



KAIREI “Cruise Report”
KR18-05

Study of adaptive underwater Optical wireless
communication with photomultiplier tube

Suruga bay

March 26th, 2018

Japan Agency for Marine-Earth Science and Technology
(JAMSTEC)

1. Cruise Information

Cruise ID

KR18-05

Name of vessel

Kairei

Title of cruise

Study of adaptive underwater Optical wireless communication with photomultiplier tube

Chief Scientist [Affiliation]

Takao Sawa [JAMSTEC]

Cruise period

2018/03/26

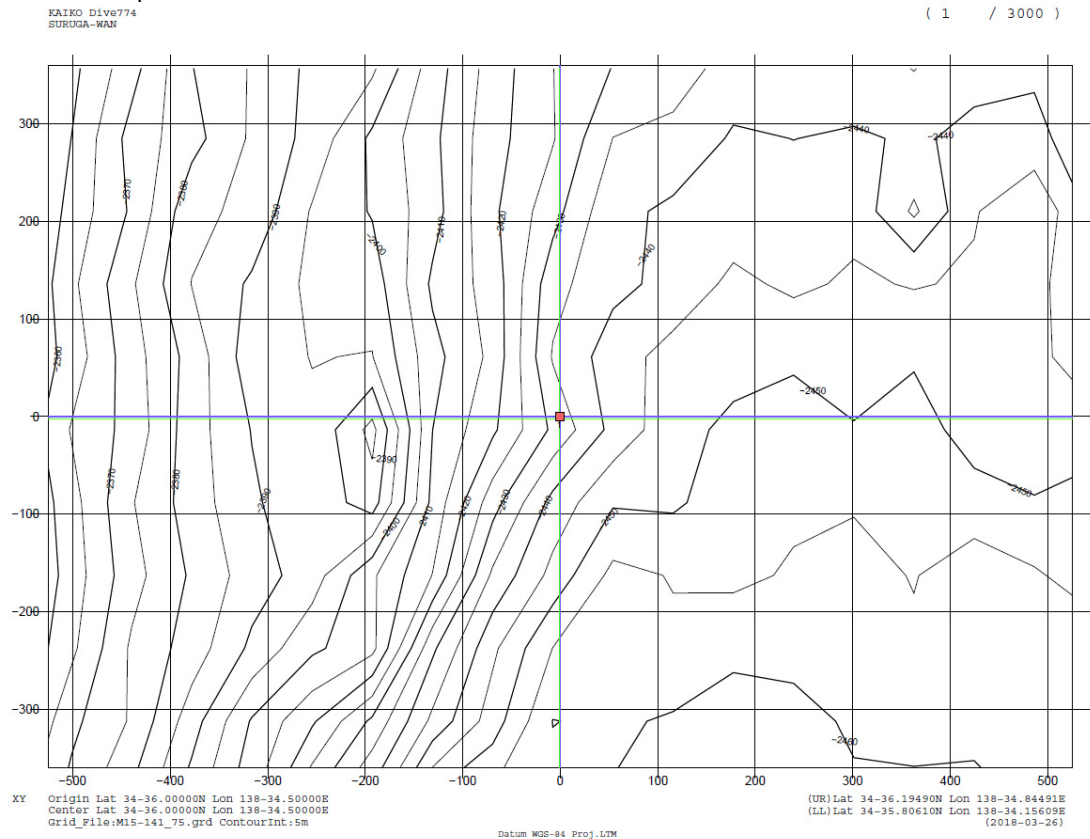
Ports of departure / call / arrival

Shimizu/Yokosuka

Research area

Suruga bay

Research map



2. Research Proposal and Science Party

Title of proposal

Study of adaptive underwater Optical wireless communication with photomultiplier tube

Representative of Science Party [Affiliation]

Takao Sawa [JAMSTEC]

● Science Party (List) [Affiliation, assignment etc.]

Minoru doshida [Acquisition, Technology & Logistics Agency]

Naoki Nisihmura [SHIMADZU Corp.]

Masahiro Tomisaka [SHIMADZU Corp.]

Kazuma Oowaki [SHIMADZU Corp.]

Yuuki Ebara [SHIMADZU Corp.]

Ryousuke Nishi [SHIMADZU Corp.]
Shinnosuke Seo [SHIMADZU Corp.]
Masanobu Tsutsumi [SHIMADZU Corp.]
Tatsuya Ishimori [SHIMADZU Engineering Corp.]
Shin Ito [SAS Corp.]
Yoshiaki Kawashima [SAS Corp.]
Naoyuki Aichi [Aiichi Corp.]
Akira Yokoyama [Aiichi Corp.]
Ryota Serizawa [Aiichi Corp.]
Genki Hamatatsu [Nihon Maruco International Group]

3. Activities

3.1 Background of this research

Because radio wave will attenuate highly in sea water as electro conductor, acoustic communication is usually used for underwater wireless communication. The sound speed in water is low around 1500 m/s, and the frequency is one to three figures in unit of kHz. These facts mean acoustic communication don't become high speed like a radio communication theoretically.

Therefore, study of UOWC: underwater optical wireless communication started from 1960's since laser was invented. And optical analysis of ocean was also started. Around 450 nm light has low absorption in clear water. But the wavelength shift to longer wavelength in proportion to an absorption caused by suspended particles like marine-snow. In addition, ships and underwater vehicles is usually unstable in ocean wave and current. The instability make alignment of the axis difficult, and results in loss of wireless connection.

In recent years, Gallium nitride semiconductor light source have progressed. High brightness and low power consumption, it led wide directivity, was achieved. A practical UOWC modem with easy axis alignment using a LD: laser diode and a LED: light emitting diode was tried, and many advances was made.

A prototype of a LD based UOWC modem had been made in our study team, and was tested in the tank and the sea, KR17-11Leg2. The results were enough for us to advance our study into next step.

3.2 Activities planned in this cruise

I. Communication trials with the underwater wireless optical communication system, loaded on ROV'KAIKO'

II. Water profiling with CTD and special instruments for optical transparency and reflectivity

III. Image quality check through a UOWC

3.3 Methods, Instruments

I. Underwater wireless optical communication systems are loaded on launcher and vehicle of ROV'KAIKO'. After the ROV dives to 500m depth, the vehicle is released from the launcher and descends up to 740m while optical wireless communications is kept.

II. CTD and special instruments for optical transparency and reflectivity are in the sample basket of the Vehicle and profiling underwater continuously through the dive.

III. HD camera images were watched on the mother ship through the data coming through UOWC modem.

3.4 Research results

The performance of our prototype UOWC modem was checked. Automatic changing of

communication speed worked correctly, and the communication performance was depended on colors of carrier light. And HD images from camera on the launcher was shown on the screen at mother ship wirelessly. And we also controlled the camera on real time.

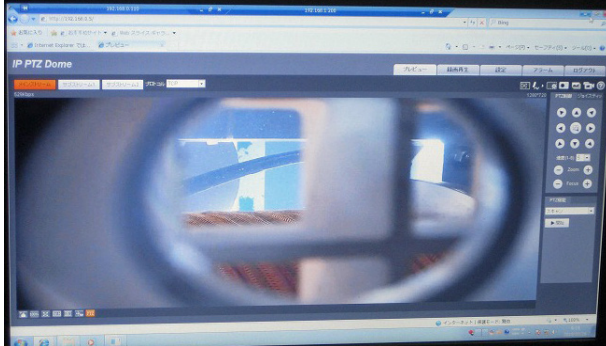


Fig. HD camera image through UOWC modem

4. Notice on Using

This cruise report is a preliminary documentation as of the end of cruise.
This report is not necessarily corrected even if there is any inaccurate description (i.e. taxonomic classifications). This report is subject to be revised without notice. Some data on this report may be raw or unprocessed. If you are going to use or refer the data on this report, it is recommended to ask the Chief Scientist for latest status.

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