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DETERMINATION OF ACCURACY OF A COMBINED SYSTEM OF TACHYMETER AND ECHO-SOUNDER AND SUGGESTIONS OF IMPROVEMENT

The coastal measuring equipment is a combined system of tachymeter and an echo sounder. It is used for description of the surface of the seabed. The quality and possibilities of detection with this system can be determined through different tests.

Береговая измерительная аппаратура представляет собой комбинацию тахеометра и эхолота. Она применяется для описания поверхности морского дна. Качество и возможности проведения измерений с использованием данной системы могут быть определены посредством проведения различных испытаний.

The object of this thesis, the coastal measuring equipment, was built in the 80´s of the 20th century. It was build by «ATLAS Hydrographics» under the provisions of the German army. The main tasks of the system are the surveying of the costal ground and the final rating for military purpose.

To guarantee the highest degree of flexibility, the equipment is divided into two parts; the land and the sea part. This is the main difference to other systems for hydrographical surveying, where the system for measuring and data recording are combined on the survey boat.

The land part includes the computer for data recording and controlling and the tachymeter. The sea part includes the telemetric echo sounder for navigation, an ultrasonic converter and an accumulator to ensure the electric power supply. These parts are combined and attached on a rubber dinghy, which is powered by an outboard motor and manned with two persons.

The ultrasonic converter is mounted at the bottom of a pylon and controlled by the telemetric echo sounder. The pylon stands at the side of the rubber dinghy and is topped by a circle of prisms and an antenna. The ultrasonic converter measures the depth with 210 kHz sound waves and the data are transmitted to the land part.

The appointment of the position is arranged by the Polartrack, an electronic tachymeter with a target tracing system. The computer collects the data of the echo sounder and of the Polartrack and saves the data in a project file.

The recorded data of the coast measuring equipment are affected by different factors. In dependence of the quality and quantity they have to be appropriate to the measured data.

These factors are:

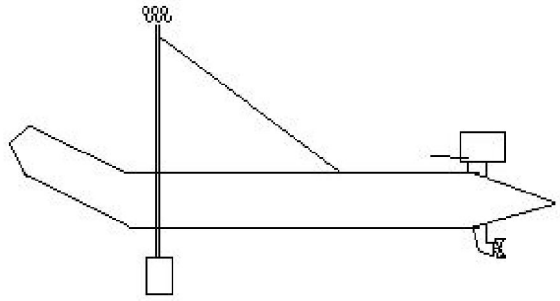
- changing of the ocean surface;
- the tide;
- the accumulation of water by wind;

the swell;

- errors of depth measuring (speed of sound, declination of the rubber dinghy);
- computing errors by the consolidation of positioning and depth measuring data;
- classic tachymeter errors.

Method. To determinate the accuracy of measuring and the consideration of affecting factors, different test were developed and accomplished.

There were comparisons of Polartrack and GPS (Global Positioning System) and a modern tachymeter to declare the accuracy of positioning in static and kinematic modus. Comparative measurements between Polartrack and a modern tachymeter were done with fixed points in the harbour to pinpoint



Draft of the rubber dinghy and the mounted pylon with the circle of prisms at the top and the ultrasonic converter at the bottom

the accuracy for the static surveying. To assign the accuracy in kinematic surveying the coordinates of the Polartrack and a GPS system were compared.

To pinpoint the accuracy of depth measuring, positioning and the affects of factors like swell and declination of the rubber dinghy, surveys were made under different conditions.

The declarations of the possibility of detection were made by tests in different areas with different objects. With dual measurements the object had to be detected. Most of these objects were military objects like bombs and torpedoes. In these areas the position of the objects were known and compared with the results of the surveying.

Results. The results of the test are surprising. The technical part of the system is reaching the age of twenty years, but the accuracy is high enough to accomplish the limit values of the IHO (International Hydrographic Organisation) for positioning and depth measuring. Only the detection of objects doesn't reach the guidelines of the IHO. The small dimensions of the objects could be the reason for this result. If the grade of reflection would be registered, the detection of objects would be possible, because the higher density of the object would reflect the sound wave in a higher degree then the ambient sea ground.

The accuracy of the DTM (Digital Terrain Model), which are rendered of the measuring data is more than enough for the main tasks of the system. Although the allocation of points is linear and not a regular net.

Suggestions of improvement. For the future all elements of the system could be designed in a better way. The using of a rigid inflatable boat (RIB) would improve the manoeuvrability of the boat and would give the crew more space. The using of a multi beam echo sounder would collect more data und could upgrade the quality of the DTM without more time for the surveying. The using of a multi beam would cause the using of a RIB, because the multi beam echo sounder needs more sensors for the registration of movement of the boat then the single beam echo sounder.

The most expensive advancement could be the changing of the positioning system. The appropriation of GPS would raise the flexibility of the system, even if more analyses have to be done.

The cheapest advancement could be the upgrading of the pylon. With some «tuning» parts the captain of the boat could positioning the pylon in the right, vertical position.

All these advancement could raise the accuracy of the whole system. So the accuracy of the results –like DTM– would be risen and thus would bring the system from the past to the present.