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Sea Scan HDS – Technical Note

Maximum SOG and Ping Rate Calculations

Calculating Maximum Ping Rate

Please note that Range is in meters, Speed of Sound in water is in Meters Per Second, and time is in units of seconds.

We have the first calculation which is the maximum ping rate for a given range. The formula we use is:

*Minimum Ping Interval = ((Range / Speed of Sound) * 2.0 + 0.005)*

Max Ping Repetition Rate = 1.0 / Minimum Ping Interval

This equation will yield the maximum ping rate based on 2 way travel time physics. A 5.0 millisecond delay (0.005 seconds) is added into the 2 way travel time in order to prevent the acoustic echoes from crashing into each other from ping to ping. Using a Speed of Sound in water of 1500 m/s we get the following table of Maximum Ping Rates:

Range	Max Ping Rate (Hertz)
5.0	85.714
10.0	54.54
15.0	40.0
20.0	31.58
30.0	22.22
40.0	17.14
50.0	13.95

The Sea Scan HDS system has a software ping rate limit of 30 Hertz. Therefore the maximum ping rate will be capped off at 30 Hertz. This yields the following maximum ping rates:

Range	Max Ping Rate (Hertz)
5.0	30.0
10.0	30.0
15.0	30.0
20.0	30.0
30.0	22.22
40.0	17.14
50.0	13.95

Calculating Across Track Resolution

In order to obtain the along track resolution we need to calculate the across track resolution. The Sea Scan 2000 has a maximum samples per channel of 1024. In order to calculate the across track resolution the maximum range is divided by the samples per channel.

Therefore the maximum across track resolution per channel is:

Range	Across Track Res. (mm)
5.0	4.88
10.0	9.76
15.0	14.65
20.0	19.53
30.0	29.30
40.0	39.06
50.0	48.82

Calculating Along Track Resolution

Based on a 1:1 aspect ratio the along track resolution will be the same as the across track resolution (square sample: width == height). In order to obtain the maximum Speed Over Ground before the 1:1 aspect ratio is impossible to obtain by changing the ping rate we need to multiply the Maximum Along Track Resolution by the Maximum Ping Rate. This will yield the maximum Speed Over Ground in Meters Per Second. We can convert this result to Knots by multiplying the Meter per Second by 1.943846:

Range	Max SOG (m/s)	Max SOG (Knots)
5.0	0.15	0.29
10.0	0.29	0.56
15.0	0.44	0.86
20.0	0.59	1.15
30.0	0.65	1.26
40.0	0.67	1.3
50.0	0.68	1.32

Now you might have noticed that the maximum speed over ground is really small and pretty much impractical. This is because of the really high across track resolution. Our current Sea Scan PC system uses 256 samples per channel (visible on the screen = 512 samples per channel actual). So if we use less samples per channel the maximum speed over ground goes up quite a bit. So we have this made up value called Virtual Samples per Channel. This value we use in the Sea Scan 2000 system to maintain an aspect ratio (not necessarily 1:1). In the case of 1024 samples per channel versus 256 virtual samples per channel we will have an aspect ratio of 4:1. We will then correct for this when displaying the data. The side effect of this is that the along track resolution goes down with the trade off being increased Speed Over Ground.

So if we recalculate everything based on 256 Virtual Samples per channel we find these values:

Range	Max SOG (m/s)	Max SOG (Knots)
5.0	0.58	1.14
10.0	1.17	2.28
15.0	1.76	3.42
20.0	2.34	4.56
30.0	2.60	5.06
40.0	2.68	5.21
50.0	2.72	5.30

These numbers are much more reasonable as maintainable speeds. You will find calculating different maximum speeds easy by taking the base maximum speeds and multiplying by the ratio of actual samples to virtual samples. For instance, using 512 virtual samples per channel would give a ratio of 2.0. To obtain the maximum speed over ground for 10.0 meters range simply multiply 0.56 knots by 2.0 to get 1.12 knots. Therefore the maximum speed over ground (to maintain the desired aspect ratio) would be 1.12 knots.

Please keep in mind that the higher the ratio of original samples per channel to virtual samples per channel the faster the maximum speed over ground will be at the expense of along track resolution. Therefore the smaller the ratio of original samples per channel to virtual samples per channel the slower the maximum speed over ground will be at the gain of higher along track resolution.

The number of samples per channel can also be adjusted as well. This however affects the actual resolution of the data. Therefore the system will not be sampling at its highest resolution.

Other Resources:

http://www.marinesonic.com/

Please feel free to contact us for more information