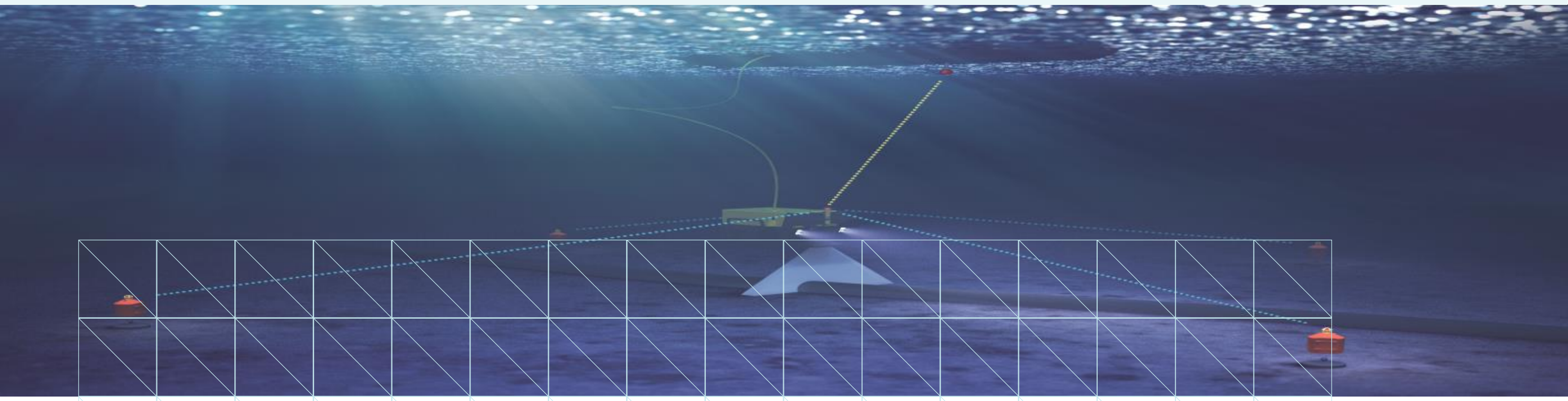
KONGSBERG

HiPAP®



Sparse LBL - User procedure

Sparse LBL enables LBL positioning of an ROV using only two cNODE seabed transponders. This function can be combined with HAIN.

Functional Description

Sparse LBL calculates an ROV position by combining ranges from the ROV to LBL transponders, SSBL horizontal position of the ROV (as measured from a surface vessel), and data from a depth sensor.

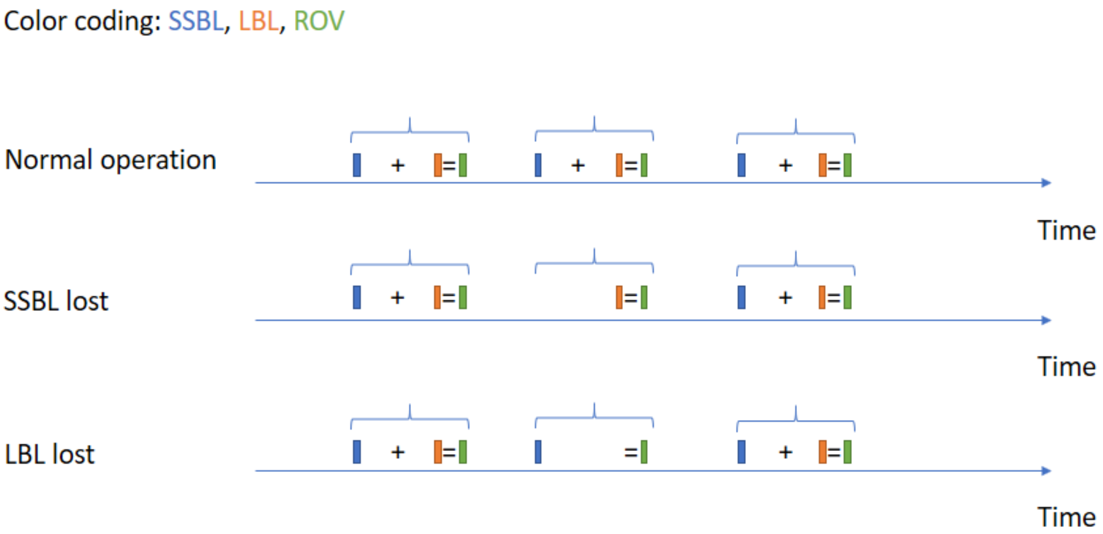
The ROV position is calculated using a Weighted Least Squares algorithm, which finds the optimal combination of the data. LBL range standard deviations, SSBL covariance, and depth sensor 1-sigma forms the basis of the weights. We refer to this as the combined position. The error ellipse from the calibrated LBL coordinates have impact on the sparse LBL positioning error ellipse through its influence on the LBL range standard deviations.

To compensate for lever arms on the ROV, roll, pitch and heading must be available. If no motion data is received, the error ellipse/covariance for the SSBL position will be increased prior to calculating the ROV position.

The calculation of the ROV position is triggered by the reception of the LBL ranges. For the SSBL position to be used in the calculations, it must be less than 10 seconds old, and not been used in a previous calculation. Without available SSBL, the resulting ROV position equals the LBL position (based on ranges and depth).

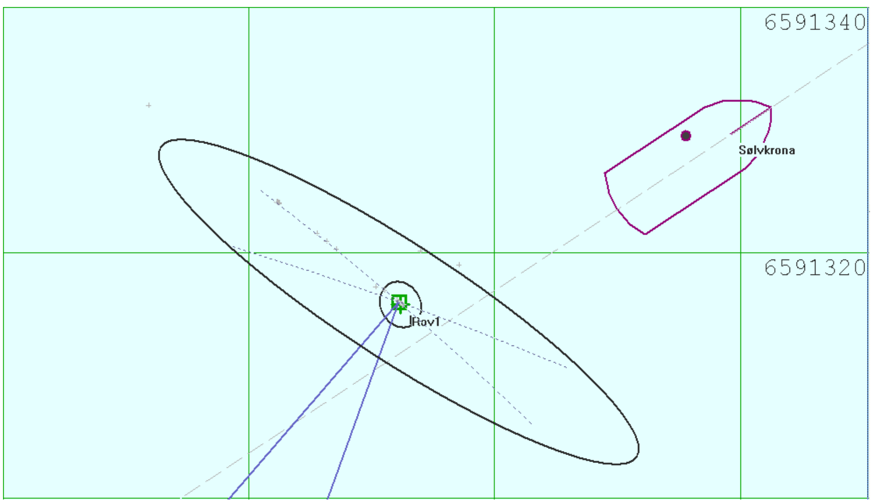
When the ROV position calculation starts, the SSBL position is adjusted using the estimated ROV speed and SSBL age. The SSBL covariance is increased to compensate for error in the speed estimate.

The figure below shows three scenarios (normal operation, missing SSBL position, and a LBL time out) each with three ROV positions calculated as time goes by.



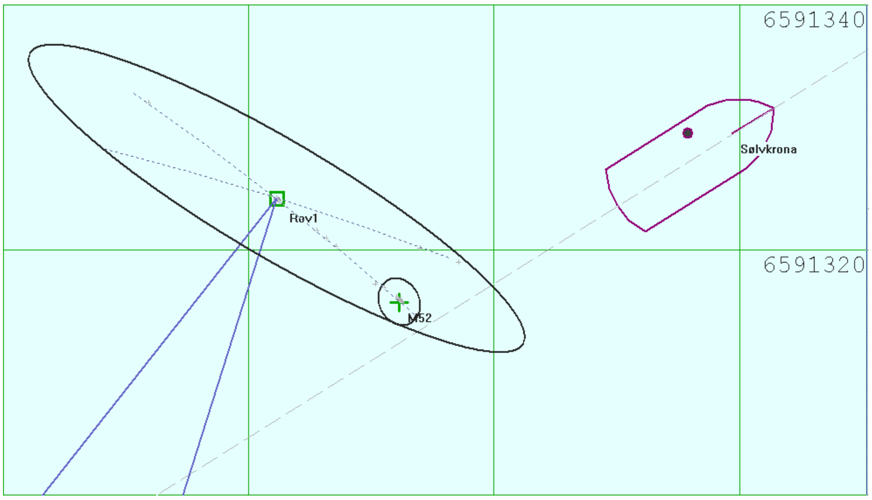
Combined position

The picture below shows a normal situation where the sparse LBL computes a combined position of SSBL and LBL. If a measurement to one LBL location times out, the algorithm proceeds as long as SSBL data is available to establish an ROV position.



Inconsistent ROV position

A situation may occur that the calculated ROV position jumps from one calculation to another. The LBL error ellipse is large, yet, the calculation of the ROV position does not take the SSBL position into account. See picture below:



A plausible cause involves two issues appearing at the same time:

1. LBL range error
2. SSBL interrogation interval > LBL interrogation interval

Because of 2. there will be times where an SSBL position is unavailable when the calculation is triggered. Then, the LBL solution alone, with ranges and depth, will be used as ROV position. Any error in the LBL ranges will result in jumping ROV positions.

If LBL range error occurs (incorrect range), the ROV position will be based on both SSBL and LBL position; a combined position will be calculated.

If there is timeout on one range, the algorithm will compute a position weighted strongly towards the SSBL position.

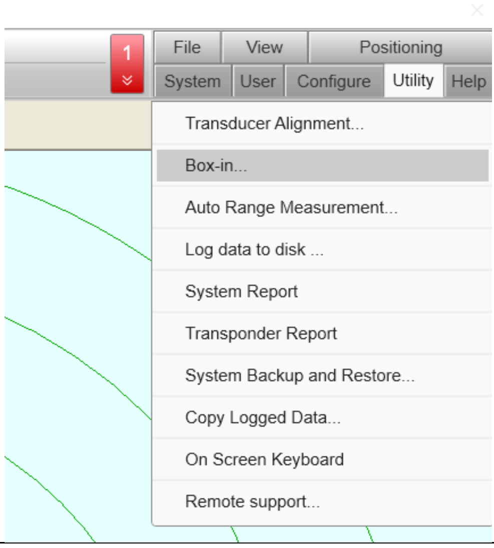
If the SSBL interrogation interval is > LBL interrogation interval and the pure LBL position is different from the SSBL position: the Sparse LBL position will alternate between the pure LBL position and the combined position. This will then appear as a jumping position.

A typical scenario can be positioning an ROV with sparse LBL on at water depth of 1800m. The sparse LBL transponder may be located with a baseline of 100m. The error ellipse of the sparse LBL transponder location will be 2-4m and for the ROV position 3-5m. SSBL position update every 2.5 sec. The ROV LBL ranges updated every 1 sec. We will then have 2 LBL measurements for every SSBL update.

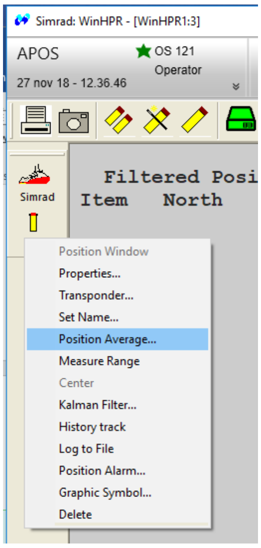
The system will compute an ROV position when receiving the LBL measurements, and a valid SSBL position (less than 10 seconds old, and not used in a previous calculation) is available. Because of the interrogation interval configuration, the next time LBL measurements are received, there will be no new valid SSBL position. The ROV position is then formed by the LBL measurements and the depth, using the previous ROV position as a starting point for the Sparse LBL computation.

Setup procedure

1. Make sure the HiPAP system is well calibrated with respect to lever arms, roll, pitch and heading sensors.
2. Always use a recent sound velocity profile.
3. Establish transponder locations for the two LBL transponders using the *Position Average* function. The more time-consuming Box-in utility may also be used.



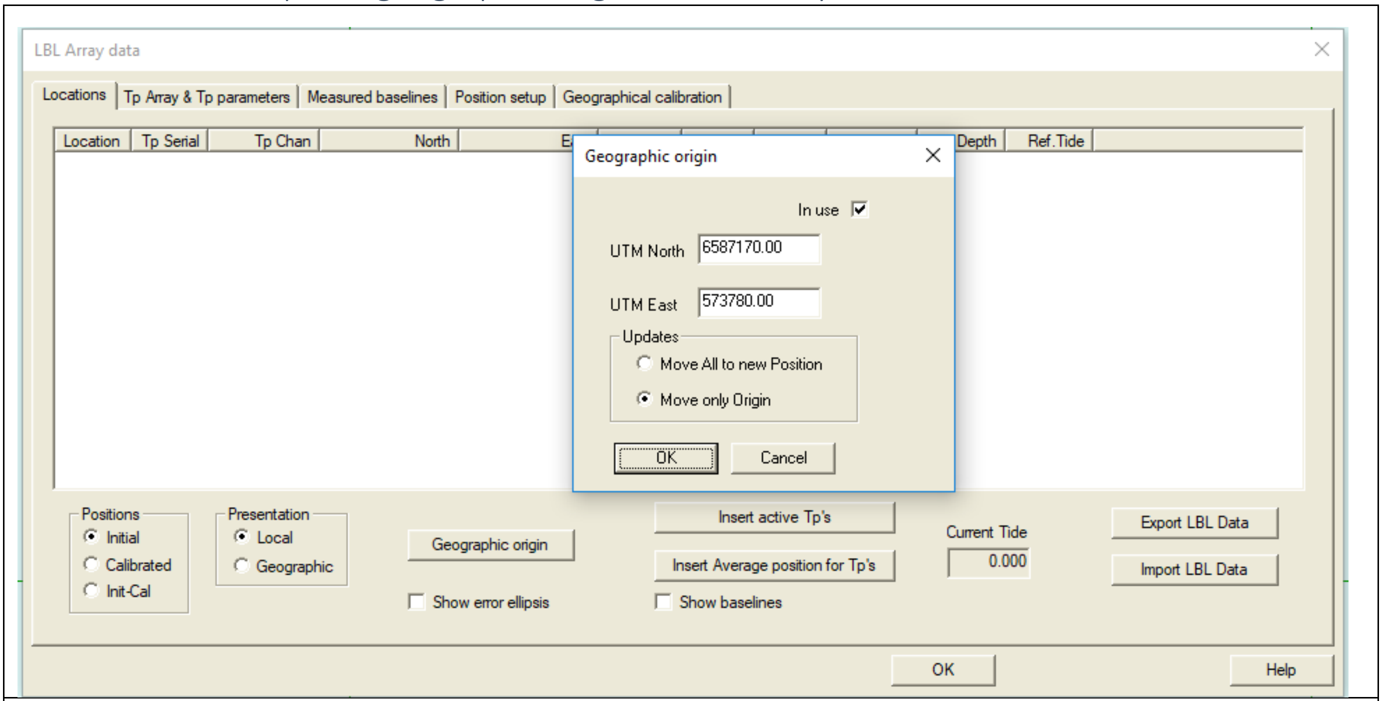
Box In



Position Average

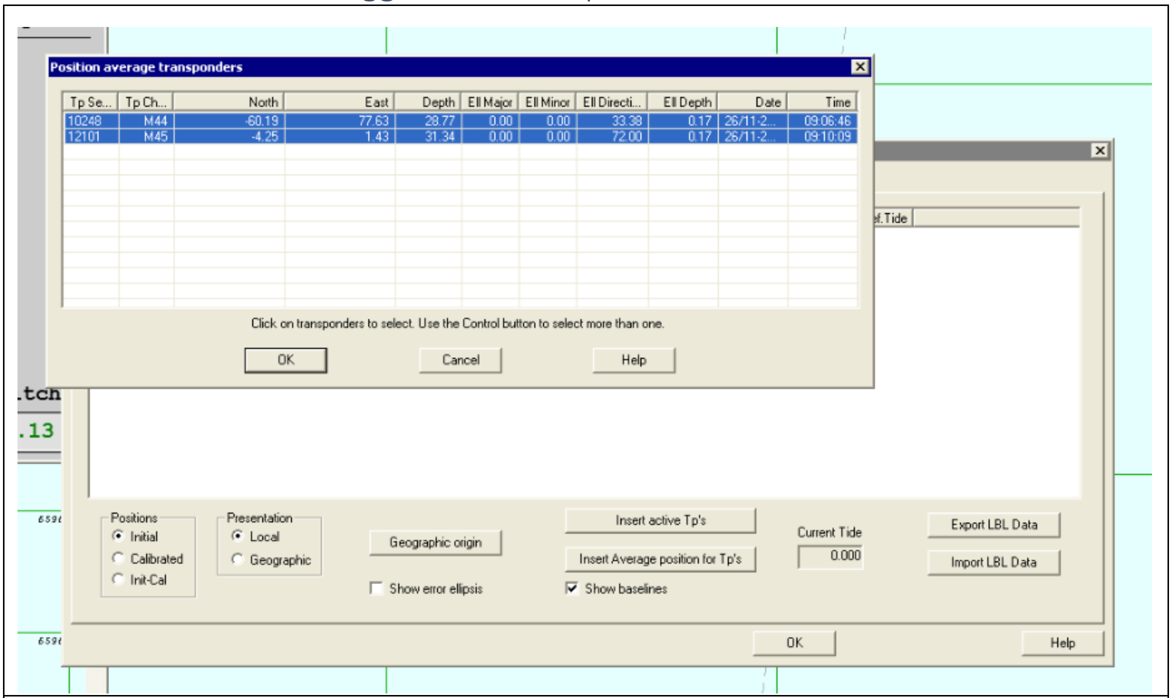
NOTE: The LBL array wizard will not work for Sparse LBL. The wizard requires a minimum of three transponders in the array. Establishing the array must be performed manually.

4. Decide upon a geographic origin for the array



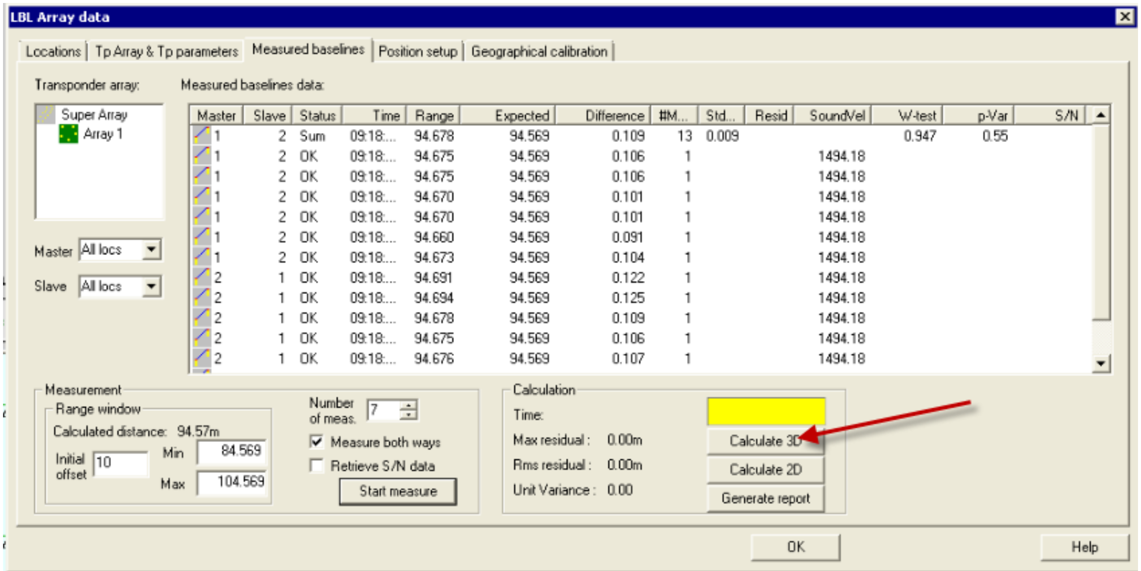
Array geographic origin

5. Use LBL Array Data, *Insert Average position for Tp's* to set transponder locations. This will suggest the transponder locations established in 3.



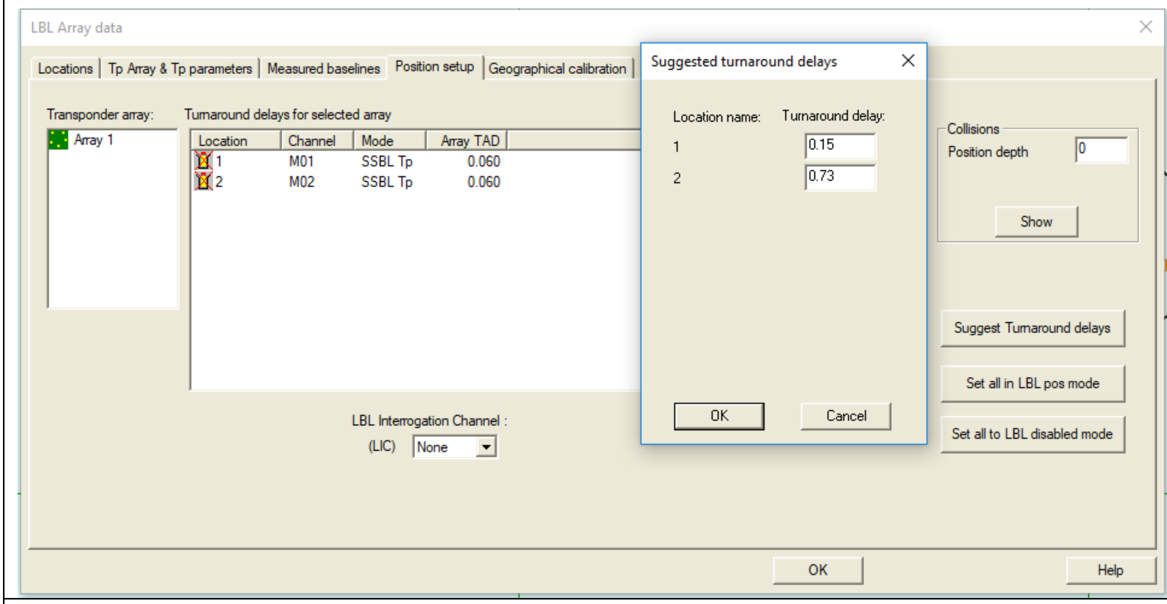
Insert Average position

6. Optional: Measure baseline. Measuring the baseline will in most cases improve the final position accuracy.
    a. If the baseline was measured, run the LBL calibration algorithm



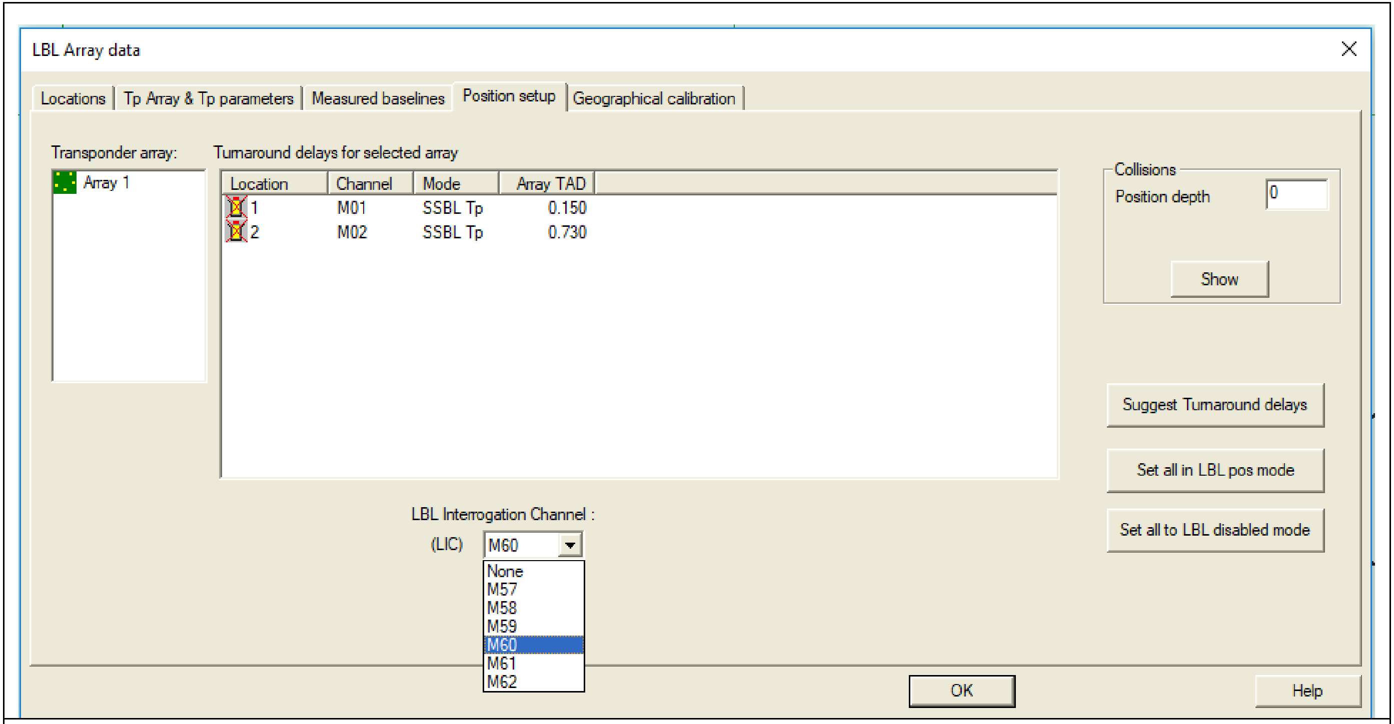
Calculate 3D

7. Suggest turnaround delays – press OK to accept the suggestion



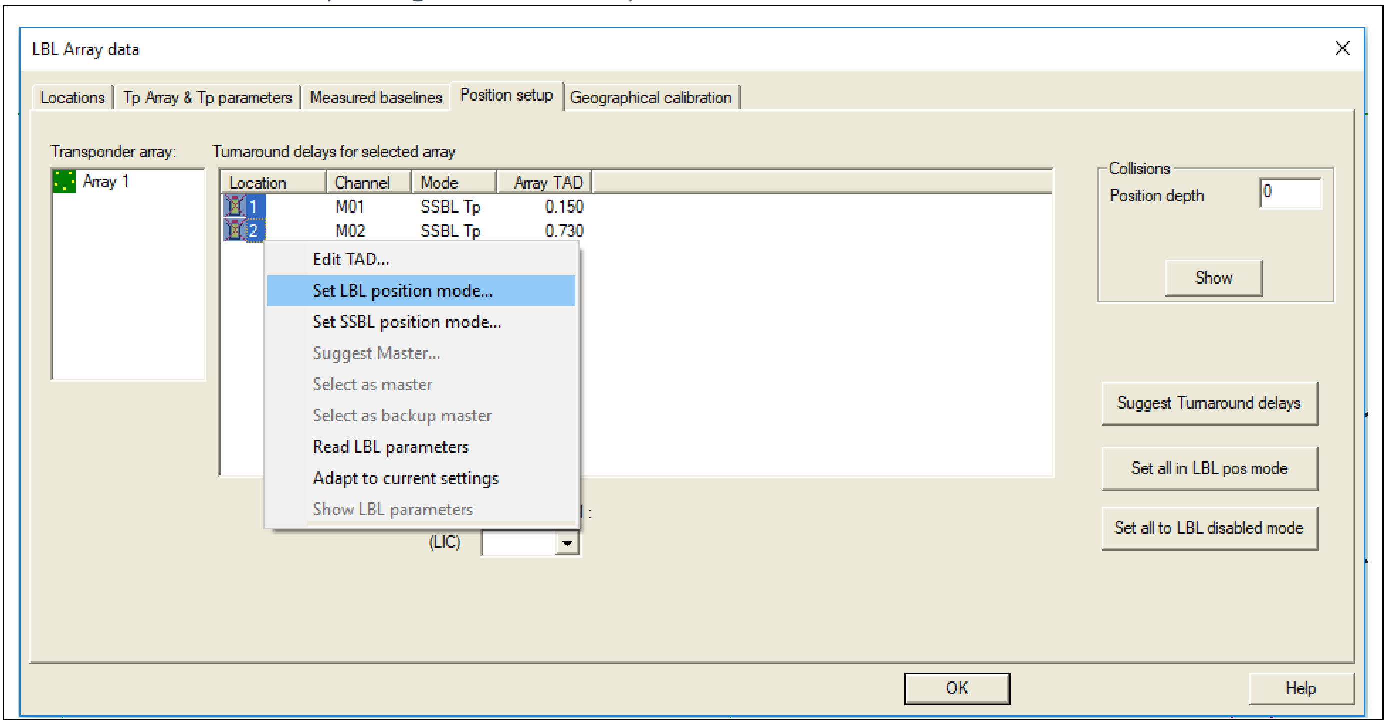
Suggest turnaround delays

8. Select LBL Interrogation Channel



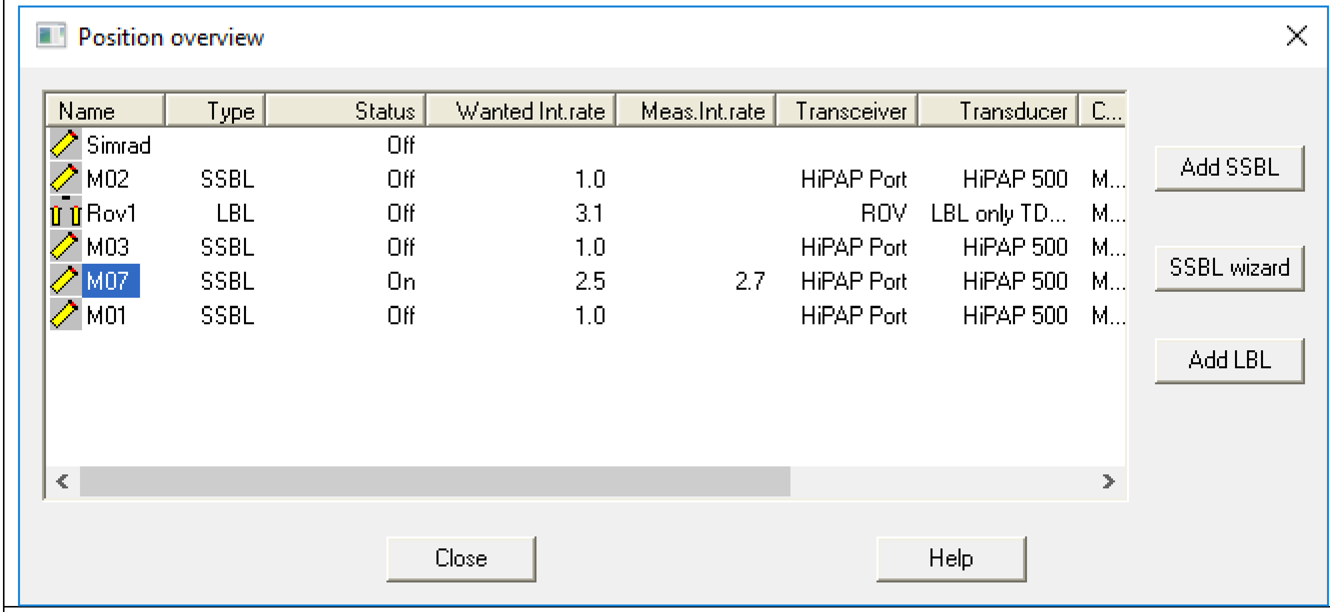
Select LIC

9. Set the transponders in LBL position mode, either one by one or as shown below, or by using *Set all in LBL pos mode*



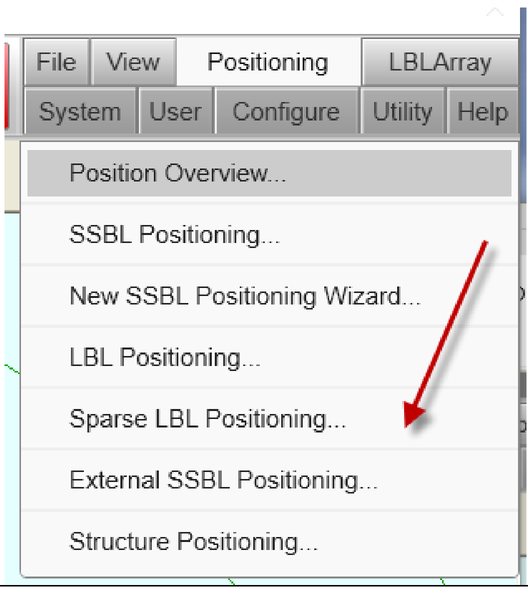
Set LBL position mode

10. Start interrogation of the SSBL aiding transponder (the one on the ROV)
    a. Note the Measured Interval Rate of the positioning (2.7s in this example)

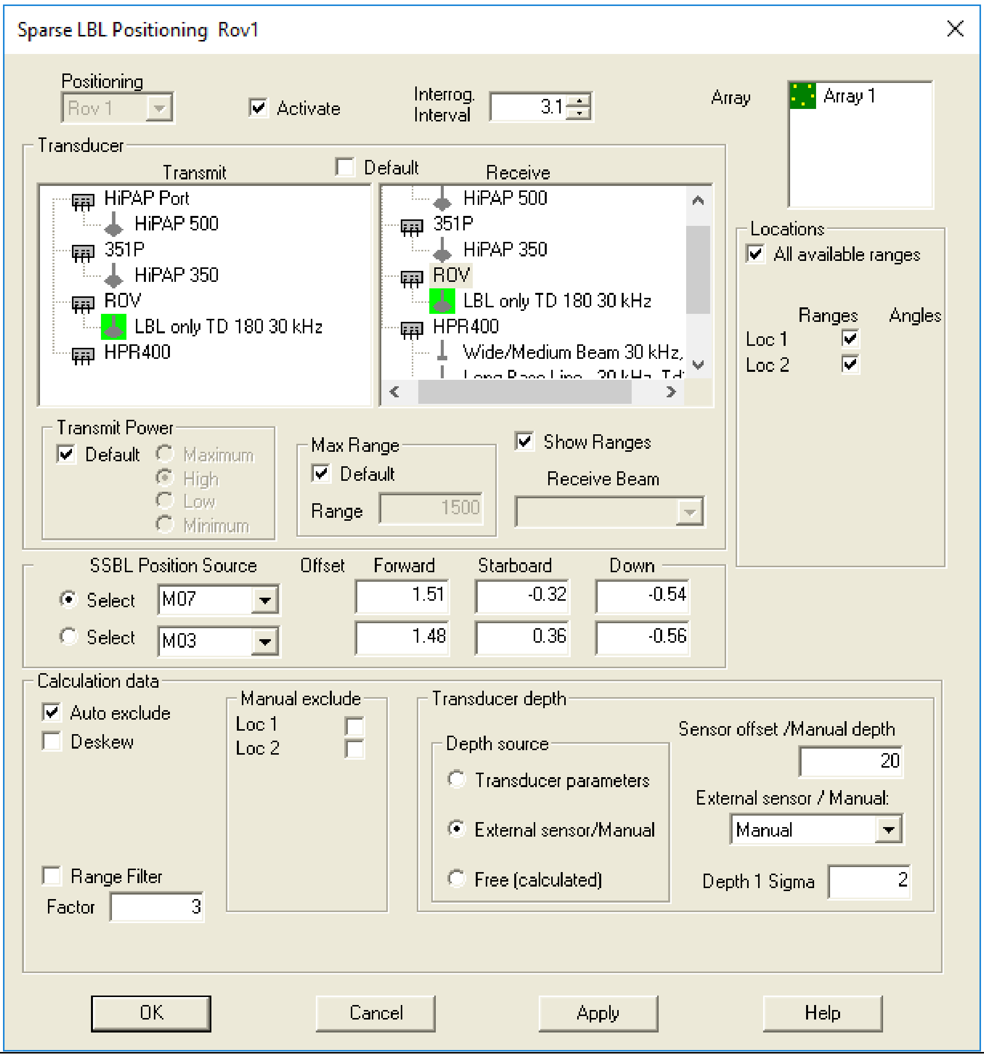


Measured interval rate

11. Create a new position object “Sparse LBL Positioning”.



Positioning – Sparse LBL Position

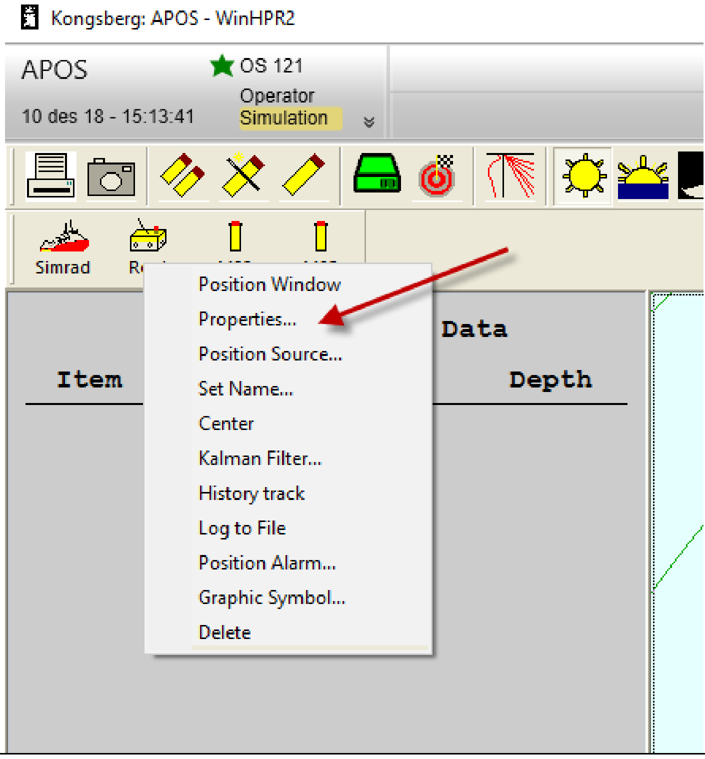


Sparse LBL Positioning

a. Select the transmit and receive transducer on the ROV (uncheck the *Default* checkbox if necessary).
b. Select the SSBL Position Source(s), and enter the offset(s). The offset is given as the vector from the ROV reference point to the SSBL source. In the above picture, the M07 transducer is placed 1.51m in front, 0.32m port, and 0.54m above the ROV reference point.
c. In the above picture, the ROV is fixed at 20m WD and External Sensor/Manual it ticked and the depth is set to 20m. The ROV depth may be received from a depth sensor on the ROV. Any depth sensors interfaced to APOS through External Interfaces will be available in the *External sensor / Manual* pull-down menu. The Sensor offset (in meters) relative to the SSBL transducer must be entered for *Sensor offset/Manual depth*.
d. Make sure that the Sparse LBL interrogation interval is > the measured interval rate of the SSBL transponder and that the Max Range setting is equal to the operating distance +10%.

Comments

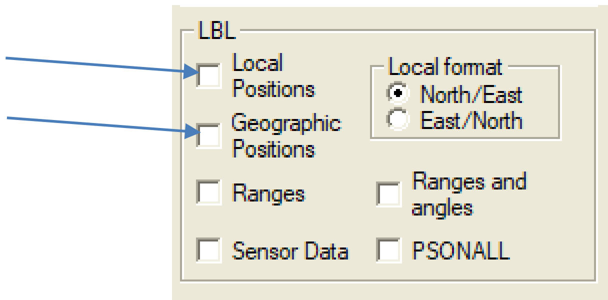
After setting up Sparse LBL from the Positioning menu any changes to the ROV positioning *must* be done by using the Properties by right clicking the ROV tool bar icon. See figure below:



ROV Properties

Position output

The Sparse LBL position output is set up as a standard output for LBL positions in the Configure->Output dialog, NMEA Positions:



Choices for position output