

Hydrophones

This method of interpreting hydrophone data has been deprecated in favor of [this method](#).

Before reading this page, make sure to check out the **Problem Setup** section of [this page](#).

This page is a summary of how we use the hydrophones to figure out our position.

Note that δ , ϵ , and ζ are defined as:

h_0 is at location $(0,0,0)$
 h_x is at location $(\delta,0,0)$
 h_y is at location $(0,\epsilon,0)$
 h_z is at location $(0,0,\zeta)$

The primary results from [this derivation](#) are equations [eq:xyz](#) and [eq:p0_initial](#).

$$\begin{aligned} \text{label}{eq:xyz} & x = \frac{\Delta x (2p_0 - \Delta x) + \delta^2}{2\delta} \\ & y = \frac{\Delta y (2p_0 - \Delta y) + \epsilon^2}{2\epsilon} \\ & z = \frac{\Delta z (2p_0 - \Delta z) + \zeta^2}{2\zeta} \end{aligned}$$
 With variable definitions given by [eq:variable_definitions](#).

$$\begin{aligned} \text{label}{eq:variable_definitions} & a_x = (\Delta x / \delta)^2 \\ & b_x = (\Delta x / \delta)^2 (\delta^2 - \Delta x^2) \\ & c_x = (\Delta x^2 - \delta^2 / 2\delta)^2 \\ & a_y = (\Delta y / \epsilon)^2 \\ & b_y = (\Delta y / \epsilon)^2 (\epsilon^2 - \Delta y^2) \\ & c_y = (\Delta y^2 - \epsilon^2 / 2\epsilon)^2 \\ & a_z = (\Delta z / \zeta)^2 \\ & b_z = (\Delta z / \zeta)^2 (\zeta^2 - \Delta z^2) \\ & c_z = (\Delta z^2 - \zeta^2 / 2\zeta)^2 \end{aligned}$$
 Let us simplify eq. [eq:p0_initial](#) using the following substitution:

$$\begin{aligned} a &= (a_x + a_y + a_z - 1) \\ b &= (b_x + b_y + b_z) \\ c &= (c_x + c_y + c_z) \end{aligned}$$

This gives us eq. [eq:p0_initial_simple](#), which is an ordinary quadratic equation.

$$\text{label}{eq:p0_initial_simple} 0 = p_0^2 a + p_0 b + c$$
 Applying the quadratic formula to eq. [eq:p0_initial_simple](#), we can solve for p_0 .

$$\text{label}{eq:p0_solved} p_0 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

This will give us two possible solutions for p_0 . We can combine this result with eq. [eq:xyz](#) to solve for x , y , and z .

Reversing the Problem

Here we describe how the simulator takes the position of the sub and calculates fake hydrophone timing data.

Need figure this part out!

From:

<https://robosub.eecs.wsu.edu/wiki/> - **Palouse RoboSub Technical Documentation**

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<https://robosub.eecs.wsu.edu/wiki/cs/hydrophones/start?rev=1505265017>

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