WHY ROTVS ARE USEFUL TOOLS IN ANSWERING THIS QUESTION

Whatâ€™s Down Below??

Early in the first quarter of 2007, Noordhoek Survey took delivery of two MacArtney Focus-2 Remotely Operated Towed Vehicles (ROTVs). The expectation was that the new ROTVs would be a valuable addition to the existing fleet of underwater vehicles. Now, half a year and hundreds of survey kilometres later, these expectations have proven to be correct.<P>

Over the past 15 years, Noordhoek has gained valuable experience in ROV and towfish surveys. The new Focus-2 ROTVs fill the gap that used to exist between the specific competences of these two survey platforms.

The ROTV body (1.25x1.25x1.85m) consists of four carbon-fibre hulls, connected by a carbon-fibre frame, forming a cube. This shape provides both a very stable body and space for the vehicle’s steering flaps. Four of the flaps are positioned at the front of the vehicle and are combined to control roll. Manoeuvring and maintaining correct horizontal and vertical position is achieved using the four flaps based on the aft of the vehicle. The flaps are controlled from the top-side control unit either automatically or manually.

The subsea control system is mounted inside one of the hulls. It comprises the on-board vehicle control computer; depth, pitch, roll and heading sensors; and the power supply for the various hydrographic sensor systems. Apart from the mentioned sensor systems, embedded in the main bottle, an altimeter is also included in the vehicle control sensor system. The altimeter is used for auto-altitude control as well as collision avoidance with the seabed.

The vehicle is designed to be equipped with a large number of different sensor packages, including, but not limited to:
-side-scan sonar
-multi-beam echosounder
-sub-bottom profiler
-Conductivity, Temperature and Depth (CTD) system
-Acoustic Doppler Current Profiler (ADCP)
-motion reference unit
-laser line scanner.

In principle, all the aforementioned survey sensor systems can be mounted on the vehicle. The sensors can be mounted both inside the four cargo bays and on the frame in the middle of the ROTV.
Hatches allow access to the bays enabling easy installation and service. Any transducers are placed outside the hulls according to manufacturers recommendations and are securely mounted taking into account the hydrodynamic design of the vehicle.
The ROTV can carry multiple sensor systems simultaneously, providing the user with data acquired at the same position and time. The advantage of this method is the fact that different sensor data can easily be compared without the need of applying major alterations to the data, allowing quick cross-sensor data interpretation.
On board the vessel, a top-side control unit and a dedicated ROTV handling system are installed. The top-side control unit consists of an interface box, the fibre optic Nexus multiplexer and control console. The control console includes the man–machine interface, as well as a monitor to display all relevant data from the on-board vehicle sensors.
Launch and recovery of the ROTV is performed by the combination of an on-board A-frame or crane and the dedicated ROTV handling system. The handling system comprises mainly a winch with 2,000 metres of double-armoured fibre optic cable.

ROTV training period
Before commencing the pipeline survey projects planned for spring and summer, Noordhoek scheduled an intensive ROTV acceptance test and training period. The ROTV was mobilised on board the Noordhoek Singapore, followed by the test and training session off the coast of Den Helder.?Noordhoek assigned an experienced team of their own ROV pilots to operate the ROTV. For the pilots, operating an ROV is daily routine, but flying an ROTV, however, appeared to be a different discipline. An ROV survey is performed at 1 knot, the ROTV surveys at 4–5 knots. The pilots were not used to the high speed at which the ROTV flies and missed the visual assistance of the cameras that normally support them in controlling ROVs. As a visual aid to the ROTV pilots, in addition to the standard data display on the control unit, the survey crew set up an additional navigation display. Using QPS QUINSy, it displayed a real-time 3D presentation of the vehicle’s position in relation to the vessel and its environment.
As with all new techniques, it turned out that building up experience is key. As the acceptance test and training period progressed, the pilots became increasingly more skilled at manually controlling the system. By the end of the session, the pilots could perfectly manoeuvre the ROTV over the set test tracks. The next step was familiarisation with the autopilot mode. In autopilot mode, the position of the ROTV is calculated in the survey computer and compared online to the database. The vehicle will then position itself in 3D relative to the database and continue to survey automatically.?At the end of the ROTV training period,enough confidence had been gained in the system’s performance to successfully commence the upcoming projects.

ROTV projects

The ROTV's first projects involved pipeline inspection surveys with hydrographic and geophysical sensors. The ROTV was operated in combination with a dual-frequency digital EdgeTech 4200 side-scan sonar system with the transducers mounted in the bottom port and starboard hull. Apart from the side-scan sonar, the ROTV was equipped with a transponder to determine its absolute position behind the vessel with an ultra-short baseline system and an accurate ring laser gyro.

Some of the databases showed routes with a high number of small-radius curves and quickly varying water depths. These are very difficult databases for conventional towfish surveys because the fish can easily deviate from the pipeline route in offset and height, resulting in a large number of time-consuming re-runs. Every time the ROTV was deployed, it stayed in the water continuously for days on end. After completing the projects, only very few re-runs were required!

It is a well-known fact that acoustic sensors are very sensitive to uncontrolled movement. While manoeuvring the ROTV along the database, it maintained a very stable position in the water, allowing the side-scan sonar to produce good-quality images over the complete swath without any noise or movement effects. Furthermore, the position of detected targets combined very well with the results of the vessel-mounted multi-beam echosounder, proving that the ROTV was stable and positioned accurately.

For this particular project, the multi-beam echosounder was vessel-mounted, but during the test period the multi-beam echosounder was installed on the ROTV itself. An ROTV-based multi-beam echosounder provides the opportunity to deliver high-resolution data at depths up to 400m. With increasing water depths, the footprints of multi-beam echosounders also increase. This leads to a decrease in data density that could be corrected by sailing more lines, which is time consuming. By simply setting the ROTV in auto-altitude mode, the vehicle automatically maintains its distance to the seabed, resulting in a constant path width and data density, thus minimising the need for re-runs while maintaining survey speed.

Utilising an ROV equipped with a multi-beam system would, of course, also fit the requirement of delivering high-quality data at depth. The disadvantage of this, however, is the large difference in survey speed. An ROV operation is performed at approximately 1 knot, whereas an ROTV survey is performed at 4–5 knots.?For a different annual contract, an ROTV was used to retrieve side-scan sonar data. Utilising an ROTV allowed the client to quickly obtain a general, high-quality impression of the pipeline, the seabed foundation and protective structures. Together with the ROTV, a light-work class ROV was mobilised. The ROV was deployed from the DPII vessel Noordhoek Singapore to perform high-priority inspection and maintenance work on anomalies detected during the ROTV survey. This year, the project was completed with underwater maintenance and repair work utilising Noordhoek's Offshore Diving Department.

A special acknowledgement is made to Brian Beard, survey manager for Noordhoek Survey.