3D at Depth, Inc

WiSSL GEN 2

Wide Swath Subsea LiDAR

Modifications from SL4

Version 1.0

March 2022

Change Record

Version	Date	Notes	Author
1.0	4 March 2022	Initial Draft	D. Florin

Table of Contents

1 Modifications from Existing Products

List of each software product and modifications for MBARI:

1.1 CCI

- Scan Data, no change Document: 3DatDepth_CCI_packets_RevC7.pdf
- UDP Commands Document: SL Sensor CCI_Manual_C4 updated to SL Sensor CCI_Manual_C5.pdf
- UDP Packet Definition Document: SL Sensor ICD_C9.pdf

Deviations

- Add start laser power/end laser power
- Update new structure parameters
- Update documentation for these changes along with layout view changes.

1.2 RTV

- RTV Revision 1.03.03 Document: Realtime Viewer SLX v1_03_03.pdf

Deviations

- Ability to operate multiple RTVs at once.
- Output to MBARI file format. See Section 3.0.

1.3 3D Collect

- 3D Collect Revision 6.06.04 Document: 3DCollect SLX v6_06_04.pdf

Deviations

- Dynamic laser power control. MBARI currently has this feature.
- Select between the automatic and the manual methods for gain control.
- Dynamic automatic gain control parameters.

1.4 EC, from Standard Version SL4

- EC Revision v0.0.4-85 Embedded Software

Deviations

- Convert MBARI to standard CTD over Ethernet packet definition. See Section 2.0.
- Develop time sync and support for PTP without PPS.
- Dynamic automatic gain control

1.5 InstaCloud, from Standard Version

- InstaCloud Revision v0.0.1-19 Embedded Software

Deviations

- MBARI specific sensor generated NAV data
- Reduce number of laser returns from 5 down to 3
- Bandwidth requirement increases ~ 9x due to increased data rate.
- Can reduce this by creating the MBARI file subsea

1.6 3D Cloud Motion, from Standard Version

- 3D Cloud Motion Revision 8.05.06 Document: 3D Cloud Motion v8_05_06.pdf

Deviations

- Outputs into MBARI file format
- Ability to read in MBARI format files and perform additional filters and classifications
    - Add Identifier into the point cloud for why it was removed - Low signal, High signal, Clutter size, Clutter group, Min Range, Max Range
- May merge this with RTV

1.7 2D viewer, from Standard Version

- Recommend not using

1.8 Simulator, from Standard SL3 simulator

- RIAAT data generator/simulator; works with RTV and CGUI. RTV will output MBARI format.
- Simulator to generate data in order to verify downstream processing and connections. Also provides operator training for GUI.
- Will not operate at same speed (will be slower than real system).
- Currently simulation data is constant range
- EC SL3 v6.06.08, InstaCloud SL3 v2.03.04

1.9 Differences from current WiSSL

- SL4 vs ECWS
  Improvements that come with the SL4 baseline:
    - Extended calibration over more parameters
    - Extended power range.
    - Higher order calibrations.
    - Larger number of reported fault conditions

Some parameters are not there:

- Min time difference to update msec
- Show time sync errors
- ZDA UDP port, Generic port is there.
- ZDA to PPS max time msec

1.10 Data production rate and telemetry rates:

- Calculated at 280 kHz PRF, 100° degree FOV
  - 24 hours of data fills ~1.2 TB of hard drive (standard format), average 13.9 MB/s
    - Sensor Range, Intensity and Angle data only, the standard format (RIAAT)
    - When temperature data is added into what is acquired, then that would take extra storage space; a rough estimate would be approximately 20%, if it was similar to the range information but it could be higher or lower depending on the amount of data and the accuracy.

- Calculated at 350 kHz PRF, 100° degree FOV
  - 24 hours of data fills ~1.5 TB of hard drive (standard format)
  - Estimate of MBARI format is ~1.4 MB/s to 1.75 MB/s (if 10% size)

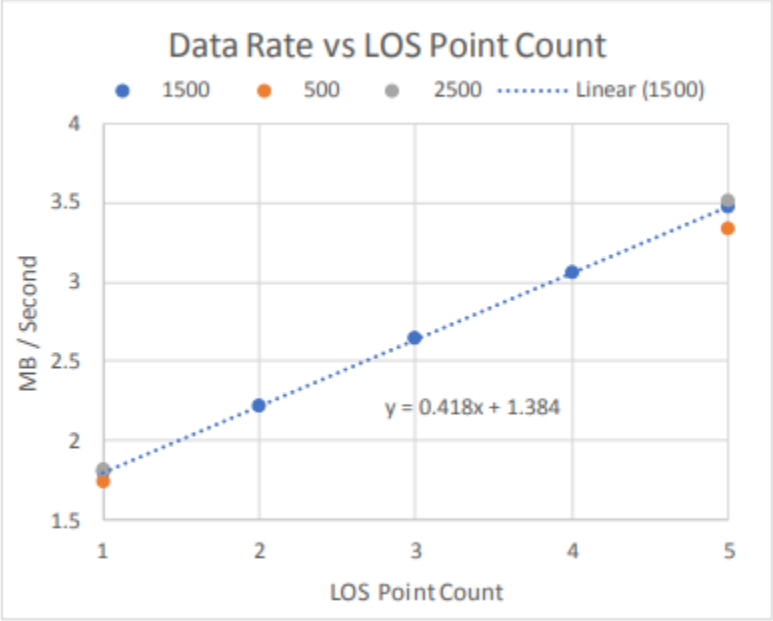

Figure 1: Current MBARI data generation rate

1.11 Features and Improvements from SL4 baseline, not fully qualified

- Temperature scan data will also create data, size/amount/format is not known yet.
- Automatic gain control will adjust laser power without user intervention.
- Interested in using laser for navigation sensing – what would this look like?

- TCP or UDP or some other interface (COMM?) – how is data delivered?
- 10 Hz update rate
- Probably will want to clean first
- Split view into “N” number of measurements
- Return closest, average, and last object?
- Number of Objects active (diagnostic status info?)
- What kind of commands and/or parameters does this have, level of flexibility?

2 Suggested CTD data over Ethernet Format

Support two different types SVX2, miniSVX:

```
Velocity <TAB> M/SEC <TAB> Pressure <TAB> DBAR <TAB> Temperature <TAB> C <TAB> Conductivity <TAB>
MS/CM <TAB> Psu <TAB> PSU  … checksum or other data not used … <CR><LF>

       1.123 M/SEC 1.123 DBAR 1.123 C 1.123 MS/CM 1.123 PSU

Pressure in dBar <TAB> Temperature in C <TAB> Conductivity in mS/cm <TAB> Optional CRC <CR><LF>

       1.1234 1.1234 12.123 *12
```

WiSSL currently uses a TCP interface for a binary CTD packet, code would need to be ported if this is still desired.

3 Suggested Output MBARI File Format

Discuss 2 vs 3 point returns.

Discuss range bit resolution required

4 Scan Rate Performance for current WiSSL

The WiSSL sensor was tested for differing scan resolutions at maximum scan angle width. The tests were performed for water, full Cross track scan width.

Index = 1.33

Scan Frequency (Hz) down and back	Pts per Scan Line cross track	Max Angle Step @ Center (deg)	Range Depth (meter) configuration	Center of Scan Cross Track Resolution at 2.5 meter LOS
35	500	0.2	10	0.0087
29	600	0.16	10	0.0070
25	700	0.13	10	0.0057
22.5	800	0.11	10	0.0048
19.5	900	0.1	10	0.0044
18	1000	0.09	10	0.0039
16.5	1100	0.08	10	0.0035
15	1200	0.07	10	0.0031
14	1300	0.065	10	0.0028
13	1400	0.06	10	0.0026
12	1500	0.055	10	0.0024
11.5	1600	0.053	10	0.0023
10.5	1700	0.05	10	0.0022
10	1800	0.045	10	0.0020
9.5	1900	0.043	10	0.0019
9	2000	0.041	10	0.0018
8.5	2100	0.039	10	0.0017
8.3	2200	0.037	10	0.0016
8	2300	0.036	10	0.0016
7.7	2400	0.034	10	0.0015
7.4	2500	0.032	10	0.0014

Additional performance testing was performed for other LOS range values. The follow configurations per range depth and intended resolution are recommended.

	Swath Width deg (air / water) per head	Points Per Scan Line	Max Range	Scan Rate (Hz)
Maximize Resolution	+/- 36/27	2500	15	4
Maximize Range	+/- 36/27	600	25	8.5
Maximize Speed	+/- 36/27	300	10	54
Other	+/- 36/27	600	10	30
	+/- 36/27	750	10	24
	+/- 36/27	800	10	23