Correlation Velocity Log

Tritech has developed an innovative Correlation Velocity Log (CVL) as a new way of dealing with velocity requirements. Called AquaTrak, it can be used for tracking subsea vehicles or station keeping. The system has advantages over competing Doppler Velocity Log (DVL) technology.

Doppler sonar is a useful and commonly used tool to record underwater movement. It forms the basis for established current measurement technology such as Acoustic Doppler Current Profilers (ADCPs) and vehicle tracking systems such as Doppler Velocity Logs (DVLs). Both rely on measuring the Doppler shift of waves.

The Doppler shift can best be recognised when a source emitting waves, moves towards an observer. From the observer’s viewpoint, the wavelength decreases and the frequency increases. Conversely, when a source moves away, the observed wavelength increases and the frequency decreases.

This is the same technology used by traffic police armed with speed guns. This change in frequency is proportional to the speed of movement.

A commercial subsea DVL unit sends out a ping from four beams. If any bounce off a structure such as the seabed, the frequency shift of the return translates into a velocity measurement relative to its reflection point.

Typically, the angle of the beams being sent out has a 30° declination, so the DVL has to be relatively close to the seabed in order to detect the return wave. It is also necessary to select the optimum properties of the pulse emitted.

A wide beam will more easily detect the scuffal; however, it is necessary to transmit as narrow, high resolution a beam as possible from the DVL to reduce any impact in performance due to objects on the seabed.

The downside is that some pulses do not bounce back. Importantly, any beam passing through the water column might encounter thermoclines which may result in refraction. The distance that each refracted beam travels is different.

In general, however, the DVL is often the tool of choice to measure the relative position and movement of a remotely operated vehicle (ROV), autonomous underwater vehicle (AUV) or towed body such as a survey array or subsea plough.

CVL

In practice, because of the frequencies used, DVLs characteristically tend to either measure long ranges in low resolution, or high resolution but short ranges. This prompted Tritech to look at ways to improve on these inherent shortcomings. Working closely with Canadian Company, Kraken Sonar Systems, they developed the AquaTrak CVL.

“The underlying technology has been in existence for a long time, but it has never been successfully adapted for this market,” said Scott McLay, Sales Director at Tritech.

“CVL works by sending two pulses from the sensor, down to the seabed but momentarily apart. As the pulses return, the first hits the transducer at one point and the other one slightly after it.

“They both left at the same place so when they come back, the CVL looks at the correlation between the two pulses. If the body wasn’t moving, the correlation would be 1. When moving, however, the second pulse is slightly displaced from where the first one came back. Comparing the two gives the speed and velocity information.”

The pulse isn’t a classical square digital pulse but instead, has a strong main peak with ripples out from its centre. With a relatively wide beam of approximately 8°, there is enough scatter for good spatial correlation when each pulse returns. The CVL might not pick up the strongest pulse, but it’s likely to detect one of the characteristic ripples. The correlation, therefore, covers a wider area and does not rely of picking up the centre of the pulse.

The system does also have its limitations, though. If the CVL is swinging about at a steep tilt/roll, it might not even get the return pulse back, however, such motion would not be common in the market addressed by the AquaTrak CVL.

“We have carried out trials with the CVL mounted on an autonomous underwater vehicle (AUV),” said McLay. “It showed it had a significantly greater range and operated at a higher resolution than the DVL baseline.

“CVL characteristically provides a high accuracy right from the start as soon as the vehicle submerges. Obviously, when in very deep waters such as 3000m, the beams cannot reach the seabed and the vehicle has to rely on other methods, but the CVL can start picking up the seabed as it gets up to 300m away. We are trying to do things that nobody else is doing,” said McLay.

The launch of the CVL comes at a particularly interesting time. The original patent on the DVL has expired and this has prompted a number of companies to bring out their own version. Tritech predicted that the market would saturate and looked at other technologies to provide velocity information for subsea vehicles.

“The CVL brings other advantages to operators,” said McLay, “due to the fact that it only has one beam pointing directly downwards. It can, therefore, have structures placed around it without affecting its operation. It can be installed within the frame of the ROV or AUV itself; it just needs an unobstructed tunnel.”

“A DVL, conversely, normally has to be located on the very bottom to allow the beams to be transmitted outwards at an angle. This is the first thing that is likely to get damaged if the vehicle touches the seabed.”

As the market-leading DVL is based on export-controlled American technology, it must adhere to strict USA export restrictions. Rental companies can experience difficulty providing this to some parts of the international oil industry because of this restriction. This is not the case with the Tritech AquaTrak CVL technology.

Tritech sees this CVL technology as being competitive in the oil and gas, survey, oceanography and military mine countermeasure markets. So what is the next step?

“We wish to develop the market for workclass ROV opportunities and then address the needs for a smaller unit more suited for observation ROVs,” said McLay.

The AquaTrak CVL is designed for ROVs and larger AUVs in a 3000m-rated housing and it operates at 150 kHz.