OUTLINE DESCRIPTION

of

SMDH DVECS CONTROL SYSTEM

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1. SUMMARY

This document provides an outline description of the SMDH "DVECS" (Distributed Vehicle and Equipment Control System) and the associated technology.

DVECS has been purpose designed by SMDH specifically for the purpose of controlling mission critical equipment such as a subsea vehicle.

DVECS has been designed to be versatile and easy to use, with a range of powerful features which maximise the functionality and capability of the vehicle or equipment.

Typical DVECS Control Desk

Many of the features of the DVECS control system are standard components, for use as required by the system operator. DVECS interfaces are designed to allow specific customer requirements to be developed quickly and easily, in support of the specialist applications for which the system is required.

The following sections provide an introduction to the design and capabilities of the DVECS control system.

2. DVECS CONTROL SYSTEM

2.1 Introduction

SMD Hydrovision are best known for the design, manufacture and post-delivery support of specialized vehicles and equipment, operating in the difficult environments of sub-sea tele-communications, oil and gas production, renewable energy and military applications.

The range of equipment produced by SMD Hydrovision includes:

- Multi purpose seabed tractors
- Cable and pipeline burial ploughs
- Tracked/towed jetting machines
- Pipeline backfill ploughs
- Free swimming/tracked CMROVs
- Special purpose ROVs
- Versatile work class ROVs
- Linear and Drum cable engines
- Draw-Off-Hold-Back Engines
- Winches, A-Frames and HPUs
- Tidal Energy Generation systems
- Heave Compensation systems
- Bespoke Control Systems

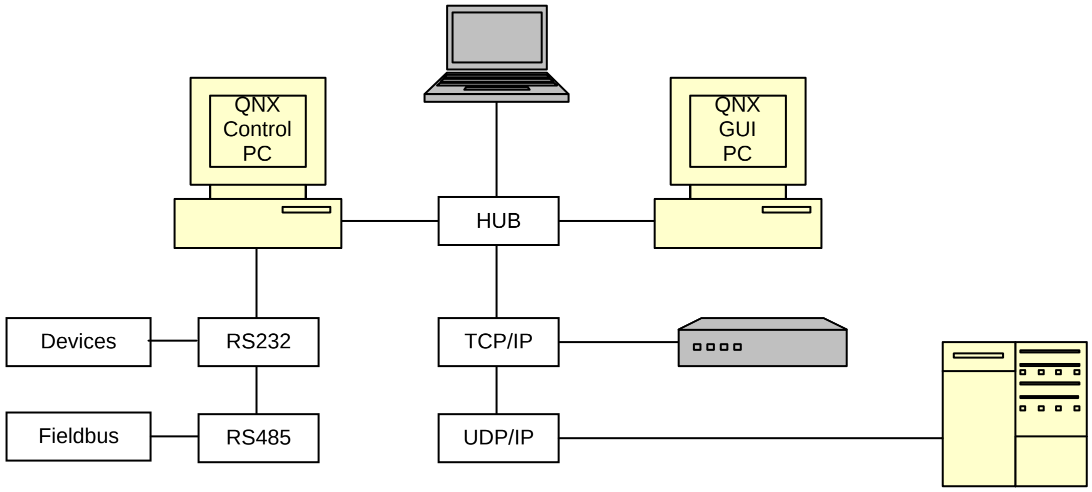
Typical SMDH Equipment

At the heart of any of these vehicle or equipment package is the **Control System**, which links the equipment to the operator and brings the system to life! To assist in the manufacture of this vital system component, SMD Hydrovision have developed a versatile control system package called '**DVECS**' (Distributed Vehicle and Equipment Control System), which allows systems to be assembled quickly, with a full complement of powerful features and a high level of reliability.

'DVECS' is designed specifically for vehicle and equipment control applications, incorporating knowledge and experience gained from many years of systems manufacture and world-wide support.

2.2 DVECS Hardware

DVECS is designed to run on a PC (Intel) platform, making available a vast range of hardware devices and off-the-shelf industrial IO equipment. This robust and reliable working environment is easy to maintain and support.



Typical Hardware Layout

2.3 DVECS Software

DVECS runs on the QNX™ real-time operating system (RTOS). QNX™ provides a powerful, flexible development environment which is very stable and is tried and tested on well in excess of 100 SMDH vehicle and equipment systems worldwide. Furthermore QNX is widely used in the automotive industry and for numerous other high reliability embedded control systems in other industries.

All software is written in-house to maximize the capability and performance of each system application. Featuring a modular design, all common system functions are handled by 'generic' software which is tried and tested extensively during field operations. More than 80% of the control system software falls into this 'generic' category, strengthening reliability and greatly simplifying post-delivery support.

All software modules are written in 'C', which is itself a widely understood and supported programming language.

2.4 Quality Control

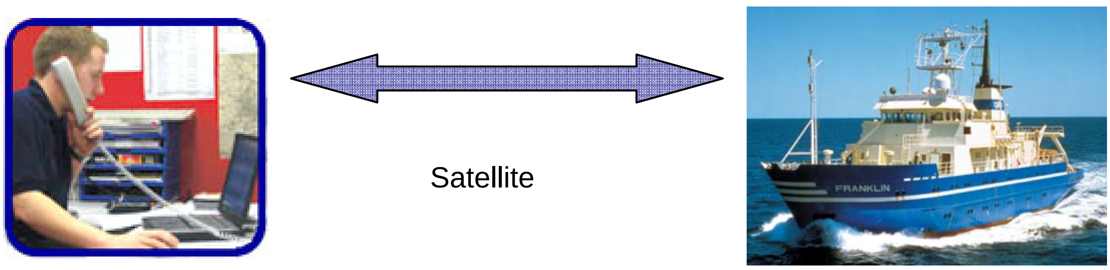
Software development procedures are approved by ISO 9002, covering systems design, testing and post-installation monitoring.

Software version control is managed using a dedicated revision control system (RCS), where details of development and modifications are described within the source code and revisions are updated automatically. Each control system project has a dedicated file storage area, which is backed-up daily to 'off-site' storage for additional security.

All control systems are assembled, commissioned and tested at SMD Hydrovision workshops prior to delivery to the customer. During commissioning, a detailed, rigorous test of all system functions is carried out, to ensure correct operation.

2.5 Support

After a system has been delivered to the customer, support is provided on a 24/7 basis, by telephone, fax and e-mail, to allow problems to be handled as quickly as possible by our software support engineers. All SMD Hydrovision control systems feature a remote diagnostic data link that can provide our engineers with 'direct' system access, from our UK base. Using this link it is possible to monitor and diagnose problems or update software in real-time.



2.6 DVECS Design

A well defined strategy for control systems design has been developed over a number of years, with the aim of maximizing power and capability without compromising reliability or maintainabity.

SMD Hydrovision DVECS systems benefit from the power and flexibility of high-speed data networks, allowing practical, cost-effective systems to be produced. The use of network architecture simplifies the difficult task of systems integration, allowing multiple control systems and data sources to be combined with ease.

During basic system design, the function of a control system is divided into logical processing areas, with computers that are linked together by the system data network. All computers work together to perform the combined control system task. Complex or time consuming calculations are shared around the processing network, to improve system performance and overall reliability.

Data input and output is managed on a dedicated Ethernet or RS485 network, which is separate from the main 'supervisory' or monitoring network. The purpose of this is to prevent interference from high level system activity and further enhance system reliability.

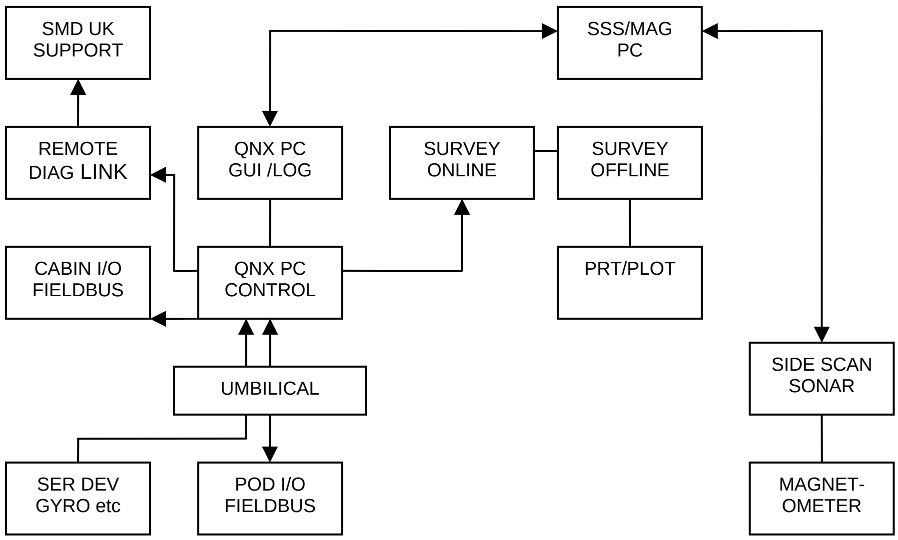
DVECS interfaces are designed to be flexible and highly configurable to allow easy integration of third party systems into the control system environment. All data transfer methods can be supported to suit almost any type of vehicle of equipment that may be required.

The control systems 'software' package, 'DVECS', provides all processing tools and functions required by the control system.
These include:

- Structured data gathering
- Centralized data storage
- Data scaling and conversion
- Specialist control functions (auto-navigation etc.)
- Alarm monitoring and control
- External data acquisition (serial and network data)
- Network-wide data distribution
- User interface and data display
- User input control (touch screens and keypads)
- Data logging and printing
- Remote status display
- Survey Navigation and Positioning

These functions are divided into two main sections, the **control system core**, responsible for low level data gathering and storage, and at a higher level, **data monitoring and control**, which handles displays and all interfaces with the user. The components of the DVECS software package are described in more detail below.

An example of a typical vehicle system configuration would be as follows:



2.7 System Components

2.7.1 Control System Core

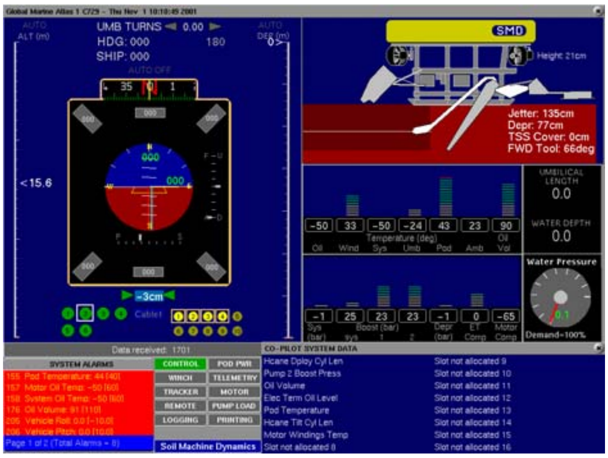
The control system core is a collection of generic tasks which work together in real-time, regardless of activity elsewhere in the system. The control core is configured during system commissioning using a dedicated user interface, the Control System Manager (see below) and runs automatically, requiring no user access during normal operations.

In the form of a closed loop, control system status is gathered and processed to determine real-world scaling and alarm conditions. Conditional control tasks are executed, to handle specialist machine functions, such as auto-navigation, automated tool control, safety monitoring etc. The resulting data is distributed on request to higher level display and monitoring tasks and control output commands from the user are passed back to the system hardware to complete the loop.

Operational access to the control system core is available through the systems user interface (see below), to allow the user to modify data scaling, alarm limits etc. when required.

2.7.2 Graphical User Interface

The control system is designed to isolate the user from the underlying complexities of the operating system and hardware. This is achieved through the system's graphical user interface (GUI), otherwise known as the 'User Configurable Display' (UCD).



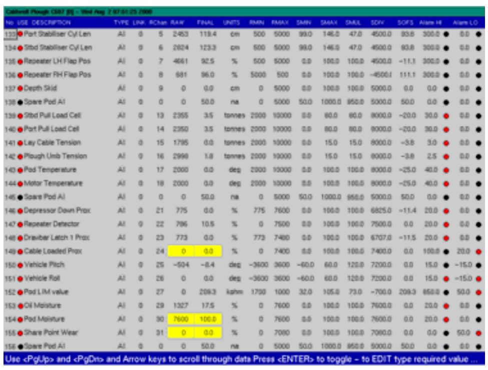
The UCD provides all functions necessary to operate and maintain the the system, without the need for expert knowledge of QNX. This powerful application provides the software tools and functions necessary to design and show control system data, in a multitude of display formats. Displays can be designed and grouped into dedicated, machine specific interfaces, quickly and easily.

The wide variety of applications for which vehicle and equipment systems are used, can benefit greatly from displays that show relevant information when it is actually required.

In many cases, control system displays are designed, and 'fixed' when a system is commissioned, making it difficult or impossible to adapt to the changing requirements of dynamic field operations. The UCD makes screen layout design an easy task, which can be expanded or modified by the user as and when required.

Display function possibilities include:

- Vehicle status
- Equipment status
- Power status
- Navigation and positioning status
- Video overlays
- Chart recorders
- External device access
- System monitoring – network info
- System maintenance – backup/restore
- Data Logging and Printing



Data Analysis Display

Display combinations are virtually limitless, and can contain any combination of data available in the integrated control system.

Screen layouts are assembled from a library of standard data display objects, using simple drag and drop techniques. Displays can be linked and switched to ensure that only relevant information is shown, when' it is required.

Featuring Touch Screen support, the UCD can be configured into a flexible and versatile information and control interface with ease.

2.7.3 Control System Manager

The control system manager provides the tools and functions necessary to design and configure the control system core. This process also provides network and application monitoring tools, useful for diagnostic purposes.

2.7.4 Survey, Navigation and Positioning System (SNPS)

DVECS typically includes a fully integrated, 'easy to use', Survey Navigation and Positioning System (SNPS), in support of vehicle and equipment operations offshore.

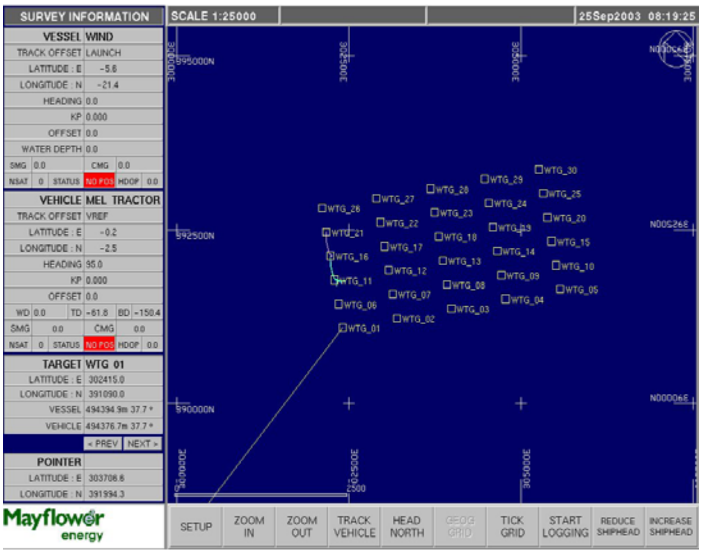
The integration of SNPS functions into the main vehicle control system greatly simplifies data transfer and processing, and removes the need for expensive and often complex third party survey software and equipment.

Much of the complexity naturally involved in the process of navigation and positioning calculation is managed automatically by the SNPS, configuration is simple and straight forward, with the minimum of user input required to get things up and running.

The SNPS gathers survey data in real-time from attached devices, (GPS, Gyro Compass, Echo-Sounder, USBL etc.) and uses this to calculate a wide range of related survey parameters required for positioning, charting and reporting of offshore project operations.

Available data items include:

- Vessel/vehicle latitude
- Vessel/vehicle longitude
- Vessel/vehicle easting
- Vessel/vehicle northing
- Speed made good
- Course made good
- KP – along defined route
- Offset – from defined route
- Heading



All data items generated by the SNPS are stored in the control system data server and can be individually selected for display, logging and printing anywhere in the control system, as required by the user.

2.7.5 Simulator Interface

DVECS now incorporates a Simulator mode which is intended for pilot training and mission rehearsal purposes. The system is designed so that the ROV control system can be used to operate either the “real” ROV or a simulated “Virtual ROV”.

The standard DVECS system incorporates the Simulator interface so that it is a fairly straightforward task to add on the additional simulation hardware required to provide the virtual simulation functionality. See Section 3 for further information.

2.7.6 External Data Interfaces

DVECS can easily be configured to interface with external devices, either via serial links or discrete I/O.

DVECS also includes a TCP/IP or UDP/IP interface which can be used to exchange large volumes of ROV data with other external systems at a high data rate via Ethernet. This facility is useful if a customer has a need to interface to an external data logging system or other system.

2.8 Data Management within DVECS

The following paragraphs provide a brief overview of the management of data gathering and storage within the SMD ROV control system.

DVECS is designed to be distributed across a vehicle or equipment spread that can be small or very large, depending on the function of the equipment. For this reason the control system software is designed in a modular format that can be arranged and configured to suit almost any system requirement.

The I/O system is spread over a number of layers that inter-communicate to transfer data to/from the main control system task (data manager).

Layer5: Data Manager
Layer4: I/O controllers
Layer3: Device drivers
Layer2: Specialist interfaces
Layer1: Hardware

Layer 1: At the lowest layer (hardware), a wide range of formats, protocols and equipment types are supported, to provide access to the vehicle or equipment hardware. These devices provide bi-directional digital, analogue, encoder and serial data flow. Devices can be installed in any location within the spread to suit the overall design of the system.

Layer 2: The second layer handles specialist system interfaces such as compound data gathering systems e.g. field bus, radio telemetry based systems etc. These modules handle communications to/from the I/O systems and format data into specific data types.

Layer 3: Layer three supports the device driver modules, one for each supported device and data type. Depending on the device type, driver modules communicate directly with hardware or with the specialist interfaces in layer 2. They separate and format data by type and then pass it directly to the I/O control managers running at the next level.

Layer 4: Layer four runs the control system input/output managers, which control the flow of data through the system. At this layer, data is combined from the range of device drivers spread across the system, into a standard I/O table used by the control system for processing.

Layer 5: This is the top level of the control system where the system data manager processes and manipulates data for the range of defined vehicle functions. From this layer all other system functions such as operator displays, touch screen controllers, data logging, system wide data distribution, navigation and positioning etc. are handled.

2.9 Typical ROV Control System

The preceding sections of this document describe DVECS in a fairly generic way. On a typical Workclass ROV configuration, DVECS is configured as follows:

- A typical topside WROV Control System comprises 4 QNX based PCs which are linked via an Ethernet network switch.
    - Pilot GUI/Control PC
    - Copilot GUI PC
    - Pilot Touchscreen PC
    - Copilot Touchscreen PC
- All control processing is hosted on the topside Pilot PC.
- Local Data Logging facility to hard disk or USB stick.
- Networked Windows® PC provided to host auxiliary applications such as multiplexer diagnostics, video matrix setup and for download and analysis of logged data. This PC can be connected to the Internet if the vessel supports this.
- Diagnostics modem for remote access.
- TCP or UDP IP interface to customer supplied data analysis systems.
- Integral interface to support optional DriROV simulator.
- All subsea valve packs, JBs and the lamp dimming unit are fitted with integral I/O which is controlled via dedicated RS485 links to the surface control PC.
- The fibre optic multiplexer typically provides data capacity for each of these RS485 links plus additional capacity for customer supplied devices.
- The TMS control system can be an integral part of the ROV control system or a separate standalone system utilising a similar architecture to the ROV.

3. TECHNOLOGY FOR ENHANCEMENT OF OPERATOR SKILLS

3.1 Introduction

Based on DVECS, SMDH have recently been focussing on ways of enhancing operator skills as described in the following sections. Whilst this is initially aimed at ROV operations, it could equally be applied to other control systems.

3.2 Background

The skill of the Pilot is key to the success of any ROV operations. Whether simply flying from one location to another, TMS docking or undertaking complex manipulator tasks, the actions of the Pilot directly determine the time taken, the effectiveness and ultimately the cost of the operation. Unfortunately, as most ROV operating companies are painfully aware, there are very limited opportunities to develop these skills in the field.

The combination of an unskilled operator, poor or zero visibility, strong current and the presence of other underwater structures or objects presents a fairly bleak picture in terms of the odds of safely and successfully completing any planned operations.

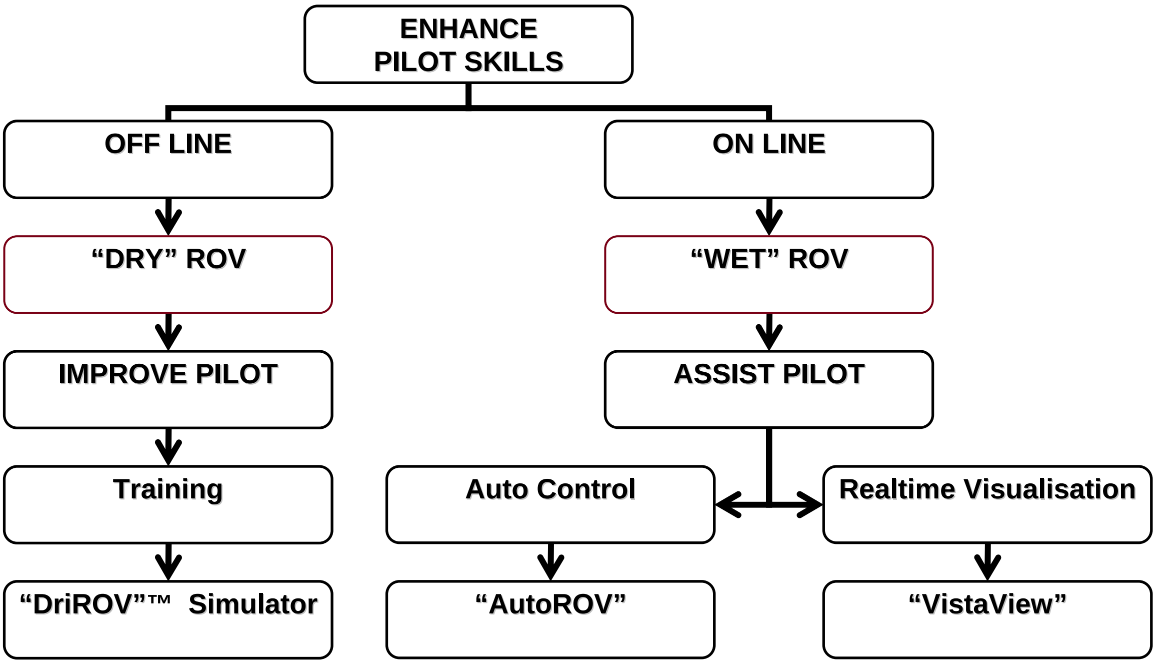
Untrained Pilot	**Trained Pilot**
+	**+**
Poor/Zero Visibility	**Poor / Zero Visibility**
+	**+**
Strong Current	**Strong Current**
+	**+**
Manual Flight Controls	**SMDH “AutoROV™” and “VistaView™”**
=	**=**
Low Chance of Success	**Good Chance of Success**
+	**+**
High Risk of Damage	**Low Risk of Damage**
+	**+**
Long Time to Complete	**Quick Completion Time**
=	**=**
££££££ High Cost ££££££	**Low Cost**

Factors Influencing ROV Operational Costs

With this in mind, SMDH have developed a number of approaches which are aimed at improving these odds by targeting the risks which are directly influenced by ROV pilot competence.

The first approach is to improve the skills of the Pilot by providing training tools which can be used offline without even getting the ROV wet, or indeed without an ROV at all. A range of training simulator systems, generically known as “DriROV™”, has been developed by SMDH to provide this capability.

The second approach is to provide the Pilot with a series of tools which can be used to assist when the ROV is on-line and in the water. These tools comprise AutoROV™, a set of automatic ROV flight controls and VistaView™, a facility whereby the Pilot can view a simulated real time 3D image of the operation from a remote “virtual” vantage point.



Pilot Skill Enhancement

It is our aim to provide customers with maximum flexibility, so all these features are available in a wide range of configurations. For example, in the case of DriROV™, we are able to offer training using our own in-house facility, or alternatively provide one of several different styles of simulator to the end user, including an option where the simulator is fully integrated into the ROV control system.

Given today’s market conditions and the general shortage of experienced ROV pilots, these new facilities provide a variety of ways of enhancing the skills of operators at all levels and also providing them with control system features which will help them to maximise these skills.

SMDH use the abbreviation Q-EOS, or “Q-Series Enhancement of Operator Skills”, as an umbrella term to refer to these features.

3.3 SMDH DRIROV™ Range of Pilot Training Simulators

3.3.1 Summary

The DriROV™ range of training simulators provides facilities for ROV pilots to gain hands-on experience on the sticks using a simulated "virtual" model of the ROV and the environment in which it will operate without requiring access to a "real" ROV. The main obvious benefit of this is that pilot training can take place at a fraction of the cost of training on a live ROV system.

The "virtual" ROV is based on a computer generated model of the ROV which can be controlled by the pilot in a similar way to the "real" ROV. The virtual ROV responds to commands from the pilot, water currents and interaction with underwater objects. The pilot receives feedback from virtual camera images, sonar and simulated instrumentation data which are generated by the simulation software. The model also includes simulation of the manipulator(s), TMS, tether and umbilical.

The trainee pilot is presented with a user interface which mimics as closely as possible that of the host ROV (see later for different options). An instructor configures and controls the simulation from a separate instructor's console. This console is used to monitor the trainee's performance and to modify the operating scenario and environmental parameters as required. Simulated fault and failure conditions can also be generated by the instructor and the subsequent response of the pilot assessed. Record and playback facilities allow later analysis of the simulation to reinforce the impact of the training.

DriROV™ is extremely flexible in that it can be used to train basic skills to new pilots or equally to hone the skills of even the most advanced pilot by rehearsing complex operations to maximise the chance of mission success. The ability to practice manipulator based operations without the risk of causing damage to "real" hardware is one of the most powerful aspects of the system.

The system can also be used for mission planning, mission rehearsal, evaluation of new tools or to assess the effects of changes to vehicle configuration such as adding a tooling skid.

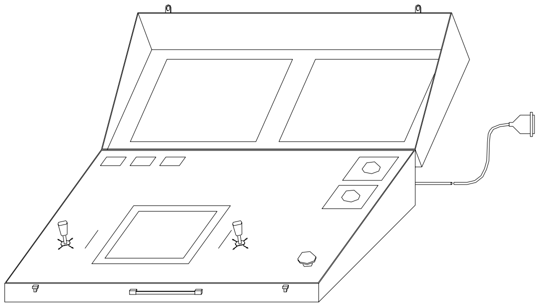
The core of the DriROV™ system is the same across the range of simulators available, though the user interface and the facilities available can be tailored to suit customer requirements and the intended application.

The system is designed in a modular way so that it can be configured or expanded to suit specific requirements. In its most basic form, the system features a simple pilot interface. Additional functionality such as co-pilot controls, video distribution, video recording and power system displays can be added as required to allow full simulated team interaction. Other modules such as alternative manipulator controls and additional camera images can also be easily "bolted on" to extend the system capability.

DriROV™ is currently available in 3 basic configurations as described below.

3.3.2 DriROV Portable System

This configuration is intended for providing training facilities in a location of opportunity such as a spare office on-board or at base. The system is housed in a series of transportable cases and a desktop training console. Typically the functionality of the portable system is minimised in terms of available camera views etc to minimise the amount of hardware required whilst maintaining portability and functionality.



DriROV Portable Desktop Pilot Interface

3.3.3 DriROV Free Standing System

This system is intended for installation in a permanent or semi-permanent location such as a base training facility, workshop or even an office space on board the vessel or rig. The configuration can vary from a simple, lightweight easily transportable system to a full size replica of the host ROV control console.

Typical Transportable DriROV Freestanding System

3.3.4 DriROV Integrated System

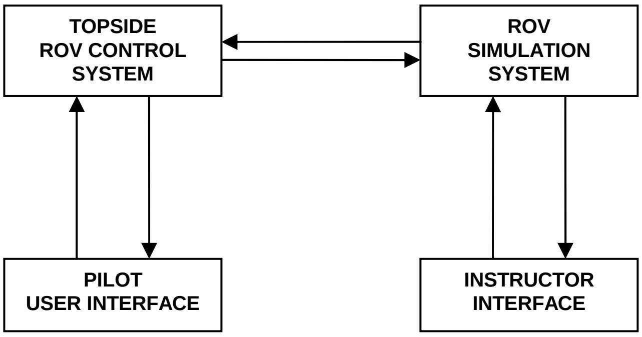
The integrated system is fitted as an integral part of a working DVECS ROV control console. The system utilises the primary ROV controls and displays as its user interface and operates in the background to generate the virtual ROV and its environment. Conceptually, the ROV control desk can simply be switched between operation of the “Real” ROV and operation of the “Virtual” ROV. This system allows pilot training, practice or rehearsal to take place during downtime or time spent WoW using the “Virtual” ROV. This system could also be used during periods when the control cabin or console is ashore or on standby.

DriROV Integrated System

3.3.5 System Description

Fundamentally the basic Simulator comprises four main elements:

- Topside ROV Control System
- Pilot User Interface
- ROV Simulation Package
- Instructor Interface



Schematic of SMDH DriROV Pilot Training Simulator

Other elements can also be added to this basic system such as co-pilot functionality, power system emulation, audience viewing capability etc.

3.3.6 Topside ROV Control System

The simulator topside control system is similar to that used in the ROV control system and comprises the control PCs, network hardware, ROV/TMS control software and image distribution functionality. With the integrated DriROV system, the actual ROV/TMS topside control system is utilised.

The topside control system communicates with the Pilot User Interface in a similar way to the “real” system. It also communicates with the ROV Simulation System which replaces and emulates the behaviour of the ROV and TMS.

3.3.7 Pilot User Interface

The actual configuration of the Pilot User Interface depends on the choice of portable, freestanding or integrated system (see above). However, whichever system is used, the basic principle is to mimic as closely as possible the ROV pilot controls. Appropriate manipulator controls would also normally be provided as part of the pilot user interface.

3.3.8 ROV Simulation System

The ROV simulation system comprises a number of powerful networked PCs which run the ROV simulation software including camera and sonar image generation.

The virtual ROV model is controlled from the Pilot User Interface via the Topside ROV control system. Feedback from the virtual ROV is presented to the Pilot as data on the ROV Pilot graphics screen and as images on the TV and sonar displays.

The virtual ROV system model is specifically configured to match the characteristics and specification of the host ROV system and TMS.

Manipulator simulation is a standard feature of the system and a wide range of simulated models is available for manipulators from various manufacturers.

A range of generic models are available for use with the system such as cutters, cleaning tools, torque tools, standard rigging, work baskets etc. Additional tools can also be provided on request.

Other man-made subsea objects such as valves, manifolds, BOP stacks, pipelines and templates can be imported into the system. A range of generic objects are supplied with the system as standard.

The basic simulation software is configured primarily for pilot training. The system can easily be upgraded to include full mission planning and rehearsal functionality.

3.3.9 Instructor Interface

The Instructor Interface typically runs on a laptop and is used to control and monitor the simulation. A 3D virtual view of the ROV and its surroundings allows the instructor to view the behaviour of the ROV as it responds to commands from the Pilot.

The instructor is also able to generate fault scenarios, modify environmental parameters and adjust the simulation scenario whilst monitoring the pilot’s response to such changes.

The record and playback facility is also controlled from the Instructor Interface.

3.3.10 DriROV Features

- Training of basic pilot skills through to complex manipulator based tasks
- Full ROV, TMS, tether and umbilical dynamic simulation
- Optional mission planning and rehearsal modes
- Full range of configurations from desktop to full size console replica
- Control cabin integrated option
- Scenario recording and playback
- Up to 4 simultaneous camera views from ROV
- Up to 2 simultaneous camera views from TMS
- Virtual sonar image generation
- Wide range of alternative manipulator simulation models available
- Available as pilot only or pilot & copilot operation for team training
- Modelling of proposed changes to vehicle configuration.

3.4 SMDH AUTOROV™

The AutoROV feature refers to a suite of automatic control routines which provide the following automatic control functions.

3.4.1 Auto Depth

ROV automatically remains at a constant water depth.

Feedback from a bathy, digiquartz or standard submerged depth sensor would normally be used as the control variable.

This function incorporates a nudge feature to modify the current setpoint.

3.4.2 Auto Altitude

ROV automatically remains at constant distance from the seabed (Auto Hover).

Feedback from an altimeter, DVL or bathy would normally be used as the control variable.

This function incorporates a nudge feature to modify the current setpoint.

3.4.3 Auto Heading

ROV automatically maintains a constant heading.

Feedback from an on-board flux-gate or gyro would normally be used as the control variable.

This function incorporates a nudge feature to modify the current setpoint.

3.4.4 Auto Hold

When activated, the ROV maintains current position in X and Y.

(Note - Z position is controlled by Auto Depth / Altitude.)

Data from DVL and HPR (or similar) is required for this facility. INS is required in deeper water where range is too great for DVL. INS can also be used in addition to DVL and HPR to improve performance

This function incorporates a nudge feature to modify the current setpoint.

3.4.5 Auto Step

ROV moves a user input distance in X and/or Y direction.

Data from DVL and HPR (or similar) is required for this facility. INS is required in deeper water where range is too great for DVL. INS can also be used in addition to DVL and HPR to improve performance

This function incorporates a nudge feature to modify the current setpoint.

3.4.6 Auto Home

ROV automatically returns to preset “home” position.

Data from DVL and HPR (or similar) is required for this facility. INS is required in deeper water where range is too great for DVL. INS can also be used in addition to DVL and HPR to improve performance

In the standard system, this feature works on relative positions rather than absolute positions. An advanced option is available whereby absolute coordinates can be utilised, however this facility also requires the integrated survey option.

3.4.7 Auto Track

ROV automatically follows pipe / cable using TSS or equivalent.

Requires tracking device (TSS or similar) to provide control input.

3.4.8 Auto Route (under development)

ROV automatically follows pre-programmed route of waypoints.

Requires integrated survey system.

3.4.9 Other Auto ROV Functions

The standard ROV is also supplied with a number of integral control facilities as standard as follows.

a) ***Selectable Thruster Plane Priority***

Vertical thrusters are selected to take priority over horizontals or vice versa.

b) ***Control Reversal System***

Joystick commands are reversed for TDU deployment at rear of ROV etc

c) ***Lost Thruster Compensation***

If a thruster fails, it can be isolated and the control system will modify control algorithms to compensate.

d) ***Pitch, Roll, Horizontal and Vertical Trims***

P&R trims are set via touch screen to compensate for offset payload etc.

H&V trims are set via sliders on desk to compensate for dynamic effects of current, tether drag etc.

DVL = Doppler Velocity Log – Works up to 200m from seabed. Data used to calculate relative position and movement of ROV.

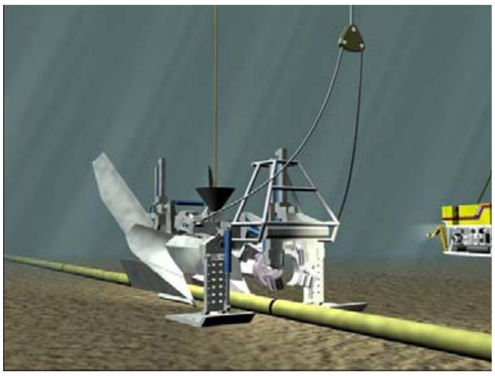
INS = Inertial Navigation System - required where DVL can't see seabed. INS + DVL provides improved accuracy.

HPR = used here generically to refer to an acoustic positioning system.

3.5 SMDH VISTAView™

3.5.1 Introduction

VistaVIEW provides the pilot with a realtime visualisation of the ROV operation from a remote "virtual" viewpoint.



VistaVIEW applied to a Pipe Trenching System

ROV & TMS position, orientation and movement are displayed in real time in 3D on a console monitor display. Tether and umbilical behaviour are modelled based on cable lengths out, tension and DVL feedback of current. The "virtual" viewpoint position can be varied by the pilot to suit the scenario and to provide the optimum view. Seabed features, subsea objects and structures can also be displayed assuming the necessary data is available.

VistaVIEW™ provides essential perspective in low / zero visibility conditions so that the pilot has a realtime view of the scenario. Anyone who has flown an ROV will appreciate that once visibility is lost in low vis conditions, it is very easy to lose a sense of where the vehicle is in relation to other underwater objects. VistaVIEW effectively provides a clear view, irrespective of visibility, thus providing the pilot with visual confirmation of ROV position and orientation.

3.5.2 Principle of Operation

VistaVIEW is fitted as an integrated component of the main control console. This includes dedicated PC hardware whose purpose is solely to generate the VistaVIEW image. Typically the image would be provided as an available image on the video distribution system so that it can be displayed in a convenient location on the video wall.

VistaVIEW requires data from the ROV control system and the ROV & TMS acoustic positioning systems to generate the simulated image. The functionality and accuracy of VistaVIEW depends on the scope of instrumentation and surveillance equipment fitted to the ROV and TMS. Full functionality of VistaVIEW requires survey package integration.

NB Vista = "A distant view or prospect, especially one seen through an opening……".

3.6 SMDH Training Facilities

As part of our ongoing commitment to providing the best possible level of customer support, SMDH have now committed to developing an in-house training facility for the purpose of training customer's personnel.

This facility will include a full size DriROV simulator which can be configured to emulate any SMDH supplied WROV system. Full DVECS functionality will be provided including CoPilot Controls, Video Distribution, AutoROV and VistaVIEW so that all aspects of the system including team interaction can be addressed.

In addition to the Virtual Training Simulator, a range of actual ROV hardware will be provided to demonstrate operation and maintenance of the "real" ROV. This hardware will include:

- Subsea Electronics Pod Chassis
- Fibre Optic Mux System
- Intelligent Valve Pack
- Intelligent Junction Box
- Lamp Dimming System
- Training Network

Other ROV hardware such as thrusters, tether samples, terminations, compensators etc will also be available as part of the training facility.

A range of training courses will be offered which will utilise part or all of these available facilities according to requirements. Alternatively the facility could be hired on a daily basis.

SMDH also incorporates another company (Bywell Subsea) which provides personnel for offshore operations. Another option which could be discussed is the provision of "Q-EOS" trained pilots through Bywell Subsea.

