the inactive rate to resume. This is an important consideration in evaluating the time spent"active" versus"inactive." Slow pulse rates can be difficult to triangulate, so the use of fast "active" pulse rates and slower "inactive" rates also provides for the easier location of moving animals.

The use of special sensors can provide biologists with a method for remotely quantifying activity data. However, thought must be given to the type of data to be collected and which type of sensor is most appropriate. Further considerations include the effects of switch orientation, delay times and pulse rates on the biological questions to be answered, ease of data collection, and battery life. *Bill Burger*

Field Notes On Receivers

Static Electricity May Be The Problem

Telemetry receivers are designed fortwo basic functions. They amplify very weak signals and they bring those signals within the range of human hearing. At Telonics, we are always concerned about the operating performance and reliability of every TR-2 in the field. If you have experienced reduced sensitivity while using your TR-2, it may be the result of damage to the front end (first RF amplifier) of your unit. The cause is often static shock to the input of the receiver.

Electro static discharge often occurs when you're getting in or out of your vehicle. Sliding across the seat builds up static electricity and it's discharged through the receiver if the antenna is touched. Synthetic materials contribute significantly to the problem. While it is impossible to avoid all clothing andl or fabrics which generate static electricity, the use of an antistatic fabric softener on clothing and vehicle seats can greatly reduce the potential for damage. This is especially helpful during cold weather when static electricity builds up rapidly. It is also good practice to disconnect the antenna from your receiver before getting in or out of vehicles.

High voltage damage may also occur when using mobile communication systems. High-powered voice transceivers generate so much radiated power that the front end of the receiver may be damaged in a manner similar to static discharge. Again, the solution may be to remove the coaxial cable from the receiver and make sure the receiver is off while transmitting with your voice communication system.

Separating your magnetic roof-mounted antenna from your transceiver antenna will also minimize possible damage to the TR-2 and increase the range performance of both systems. In general, all antennas perform more effectively when they are not in close proximity to one another or to other conductive objects. *Susie Crow*

Why It Works

Almost Everything You Ever Wanted To Know About Antennas

For those of us who have been involved in telemetry for a number of years, I think most would agree that antennas are one of the more frustrating pieces of equipment around. These strangely contorted pieces of metal strung together in precisely positioned arrays must face and hopefully withstand the abuses of intense winds, rainfall, hail, snow, icing, salt water spray, tornados, hurricanes and even direct lightning strikes. In addition, these finely tuned instruments may be called upon to withstand a sixty mile ride in the back of a pickup with a forty pound cooler sitting on top of them. They may have to sustain the impact of smashing into an unexpected low hanging branch as we move the truckmounted array from antenna site one to antenna site two at four in the morning. In some extreme acts of abuse, the biologist himself may literally throw his body against the antenna as both cascade down an embankment after a misplaced step. Putting all this aside, there simply is not any way to do without antennas, and their use and proper application in the overall study design can either make or break a study.

In a brief article such as this, it is not possible to explain all the intricacies associated with antenna design, production, and/or proper application. However, it is sometimes good to take a step back from that level of examination and look at the broader concept.

The antenna's principal function is simply as an impedance matching device. Impedance is the counterpart of resistance, but as applied to an alternating current condition such as radio frequencies. The antenna is therefore a transformer, essentially providing a mechanism for interfacing between the radio wave traveling in air and the wave traveling into your receiver or out of your transmitter. It is a bilaterally symmetrical device which operates the same way whether you are receiving or transmitting a signal.

In most wildlife applications, the transmitting antenna is very constrained and many times it is simply an unmatched piece of wire selected more for durability than any electrical characterislics. By comparison, the receiving antenna is complex and takes advantage of several antenna characteristics which make proper selection crucial. For example, if the antenna is positioned at a central location and data only is required, an omnidirectional antenna designed to receive signal equally from all directions is preferable. In other situations, hearing the signal is not enough. Location is also required and the omnidirectional antenna does not help in this regard. Therefore, arrays of elements (such as the Yagi-Uda Array) are used, resulting in gain patterns which characteristically make the signal stronger in one direction and weaker in another. In handheld applications, on vehicles and on aircraft where vegetation and/or the close proximity of metal interfere with the antenna's frequency, pattern and gain, the small H-Antenna is the preferred choice. Smaller arrays are less influenced by nearby objects, while larger arrays must generally be mastmounted in freespace to achieve their promised performance.

The larger arrays do have their place, and for applications where every meter of range is important, it helps if they are mast mounted. It also helps if we don't expect too much. The difference in performance between an H-Antenna and a five element beam is approximately six decibels, or about two times the line of site range. The next step up is a big step. To significantly increase the line of site range of the five element antenna, a fourteen element antenna must be considered. The fourteen element antenna has only four decibels more gain than the five element. This does not translate to even one and one half times the line of site range performance of the five element antenna. In addition to gain, the pattern of the larger antennas is narrower and thus reduces errors in bearing frequency when compared to antennas with fewer elements. However, the larger arrays have an inherent problem. As the arrays grow in size the sidelobes can become significant in signal reception and actually confound direction finding in mountainous areas with a lot of signal bounce.

In some applications, as in the case of precision direction finding systems where the minimum bearing error must be kept to 2-3 degrees, two small antennas must be arrayed together with proper phasing. The narrower null allows a much more precise bearing accuracy than could be achieved with larger (narrow beam) antennas.

In summary, selection of the proper antenna comes down to knowing its particular characteristics, choosing the right one to do the job, and maintaining it in the field so that it retains thosecharacteristics throughout the course of the field work.

Stan Tomkiewicz

Lab Notes On Transmitters

Proper Care and Exercise Are Key to Operational Life

While VHF transmitters are often stored for long periods of time, this will not significantly affect the overall life of the unit if proper care is taken.

All transmitters shipped from Telonics are in the "off" position to avoid unnecessary battery usage. Great care is taken to make sure each transmitter is properly packed in the shipping container. This prevents the magnets from moving during transit. Proper packaging also keeps the magnets separated to avoid cancelling out their respective magnetic flux fields, thus activating the units.

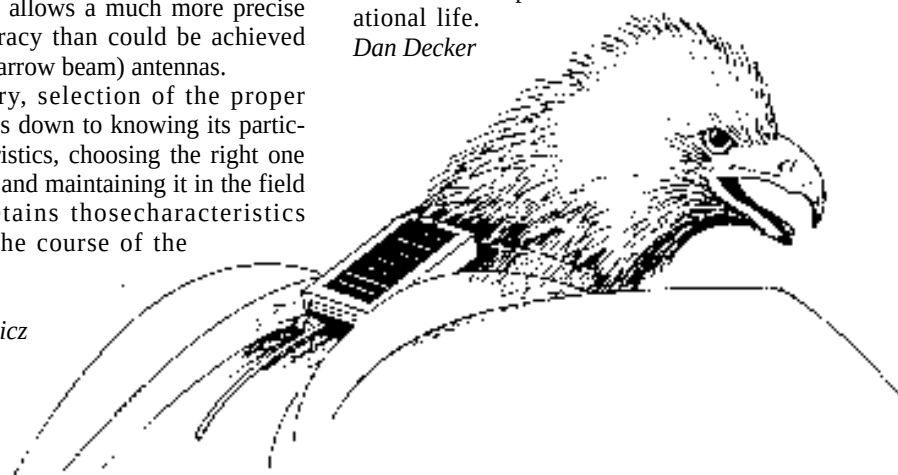
When a transmitter arrives at your location, each one should be checked to make certain that the magnet has not moved during shipping. Documentation should begin at this time and the condition of the transmitter should be noted.

Ideally, transmitters should be stored at room temperature on a wooden shelf with the magnets no less than one inch apart. If the magnets move or are cancelled out by attraction to other metals, the unit could be activated during a storage period. Regular checks should be made to ensure that the transmitter is off and not consuming battery capacity.

Stored transmitters should be exercised on approximately two to three days per month. Both before and after an exercise period, the transmitters should be checked to make sure that the units are properly turned on and off. This can be done with a receiver. Once the exercise schedule is established, it is important that accurate records be kept.

If storage is initiated properly and well documented, the condition of the transmitter will never be in question. It will always be ready for deployment without significant loss to overall operational life.

Dan Decker



View From The Basement

Telemetry From The Personal Point of View

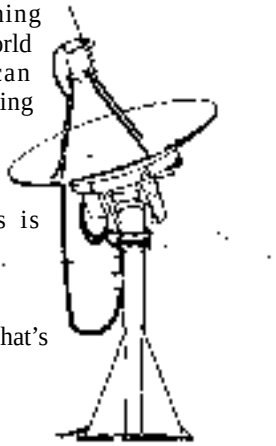
It seems only a few years have passed since a few of us threw caution to the wind and made the decision to devote full time to the rapidly advancing field of wildlife and environmental telemetry. I suppose it's true that time flies when you're having fun because that decision was made some fifteen years ago, subsequent to working in the field solely as a hobby since the early sixties. Your support and friendship over the years have been, and continue to be, sincerely appreciated.

In retrospect, we had a pretty good idea of the technological advancements needed by the field when we began designing systems. However, in all honesty, we had no idea that the generally accepted logarithmic slope depicting the advancement of technology versus time would be so acute in some areas and so far off the mark in others. Satellite technology continues to bend the curve increasingly upward at a hyperabrupt rate. Other equally important areas seem to plateau out...apparently holding indefinitely at a given level while awaiting some new development to break things loose again.

Experience has taught us that new developments are not always the answer. Many times common sense brings solutions to problems which are far more efficient than glitzy new technology. One good thing about living a long time is you have the chance to observe cyclic patterns in human behavior. It has been interesting to note that a similar phenomenom occurs in technology. The dominant seven to ten year cycle has been noted in several fields...causing the "reinvention" of both hardware and ideas. We feel that recognizing these technological throwbacks is an important facet of the trust placed on our staff by the field.

Historically, there have been times when "high technology" has been presented to a funding group as the ultimate carrot. It might be the promise of automated tracking of large mammals in variegated terrain through the use of transponder type systems, or the funding of research in areas of technology which were technologically unsound in our opinion. In such cases, it has been our practice to tell folks there is a problem and why there is a problem. This does not always endear us to the parties involved, but we think it is irresponsible to stand by and watch silently while funds are expended which could otherwise provide a meaningful return in some important field of research. Time has proven our position to have been correct in every case over past years and we will continue our policy of telling things like they are technologically. We hope that, like us, you are pleased our laboratory is one of the few remaining places in the world where you can count on receiving a straight answer to your questions. Since Telonics is committed to-- you and your work, we think that's only fair. \

Dave Beaty



Rules and Regulations

Lithium Batteries Require Special Handling

During the past year, shipments containing transmitting subsystems have required additional transit time with a corresponding increase in costs. The delays are caused by the fact that the majority of transmitters produced by Telonics contain lithium batteries.

The Department of Transportation (DOT) has classified lithium batteries as dangerous goods simply because they contain lithium. If severely abused, there is the possibility that the batteries could rupture-ignite and emit toxic gases. Therefore, the packaging requirements are strict and the mode of transportation limited to motor vehicle, cargo only aircraft, rail freight or cargo vessel.

While shipments within the continental U.S. have not experienced any particular delays, you should allow at least one week freight time when shipping to either Alaska or Hawaii. Anchorage is the only Alaskan city serviced by cargo only aircraft and all shipments must be forwarded by truck to other destinations throughout the state. Shipping to Hawaii requires that we first ship to a freight forwarder in Los Angeles, who in turn offers transportation to the Islands by either air or surface carriers.

Intemational shipments, governed by IATA standards, have been taking considerably longer as the shipment must first be placed on a cargo only aircraft to a major city. Forwarding the shipment on generally requires surface carriers, since connecting air service is often unavailable.

Telonics is a participant in the DOT exemption for shipping lithium batteries, and our customers can forward goods to other destinations providing the same packaging and carton are used. Manufacturers who ship lithium batteries outside the dictates of the exemption are doing so illegally.

Scott Jarvis, Manager of Shipping and Receiving at Telonics, recommends Federal Express as one of the most economical ways to ship dangerous goods. In addition, Federal Express maintains a "dangerous goods hot line" to aid customers with airway bills and other required documentation. Brenda Milam

Premiere Issue

We've Been Talking AboutItFor Years

Getting into the publishing business is very exciting and it's something that Telonics has been wanting to do for a long time. Our primary objective in developing the Telonics Quarterly is to better serve our customers. In a rapidly changing industry, we hope to provide current information of practical help to the field scientist.

Since Telonics is a firm involved in research and development, we'll try to share what we're learning. We also get lots of questions, so various members of the staff will be answering the more common ones. And we'll continually pass on our best advice about the care, feeding and use of equipment you already have.

We hope you find the Telonics Quarterly helpful, and we encourage you to let us know what kinds of information you most need. If you have comments or suggestions, feel free to write or call us at (602) 892-4444. Your input will be much appreciated.

Satellite Update

Uplink Receivers Offer
A Range of Capabiliies

About four years ago, we began looking for a receiver that would efficiently test and calibrate ARGOS PTT's in our laboratory as well as in the field. We wanted a small, reasonably priced subsystem which would receive and display data from nearby PTTs. Since we were unable to locate a unit fulfilling our requirements, we decided to design and build our own.

The result was a microprocessor-based receiving subsystem capable of receiving transmissions from a distance of a few meters. The subsystem fed the decoded sensor data and ID code information to any suitable terminal (e.g. lap top computer) through a RS-232C port. The device did not display data and error codes directly, but provided a simple indication of message quality. When the communication port was connected to a small lap top computer or serial printer, the data could be displayed.

We found this device to be extremely useful in field work, allowing reception and direct feedback when calibrating sensors on test animals. It also provided data for developmental work on more advanced PTT designs in the laboratory.

After several months of gathering additional information regarding the technology of low current, low temperature displays, and as our experience with low current microprocessors increased, we designed a more advanced unit. The new generation serves as an independent receiving/diagnostic subsystem. It feeds a data logging terminal, printer or computer with time and date flagged, data and appropriate error codes. The range of the subsystem is adequate for use in the field after the deployment of PTT's.

The multi-purpose capabilities of the subsystem make it invaluable to oceanographic studies as well as to biologists deploying PTT's on animals. Each PTT unit can now be tested directly without waiting for a satellite overpass, data processing and dissemination through the ARGOS system. This testing allows field scientists to determine if the equipment is functioning properly before they leave the deployment area.

The latest uplink receiving subsystem has been used for automated PTT manufacturing processes, logging laboratory data during system calibration, and receiving data from the field. In all of the above cases, the subsystem is primarily performing a test function. However, the usage can be extended by supplementing experimental data during periods of time when satellites are not present.

Jeannie Russell