Automated Wildlife Telemetry/Signal-processing Engineering Opportunity

Who and What?

Ecologists at the University of Georgia, U.S. Geological Survey, and U.S. Fish & Wildlife Service look to develop an automated telemetry system to generate high resolution spatiotemporal wildlife telemetry data over a relatively small scale (1.5 km x 1.5 km study area). It will be deployed to study the ecology of imperiled Black Rails.

How?

Currently, there are three commercially available transmitters for use in an automated telemetry system for small animals:

1. **Lotek "nanotags"** transmit at 166.38 MHz and use On-Off Keying to encode tag identity.
2. **Cellular Tracking Technologies "Life Tags"** transmit at 433 MHz and use Frequency-shift keying to encode tag identity.
3. **"Beeper"** tags transmit at various VHF frequencies with tag identity via the transmission frequency.

To localize these signals of interest (individually tagged animals), we envision an automated telemetry array composed of a fairly dense grid of 9-16 stations (cost-dependent) covering the ~ 2.5 km^2 study area. Each solar-powered station comprises a pop-up mast (~ 5 m tall) topped with a small square/circular array of 4-6 monopole or dipole antennas, connected to a single sofware-defined radio (SDR) receiver (e.g., FunCube, RTL SDR). Our current expectation is that each multi-element array will use a commutating switch to select antennas around the array and thus approximate a doppler antenna. Each station could then use a phase-based direction finding method to produce an estimated bearing (direction of arrival; DOA) of each received signal using the general method described below. Transmitter localization then occurs via triangulation based on simultaneous tag detections and DOA estimates by multiple stations.

Needs

This is largely a software-development, signal-processing project, with some hardware development on the front-end. In particular, we are not aware of commercially-available antenna-switching hardware for this application, thus it may need to be designed/developed. Additionally, we do not believe this system has been used previously with SDR. The HAM radio community is expected to be a valuable resource, however, as it might have already developed a relevant kit, or implemented such a system for transmitter hunting competitions. Software will need to be developed to handle the antenna-switching and data processing aspects (e.g., demodulating the received signal, retrieving Doppler shift measurements and detecting the point of zero crossing, and triangulating positions of simultaneous detections of multiple stations). Localization will not occur in real-time. Open-source software (Sensorgnome; see also here) developed for the Motus Wildlife Tracking System exists to extract detections of Lotek nanotags recorded via SDR; building upon this base would be ideal. We expect to deploy beacons/tags to help calibrate the system and resolve ambiguity. Field testing of hardware and software will occur locally (University of Georgia, Athens, GA) prior to field deployment.

Desired experience/interests

- Linux/Unix command-line familiarity
- C/C++/Java/Python/R/Matlab familiarity (one or more)
- Ham radio
- Software-defined radio
- "Hacking"
- Circuit board construction

Compensation

Modest compensation is available and is negotiable.

Contact

To discuss the project further, please contact Adam Smith, U.S. Fish & Wildlife, adam_d_smith AT fws.gov.