Dynautics

Autopilot configuration and test – use of SimBox

By means of our vehicle simulators (Ship Sim, AUVSim), we provide a managed route to develop from concept to full-scale missions, minimising development timescales and risks. Our SimBox system provides all the hardware necessary to carry out extensive simulation tests.

Stage 1: from concept to simulation trial

The first stage of this process begins with the creation of the vehicle concept. The basic design of the vehicle and its machinery and sensor fit can be entered into the simulator. On-screen sliders can be linked to the actuators, allowing the vehicle to be test-driven using the Simulator to check its stability and manoeuvrability.

Stage 2: autopilot configuration

In Stage 2, the design is refined and the autopilots are configured to drive the appropriate actuators. The autopilots may then be tuned, either manually or using the self-tuning manoeuvres built in to SPECTRE.

At this stage, the vehicle may be tested in simulation, running through the mission profiles and tasks which are to be performed by the real vehicle, to ensure that the vehicle design meets the required criteria in terms of stability, speed, manoeuvrability and controllability.

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Stage 3: autopilot hardware configuration and test

The vehicle configuration parameters can be downloaded to the SPECTRE autopilot for the first stage of hardware testing. SPECTRE machinery demands are sent to a Simulator PC which simulates the vehicle's response and resulting sensor output which it sends back to SPECTRE via serial, analogue or digital outputs, as appropriate. SPECTRE receives commands from the Remote Control Workstation (RCW). SPECTRE also sends back sensor, machinery and autopilot data back to the Remote Control Workstation, enabling the operator to monitor the vehicle and to send mission commands down to it.

As well as testing the entire system, this equipment set-up can be used to train the operators and to test mission feasibility.

Stage 4: vehicle hardware testing

In Stage 4, the vehicle actuators may be incorporated into the test. This allows the system to be tested, once more, under simulated conditions, but the test may include more of the actual vehicle hardware.

One crucial aspect of this test is that the actual machinery lags and response characteristics may be included in the test – hitherto tested using the lag models within the simulator. This step ensures that the machinery performance is adequate for system sea trials. Most importantly, this test may be used to ensure that actuators are accurately controlled. For example, it is important for optimum performance, that hydroplanes reach the setpoints commanded by the controller, to a good degree of accuracy – backlash in a spindle mechanism, for example, may seriously degrade the controller performance. If carefully performed, this pre-trial test may be used to ensure that all such problems are identified and may be eliminated.

In this way, before committing the vehicle to the water, the entire system, including the on-board autopilot, can be tested by performing a virtual sea trial. This is a time and cost effective way to identify any potential problems and to prove the performance of the complete system. Full mission testing can be carried out at this stage to check that the mission is viable.

Stage 5: sea trials

Finally, the vehicle is committed to the water for Sea Trials. Again, the controller on board is connected to the Remote Control Workstation via an umbilical cable or an acoustic modem link – or, in the case of a surface vehicle, a radio modem, for monitoring, mission download, and intervention as necessary. Gradually the degree of intervention may be reduced until the vehicle is operating in fully autonomous mode.

On completion of Sea Trials, the vehicle is commissioned ready for missions.

SimBox

Dynautics can provide all the hardware required to test the autopilot, assembled in a handy carry case, as shown in the figure below. This comprises the autopilot, a GENIE interface box, plus sufficient serial ports to connect to the RCW PC and to the simulator PC. Connections to the debug port on the autopilot are included to allow quick and easy reconfiguration of the autopilot or even to reprogram the board.

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