RFC 1: Collisions in Delay-Based ID Encoding Protocol

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Contents

1 Introduction

The protocol proposed for this project encodes an unique identification number in the transmitted signal by the delay between two consecutive pings. While this method is easy to implement in hardware, and works well in the case of only a signal transmitter, the addition of multiple transmitters within range of a receiver brings about the potential for collisions between different signals. In some cases, the collisions may be undetectable, leading to incorrect reporting of nearby crab IDs. Completely solving this problem will require a change to the underlying protocol. However, the likelihood of such collisions may be low enough that we move forward with this known flaw in the protocol.

2 Original Protocol

In the current iteration of our detection and identification protocol, every transmitter will transmit at the exact same frequency, likely somewhere around 40kHz. This is ideal from a hardware perspective, as the piezoelectric equipment can be tuned to work on a single frequency with a high degree of accuracy.

Every transmitter will periodically send out two quick "pings," each separated by some delay d. The value of d will encode the ID of the transmitter. For example, $d = 42$ms may correspond to

ID 30, and a delay of 50.5ms may correspond to an ID of 38. Note that these numbers are only examples. Because the receiving hardware can easily detect the two pings, it can measure the value of d by calculating the time difference between the rising edges of the consecutive signals. See Figure 1 for an illustration.
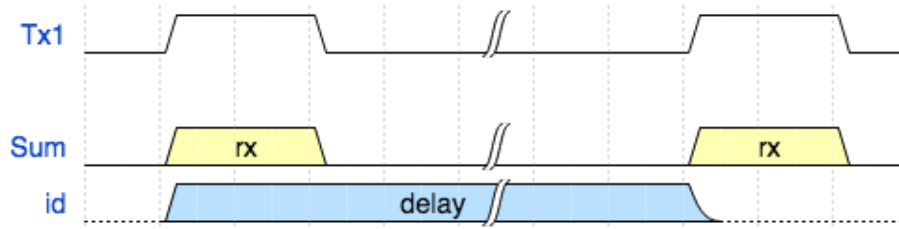

Figure 1: A single transmitter ($Tx1$), the input received by the receiver (Sum), and the calculated delay d based on the time measured between the rising edges of the two pings from $Tx1$.

While this method may be reliable with just a single receiver, it does not work so well when multiple transmitters are brought into play.

3   Problem

3.1   Details