Dynautics

Autopilot Algorithms

Dynautics has designed and implemented self-tuning controller algorithms in the SPECTRE autopilot and simulators

The vehicle performs a sequence of manoeuvres from which it learns the vehicle's responsiveness. These algorithms have been thoroughly tested and have been licensed to Raymarine Ltd, who use them in their high-end autopilots.

Self-tuning algorithms for heading, speed, height, altitude, roll and pitch, and fore/aft and lateral movements have been implemented.

Heading Following

In heading following mode, the user selects the desired heading and the autopilot controls the appropriate thrusters, rudders, etc. in order to achieve the desired heading on the vehicle's compass. Under speed control, the autopilot controls the appropriate thrusters, etc. in order to maintain the set speed as measured by the speed log – relative to Earth or water as may be required.

Track (Waypoint) Following

In track following mode, the user enters a set of waypoints, optionally specifying a desired depth / height for each one. The autopilot will then control the track of the vehicle to make it move to each waypoint at the correct speed. Waypoints may be set up on an electronic chart system or ECDIS, and downloaded; alternatively they may be entered directly by providing coordinates.

The track controller effectively provides a high level mission control, including the following features:

- Choice of track acquisition conditions - for example, starting at the nearest waypoint, or at the start of the track.
- Choice of operational modes on completion of the track, e.g. repeat track.
- Linkage between waypoints and events – for example, so that the speed or depth/altitude changes at a specific waypoint.

Dynamic Positioning relative to a point

In order to hover on a point, the autopilot controls the position of the vehicle relative to a user-defined waypoint. Two modes are possible:

- DP0 (DP zero), in which the vehicle heading is chosen by the autopilot to minimise thruster activity and fuel usage. This mode is efficient if there are significant environmental forces (tidal stream and / or turbulence or waves);
- DPH, in which the operator specifies a heading to be maintained subject to environmental constraints. This might be used, for example, if a sensor is to be directed on a stationary target. This mode requires the vehicle to be capable of thrusting laterally.

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Dynamic Positioning relative to an area

When Dynamic Positioning in an area, the vehicle is controlled to maintain its position within a nominated region, typically a circle of specified radius. As with DP relative to a point, this is subdivided into ADP0 and ADPH. Area DP is a very versatile mode and is the most fuel-efficient method of hovering, because it allows the vehicle to drift a controlled amount without making continual corrections and counter-corrections. During DP, several area conditions may be specified simultaneously.

For example, the vehicle may be commanded to stay:

- Within a set distance of a datum (waypoint).
- While avoiding one or more defined danger zones.

These conditions may be superimposed simultaneously. At the same time, the operator (in Remote Control mode) may use a joystick to superimpose a controlled drift - for example, hover within a set zone alongside a pipeline, and slowly drift along it, while maintaining a desired heading so as to bring sensors to bear on the pipeline. This provides a relatively simple interface for the operator, as well as minimizing control communications bandwidth, because the autopilot takes care of the second-by-second control of the thrusters, and the operator only has to issue a simple "drift" command.

Attitude (roll and pitch) and depth / height control

The autopilot system incorporates controllers for attitude (roll and pitch) and depth / height control. Roll and pitch may be controlled to user-specified setpoints. Depth control follows a set depth below surface, while height control may be used for terrain following. In both cases, a rate limit may be specified to control transitions from one depth to another.

Collision avoidance

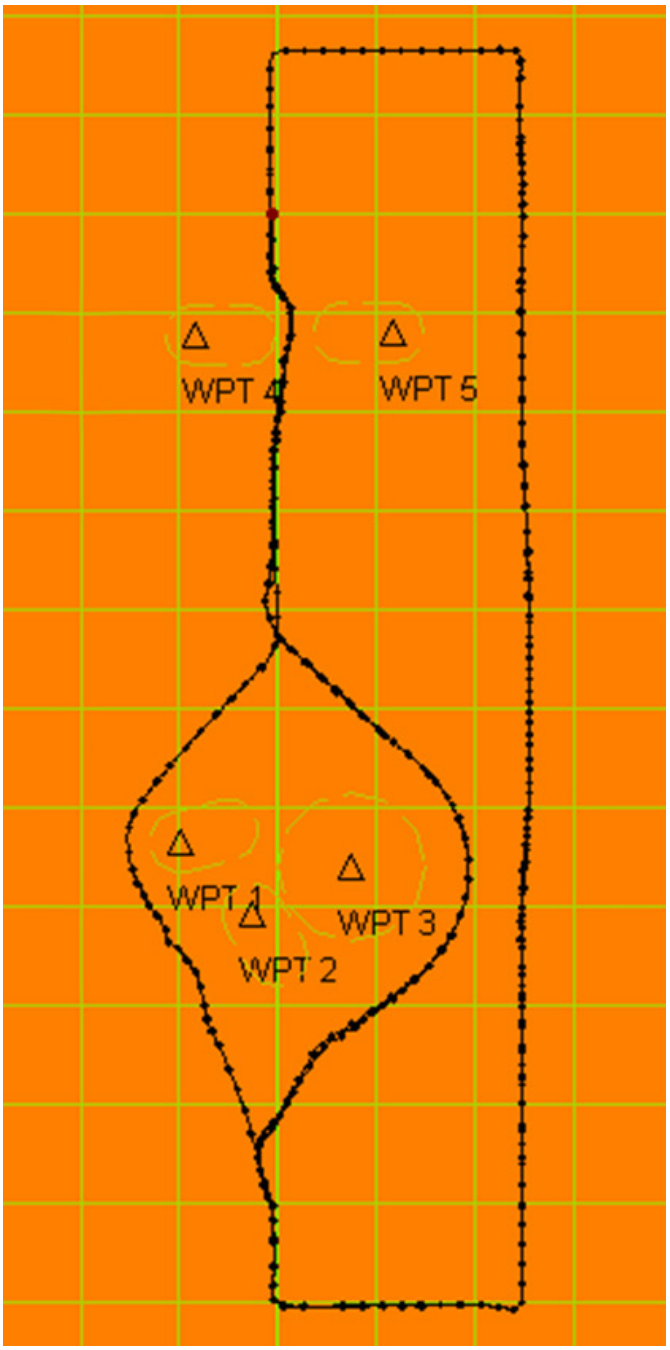
The Collision Avoidance module is integrated into Dynautics SPECTRE remote control system. The operator can specify exclusion zones surrounding static and dynamic obstacles, and extended zones ahead of moving targets. When engaged, the CA module then assesses obstacles and, when necessary, takes control of speed and steering, avoiding the exclusion zones and then returning the craft to its original mission track. The SPECTRE module also supports an "external CA" mode in which mission status is exported to a separate processor which maintains a database of static and dynamic obstacles and plots a modified track to avoid collisions. This "External CA" mode uses a simple interface which is designed to support third party external CA processors from other vendors.

AIS Collision Avoidance: when the vehicle is fitted with an AIS receiver, it can build and maintain a database of potential obstacles.

It will assess the most significant obstacle to avoid and modify its course (and speed, if possible) to avoid collisions. The Operator is kept informed of the presence of the AIS obstacles and can disable them if appropriate, and/or modify the exclusion zone surrounding the obstacle.

Safe Boundaries

The Operator can specify a safe working area within RCW and a series of audible alarms may be triggered if the vehicle approaches or passes this boundary. The system may be configured to send SMS text messages, which is particularly useful during long range missions, hundreds of miles offshore, controlled via satellite comms over a period of several days or weeks.



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