



robotics @ MARYLAND

SONAR CRIB SHEET

1. CONSTANTS

TABLE 1. Physical Constants

Symbol	Quantity	\approx Metric value
v_a	Speed of sound in air	343 m/s
v_w	Speed of sound in water	1500 m/s
Z_a	Acoustic impedance of air (STP)	420 MPa s/m
Z_w	Acoustic impedance of water	1.5 MPa s/m

TABLE 2. AUVSI Specific Parameters

Symbol	Quantity	\approx Metric value
T_{ping}	Ping duration	1.3 ms
ν_{ping}	Ping frequency	22 kHz $< \nu_{ping} < 30$ kHz
d_{ping}	Ping wave train length	1.95 m

2. SURFACE ECHOES

A source and receiver are at depth z separated by distance R . The source emits a ping at time $t = 0$ and arrives at the receiver at time $t_{ping} = R/v_w$. Then the first surface echo arrives at a time $t_{ping} + \Delta t_{echo}$:

$$\Delta t_{echo}(z, R) = (2\sqrt{z^2 + (R/2)^2} - R)/v_w.$$

TABLE 3. Δt_{echo} at a depth of $z = 3$ meters

R (m)	Δt_{echo} (ms)
0	4.0
10	1.0
20	0.6
30	0.4
40	0.3
50	0.2