

YK10-02 Cruise Summary

Cruise Number : YK10-02

Ship Name : "Yokosuka"

Title of the Cruise : Sea Trial of AUV "URASHIMA"

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Title of Proposal : "Elemental Technology Tests for Deep & Long Cruising Range Autonomous Underwater Vehicle "URASHIMA" "

Cruise Period : 25 February 2010 – 4 March 2010

Port Call : Shimizu port (Departure) - JAMSTEC (Back)

Experiment Area : Suruga Bay, Suruga Trough Sagami Bay

Overview of Sea Trial

Background :

In late years, deep-sea investigation becomes important for a study about the global warming and study about ocean earthquake. Recently the vehicle has begun to undertake cruises for scientific applications. These applications require precise maneuvering of the vehicle for detailed investigations. For high performance maneuvering of the vehicle, it is necessary to design a control system based on a mathematical model for the vehicle. Since the vehicle was built, PI control has been adopted. In order to improve control performance, the motion controller can be design by means of a model-based approach. An accurate mathematical model based on vehicle dynamics is needed for design of the high-performance controller. It is necessary for the mathematical model to express the actual motions of the vehicle precisely.

Outline :

The sea trial of maneuverability of the vehicle was carried out to improve the precision of the model. The items of performance test are accelerate test, transient response test, controller performance test, step response test and floor tracking test.

Experiment items :

1) Accelerate Test

The initial condition of the vehicle is inaction. Trim is 0 degree, elevator deflection is 0 degree, rudder deflection is 0 degree and speed is 0 m/s. The vehicle is commanded with the number of revolutions of the thruster. The motion data of the vehicle until terminal velocity is measured.

2) Transient Response Test

The initial condition of the vehicle is constant speed, zero deflection of elevator and rudder. The motion data of the vehicle when elevator or rudder deflection is changed is measured.

3) Controller Performance Test

The motion of the vehicle when the vehicle keeps position controlled by depth controller or altitude controller is measured during sampling period. Control gain is tuned up to optimize the controller of the vehicle.

4) Step Response Test

The response to step command input of the vehicle when cruising by depth control or altitude control is measured.

5) Seafloor Tracking Test

The tracking performance of the vehicle against for the flat bottom seafloor or seafloor with ups and downs is tested.

Experiment results

2010 February 25

Test Point: 35° 3.0986' N 138° 36.5527' E 1,000m Depth

The vehicle dived to 700m in depth, and it was measured motion from 0 m/s to terminal velocity at three phase number of revolutions, and difference of the motion by rudder and elevator operation. The following things were confirmed on the acceleration test.

2010 February 26

Test Point: 35° 3.2127' N 138° 43.1068' E 1,000m Depth

The vehicle dived to 900m in depth, and it was measured motion controlled by depth controller or altitude controller.

2010 February 27

Test Point: 34° 50.6912' N 138° 24.6175' E 500–700m Depth

Morning: undulation high. Measured the depth sounding by ship.

Afternoon: The vehicle was carried out seafloor tracking test. The earthquake trace investigation with Side Scan Sonar (SSS) and Multi Beam Echo Sounder (MBES) at off Yaizu. The vehicle kept 80m altitude above from seafloor by altitude controller during cruising. The cruising speed was 2.8 knots. The vehicle can cruise along survey line. The vehicle cruised approximately 15km in half day. Because the vehicle could approach the seafloor, a detailed image was obtained.

2010 March 1

Test Point: 34° 50.3156' N 138° 24.4311' E 1,200m Depth

The vehicle was carried out seafloor tracking test. The earthquake trace investigation with Side Scan Sonar (SSS) and Multi Beam Echo Sounder (MBES) at off Yaizu in the same way as the day before yesterday. The vehicle kept 80m altitude above from seafloor by altitude controller during cruising. The cruising speed was 2.8 knots. The vehicle can cruise along survey line. The

vehicle cruised approximately 30km in day.

2010 March 2

Test Point: 34° 59.5842' N 139° 13.1445' E 1,200m Depth

The vehicle was carried out seafloor tracking test. The earthquake trace investigation with Side Scan Sonar (SSS) and Multi Beam Echo Sounder (MBES) near Hatsushima island there is slant place with ups and downs. The vehicle kept 80m altitude above from seafloor by altitude controller during cruising. The cruising speed was 2.8 knots. It was confirmed that the vehicle difficult to cruise with keeping altitude at the place where ups and downs were too big.

2010 March 2

Test Point: 34° 57.3954' N 139° 12.1646' E 1,200m Depth

The vehicle was carried out seafloor tracking test. The seafloor there is slant place with ups and downs survey with Side Scan Sonar (SSS) and Multi Beam Echo Sounder (MBES). The vehicle kept 80m altitude above from seafloor by altitude controller during cruising. The cruising speed was 2.8 knots.