A novel method to calculate 2D acoustic telemetry tracks: application example in high noise environment

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The advances in telemetry nowadays allow to position fish at a high spatio-temporal accuracy when detection stations are placed in a grid (i.e. 2D telemetry). Yet, the high spatial accuracy needed when studying animal behaviour at such fine-scale temporal resolutions is not always reached. Most available post-processing software for acoustic telemetry can be expensive or even black boxes. In addition, the accuracy of determining fish positions is not always expressed in meters, but rather in a complicated metric which makes interpretation difficult.

In this work we demonstrate the results of a new intuitive algorithm for processing 2D acoustic telemetry data. We illustrate the algorithm with a case study using five hydrophones placed near the outflow of a small hydropower station. Position accuracy estimations were verified with GPS test tracks. To eliminate a priori impossible transmitter positions in the dry areas, the potential area is restricted to a wetted surface of a river. After time synchronization of all hydrophones, transmitter positions are found by iterating over grid cells covering the study area. The true position of a transmitter is determined using the time-of-arrival (TOA) of a detection on at least three hydrophones. The method enables the estimation of transmitter locations with an accuracy comparable to that of the commercial InnovaSea system (VPS: Vemco Positioning System), but with fewer outliers as the algorithm is bounded by river edges. We show that the performance of the receiver array decreases rapidly as the transmitter moves outside the enclosing receiver polygon. The accuracy is given in meters, thus allowing to filter the obtained positions individually based on specific study requirements. Therefore, we think this method will benefit many fish ecologists in their analysis of 2D telemetry networks.