Ocean Observatory - LoVe

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1 Introduction

The sensor system to be deployed in Hola in the Ocean Observatory LoVe, consist of:

- X-Frame, with 400 meter cable.
- Satellite with 50 meter cable
- Satellite base unit.

1.1 Modules

1.1.1 X-Ramme for LoVe

The X-Frame is a node for the different sensors installed. The unit is controlling, collecting and saving data from connected sensors. The X-Frame is also distributing power to connected sensor from the infrastructure, or from internal battery bank (Autonomous) The main sensor is a 70 kHz single beam sonar, installed in a horizontal view from the side of the X-Frame. A second 70 kHz transducer is installed in a gimball, facing up towards the surface. This transducer can be used for quantification of biomasse in the water volume between the seabed and the surface.

The size of the X-Frame is 1,6 x 1,6 x 0,9 m (lxbxh) and weight max 600 kg. (weight depending on payload)
1.2 Satellitte

Unit for close observation of an local environment, such as coral reefs. This unit is connected to the X-Frame, bringing various sensors, such as video and still camera to a selected location. Many different sensors can be connected to the satellitte. Signal and power is supplied via a cable. Different motors is turning training and tilting the camera frame for optimal camera angle. Motors and camera is controlled by an operator via Internet through the infrastructure cable. Different sensors are installed to monitor the oceanography in the area.

1.2.1 Satellitte frame

The Satellitte consist of:

- Satellitte unit
- Satellitte base
- 50 meter Satellitte cable

The satellitte is 1,8 m high, and 1,4 m wide when parked in deployment position, with a weight of app. 160 kg in air, (130 kg in water)
1.2.2 Satellite base

Different sensors need to be maintained regularly, such as the front glass of cameras. To be able to do this, the satellite has to be retrieved to the surface for maintenance and cleaning. The purpose of the satellite base is to be a fixed deployment point, securing that the cameras will be redeployed in exactly the same position as last time. When the satellite is retrieved, the Satellite base is left at the seabed. This is an important issue if a fixed point are to be monitored over a longer time.

The base unit is 1.4 m, 1 ton circular concrete block. A guiding system is installed to make deployment and reconnection of the satellite easier. A locking system is securing the satellite to the satellite base. The weight of the unit in water is approx. 600 kg.

Fig. 4 Satellite base
1.3 SDU

SDU is the main connection point to the infrastructure of the observatory cable, already deployed. (Subsea Distribution Unit) The unit has two sets of “Wet Mateable ROV recepticles” each set having a Seacon fiber connector and a Tronic power connector. In front of each connector set is a fixing point for a strain releaser.

A handle Ois installed on each side of the SDU for ROV to grip when stabbing the connectors.

![Fig. 5 Picture of SDU]

Fixing point for Strain releasers

![Fig. 6 Strainreleaser fixed to the SDU frame]

![Fig. 7 SDU Drawing]
1.4 Cable

1.4.1 X-Frame cable

The cable between SDU and the X-Frame is 400 meter long, delivered on a 2 m drum. In one end of the cable is the strain releaser with two ROV connectorer, and in the other end a strain releaser for the X-Frame, and a penetrator for the X-Frame Interface unit.

Spec X-Frame cable:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>400 m</td>
</tr>
<tr>
<td>Diameter</td>
<td>19,8 mm</td>
</tr>
<tr>
<td>Minimum bend radius</td>
<td>305 mm</td>
</tr>
<tr>
<td>Weight in air</td>
<td>918 kg/km</td>
</tr>
<tr>
<td>Weight in water</td>
<td>601 kg/km</td>
</tr>
<tr>
<td>Total cable weight on land</td>
<td>367 kg</td>
</tr>
</tbody>
</table>

Fig. 8 X-Frame cable with strain releasers, penetrator and ROV connectors

1.5 Satellite cable.

The Satellite cable is 50 meter long with connectors in both ends including ethernet connection and power to the satellite. Close to the satellite side of the cable, there is installed a 2 meter long cutting section. The cable can be cutted her for easier retrieval. When deployed again, a new cutting section can be installed, and the old cable can be used again as is. The cable has a diameter of 12,5 mm, and a total weight in air of 10 kg.
2 Deployment

2.1 Deployment procedure

Cable

The X-Frame Cable was spooled on the port seine winch, on top of the seine wire to maintain as large diameter as possible for the drum. A rubber math was placed on top of the wireturns to serve as protection between the wire and the cable. The penetrator and the strain releaser was fixed to the aft side of the winch. A chinafinger was installed 100 meters from the end to take the strain from the cable, and secure the cable during the operation, when the last part of the cable was to be connection of the cable during deployment. Cable was shot out via forward seine block (Scheve diameter: Ø65 mm)

X-Frame and satellite

The Satellite was fixed to the X-Frame in 30 meters of soft sling, with shorter softslings installed for hooking to the crane. The cable between the satellite and X-Frame was fixed to the softslings using strips

The deployment was performed according to following procedure:

- Deploy cable with strain releaser and ROV Connectors to the SDU
- ROV to connect and secure the strain releaser to the SDU
- ROV to remove the dummy plugs from the receptacles at SDU, and stab the ROV connectors
- Shoot out further cable until chinafinger is in block, while ship is slowly moving towards the deployment point for Satellite
- ROV to follow touchdown point for cable, to monitor that unnecessary strain not was applied to the cable under the whole operation.
- Hook forward crane to Chinafinger installed on the cable, and take over tension from the cable.
- Spool rest of cable on deck.
- Connect penetrator at the end of the cable to the X-Frame
- Clear deck for powertest
- Startup power from shore.
- Full check of power and of all functions via infrastructure cable from shore.
- After function test on deck via infrastructure cable, shut down power to the infrastructure cable from shore.
- Confirm that power is switched off.
- Connect wire on port seine winch to the chinafinger, take the tension from the crane, and continue lower the cable using the wire.
- Rest of cable to be deployed while the ship is continuing towards Waypoint
- Repeate the procedure made for deployment of satellite and X-frame with involved personell on deck prior to continuing the work. Make sure that all persons do know their tasks, and that they are familiar with the critical parts for the deployment.
• Deploy the satellite, and the X-Frame henging 40 m above the Satellite, using both ships cranes.
• Connect wire to starboard winch to the X-Frame lift, and lower both towards the seabed while ship is moowing towards the WP for the satellite.
• When the chinafiner is touching bottom, disconnect and retrieve the forward deployment cable.
• Position satellite 1 m above seabed in position
• ROV to turn the Satellite to face right angle.
• Place Satellite on seabed, and clear softslings from satellite arm.
• Ship move towards X-Frame position while X-Frame is lowered down.
• It is important that no tension is applied to the cable, since this can bring Satellite out of its position.
• Place the X-frame at seabed, with transducers facing a compass direction of 60 degrees towards north.
• Release and retrieve the deployment wire connected to X-Frame.
• The system to be started up via internet, and check all functions.

Protection of ROV connectors

When deploying the connectors special care must be taken to prevent the ROV connectors to be dragged into the sand and mud in the seabed, causing particles to contaminate the connectors. The strain reliever was slightly positive buoyancy, by using four trawl spheres hanging 10 meters above the unit in a rope. The connectors was also strapped to the sphere rope, always hanging 2 m above the strain reliever. Everything was lowered to the seabed, using the Net-End winch with 60 kg of weight attached to the fixing point. The fixing point was on the cable, 5 meters away from the strain reliever, and the weight was attached in a 3 m long rope. Arranged like this, we could lower the weights all the way down, resting at the seabed. No movements from the ship was transferred to the strain reliever and the connector, and the strain reliever was floating above the bottom, easy to access for the ROV. When the strain reliever was attached to the SDU, one by one connector was cutted loose from the rope, and connected. After the connection was finish, ROV cutted the rope for the trawl spares, and the rope for the fixing point to the cable. The floats rised back to the surface for retrieval, and the weight was retained connected to the lowering wire.
2.2 Deployment

The deployment was performed the 11\textsuperscript{th} of August. The seastate was very calm, 1-1.5 m and the deployment was performed according to procedure. The units was deployed and installed on the seabed, using a powerful ROV. After the connectors was connect properly, a full function test was performed.

2.3 Deployment positions:

- **SDU:**
  
  N 68°54,596’
  E 014°23,384’

- **Satellite:**
  
  N 68°54,472’
  E 014°23,087’
  Heading: 290\degree
  Depth: 255 meter

- **X Frame:**
  
  N 68°54,474’
  E 014°23,145’
  Heading: 60\degree
  Depth: 258 meter

Distance from SDU to Satellite: app 350 m (400 m cable)
Distance from Satellite to X-Frame 40 meters (50 m cable)
2.4 Deployment of Satellite

Fig. 9 The satellite is being deployed in parked position

Fig. 10 Satellite seen on ROV camera just before reaching the seabed
2.5 Deployment of X-Frame

Fig. 11 Deployment of X-Frame

Fig. 12 X-frame deployed at the seabed
3 Startup of the Ocean Laboratory

The sensors installed gave excellent data, and the selected direction of the acoustics gave a clean picture without any discovered shadow zones.

The run-up procedure was started up: 12th of September 2013, at 02:00 UTC.

All clocks in the system synchronized 12/09/2013 at 2:26 UTC.

Following is the parameters for the startup of each single sensor in the system.

3.1 Sensors setup for Cabled Infrastructure:

3.1.1 Power control

Power consumption in the main cable was monitored:

CH 4: Voltage. 1,982 Volt, equal to 240 V measured at X-Frame during deployment

CH 5: Current.

Without load from X-Frame: 2,820 = 5.05 Amp

With load from X-Frame: 2,841 = 5.54 Amp
3.1.2 Power control for Satellite and X-Frame

DO0  Power to satellite

DO1  Power to GPT container

3.2 Environmental Sensors

Start logging sensors: 12/09/2013 2:26 UTC

Fig. 13 Control program for sensors
3.3 ADCP

3.3.1 Continental

Start logging: 12/09/2013 at 2:28 UTC

![Data from Nortek Continental ADCP](image)

Fig. 14 Data from Nortek Continental ADCP

3.3.2 Aquadop

Start logging: 12/09/2013 at 2:29 UTC

![Data from Nortek Aquadop ADCP](image)

Fig. 15 Data from Nortek Aquadop ADCP
3.4 Camera

Started camera and take test picture: 12/09/2013 2:26 UTC

*Fig. 16 First camerashot from camera in coral reef*
3.5 Hydrophone

Hydrophone started logging at 12/09/2013 2:31 UTC

Hydrophone picture recorded sound from the ROV in operation during the deployment.

![Hydrophone signal recorded during deployment](image)

*Fig. 17 Hydrophone signal recorded during deployment*
3.6 EK60:

*Startup logging EK60: 12/09/2013 2:41 UTC*

- Vertical range: 275 meters
- Horizontal: 750 meters
- Ping Rate: 2 sec

### 3.6.1 Rawdata

- Path: C:/Data/EK60
- Range: 1.000 m
- Max file: 25 Mb

### 3.6.2 Display:

- Vertical sensitivity: -75 dB
- Horizontal Sensitivity: -66 dB

### 3.6.3 Environmental:

- Temperature: 7,5 degr C
- Salinity: 36,0
- Soundspeed: Calculated (1485.9 m/sec)
- Distance to surface: 255 m
- Depth sensor: 255,8 m

*[Fig. 18 Echogram from EK60 just after deployment. Upper picture Vertical transducer, Lower part horizontal transducer]*
3.7 Computer in X-Frame

Fig. 19 Desktop remote display for the online computer in the X-Frame at the seabed

Bergen 7th of October 2013

(Sign)

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