Rachel O'Grady
MAI Project

Estimating Distance and Calculating DAS

Estimating distance from Antenna 1 and Antenna 2 to object using time delay

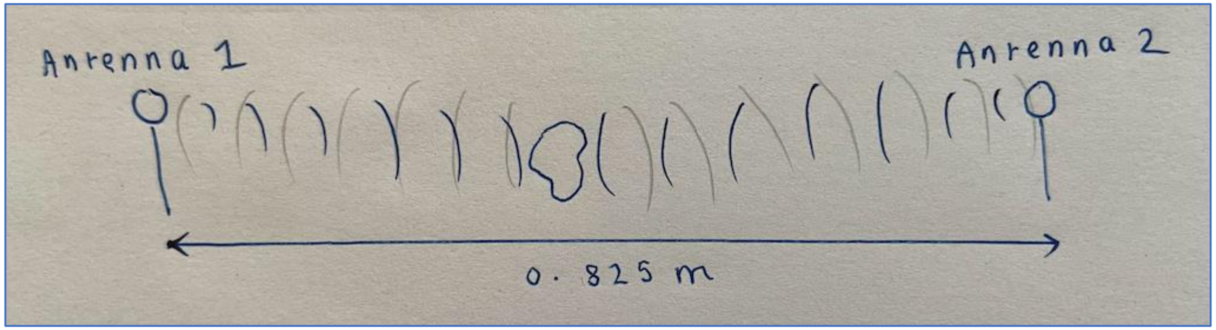

fig 1: sketch showing the distance between the two antennas and an object in between

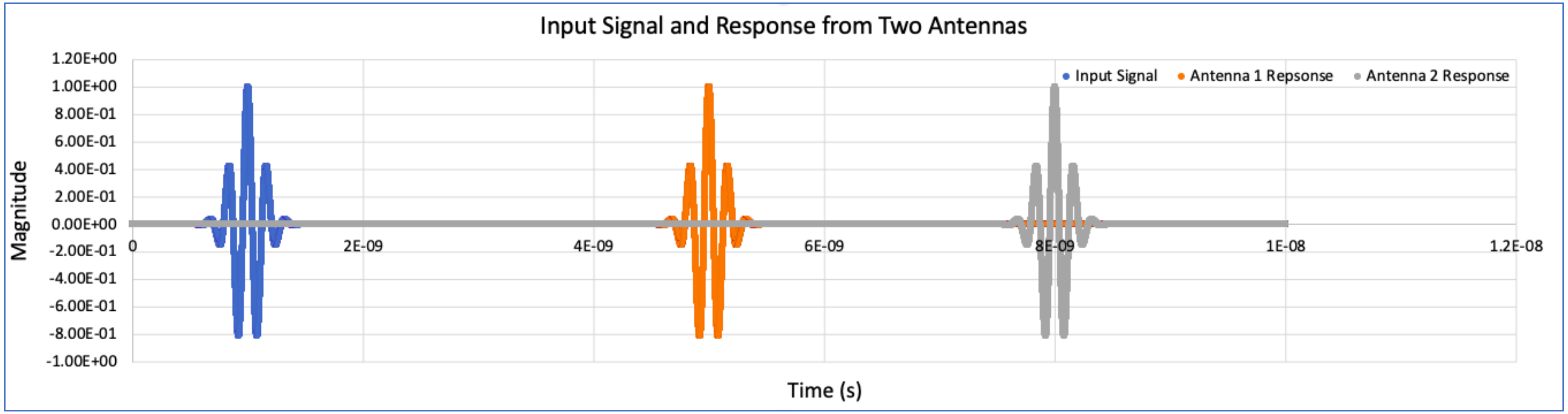

fig 2: plot of the ranging data showing the input signal, response from antenna 1 and response from antenna 2

From analysis of the ranging data, it appears that all three signals are identical and symmetrical. To determine the time delay between the input signal and response of both antennas, a point along the input signal is chosen where the pulse appears to start. The magnitude at this point is repeated in the response of both antennas. The time at which this magnitude occurred for all three signals is recorded.

	Magnitude	**Time (s)**	**Cell number**
Input Signal	0.00010008	$4.77\text{x}10^{-10}$	4773
Antenna 1 Response	0.00010008	$4.48\text{x}10^{-9}$	44773
Antenna 2 Response	0.00010008	$7.48\text{x}10^{-9}$	74773

To calculate the time delay for each antenna, the input signal time is subtracted from the antenna response times at this magnitude:

Time delay Antenna 1:

$$4.48 \times 10^{-9} - 4.77 \times 10^{-10} = 4.003 \times 10^{-9}\ s$$

Time delay Antenna 2:

$$7.48 \times 10^{-9} - 4.77 \times 10^{-10} = 7.003 \times 10^{-9}\ s$$

The distance between the antennas and the object is calculated using d = s x t where s = $3\text{x}10^8$ m/s.

Distance from Antenna 1 to object and back:

$$3 \times 10^8 \times 4.003 \times 10^{-9} = 1.2009\ m$$

Distance from Antenna 2 to object and back:

$$3 \times 10^8 \times 7.003 \times 10^{-9} = 2.1009\ m$$

The distance from the object to both antennas is half the distance calculated above, Therefore:

- Distance from Antenna 1 to object = 0.60045 m
- Distance from Antenna 2 to object = 1.05045 m

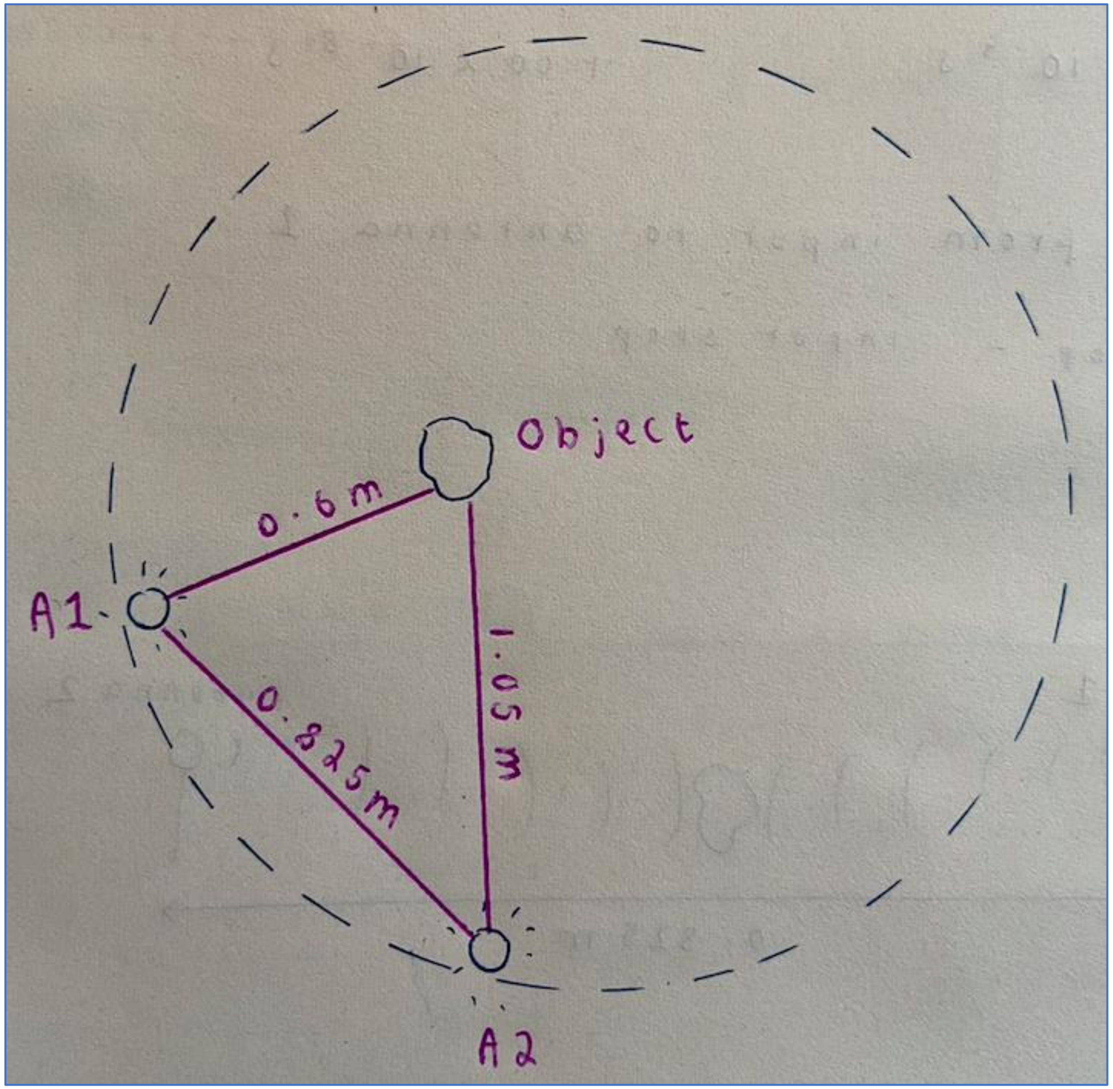

fig 3: sketch of the scene – antennas in relation to object