CHAPTER 4
Experimental study of recent issues in underwater data communication under different water channels

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ABSTRACT

In this project, several kinds of agents are evaluated to change the coefficients of experimental water precisely. Then, seemed as criterion for the reliability of water recreation, the frequency domain characteristic of data communication through water channel in experimental water is measured and compared. The results show that the type and particle size of the agents will significantly affect its water properties, and the frequency domain component of the water communication signal will be affected by the agent's concentration. By having a separate TX and RX module in the water between the modules we can transmit the sea researcher's biomedical conditions and interactions to the monitoring end available on the ship.

Keywords: — Water communication signal, Separate TX and RX module, biomedical conditions, data communication etc.

INTRODUCTION

Compared with DSP and FPGA, the underwater acoustic modem developed and DAQmx use graphical programming instead of embedded programming, which shortens the development cycle. Developers can

get rid of the complex work of deep understanding of specific chips and focus on the implementation of communication algorithm [2]. At the same time, with the use of graphical programming, the realization of visual interface is relatively simple. It provides great convenience for the verification of new algorithm. Once the algorithm verification is validated, we can port it to DSP or FPGA system. Tao et al. [3] used NI to realize two modulation modes, FH-4FSK and DSSS-DBPSK respectively. The coding communication range is 4000m with, and the BER is on the level of 10−3. However, the transmission rate of this communication system is low, so the implementation of high-speed OFDM communication mechanism is not considered. Chen et al. [4] implemented a relatively complete OFDM modulation system based on Lab VIEW, including channel coding, Doppler estimation, channel estimation and other functions. After the lake test, under the condition of 1km communication distance, the BER can reach the level of 10−3. However, when dealing with a large number of data calculations, using is obviously not enough. MATLAB provides a convenient platform for algorithm verification, and has significant advantages in a large number of data calculations, especially in the Fast Fourier Transformation (FFT, the key step in many modulations and demodulation algorithms) is much faster than any other embedded system libraries. But MATLAB lacks the interface with the hardware, so it can't send the signal generated by itself directly through the transducer. It requires a specific IO interface, while the DAQmx system can only provide common system interface. Therefore, this system uses MATLAB, NI and DAQmx to build a set of modem, which is simple to implement and convenient to debug. It can verify various communication algorithms written by developers on this system.

Marine environments are not easy scenarios for human activities, especially when the operations have to be performed at depths larger than 50 m. underwater research is hampered by the requirement of developing waterproof and weight compensated devices, protected against high pressure. Despite these limitations, the range of underwater applications continuously increases. Research on archaeology or marine environment, maintenance and inspection of oil and gas infrastructures, and fish farming are some examples of human activities conducted at sea. Technological advances have enabled the automation of some of these activities, and also the cooperation of several devices in order to conduct complex tasks. The rise of the number of devices employed in underwater activities has motivated intense research in the field of underwater wireless networks to interconnect all these devices. A current trend in robotic intervention is focused on cooperative applications with multiple remotely operated vehicles (ROV) or I-AUVs (Autonomous Underwater Vehicles for Intervention). For this, some robots conduct a given task while others perform additional activities, such as visual surveying, to provide the operator with visual feedback of the progress of the operation. The communication between the ROVs or autonomous underwater vehicles (AUV) and the operator is usually based on umbilical cables or acoustic transducers. While these approaches are valid in experiments with a small number of vehicles, the participation of more and more robots in underwater interventions require novel solutions. In general, acoustic communications are a good solution for long range transmissions (>1000 m), but having several robots sharing the same acoustic channel might degrade the performance of the communication link. Therefore, alternative solutions based on radio frequency (RF) [1–3] are also considered for short range communications between ROVs. The problem with RF is the strong attenuation of electromagnetic signals in marine water, which limits the communication range to 15 m [4]. Visual light communication (VLC) [5–7] is another alternative that has a higher range than RF, but requires that the transmitter and the receiver are aligned. The communication link based on VLC is heavily influenced by water turbidity, being hard to operate in dirty water.

LITERATURE SURVEY

- Real-Time Text Transmission Implemented For Underwater Wireless Communication Using a LED Array

With the integration of smart sensor technology, wireless communications paves way for better and challenging applications like environment monitoring of difficult terrains, gathering of widely varying

oceanographic data, search and rescue missions especially under water. Underwater communication is a trending field of interest and approaches are under development for achieving low power consumption, compact size and better range. Use of optical waves for underwater communication is an effective approach for secured communication at faster data transfer rates. The paper deals with the implementation of a Li-Fi based module for underwater communication. The system is designed and implemented on the principle of transmission through LED array and reception using a solar panel. The experimental observations analyze the distance versus power relationship for the transfer of textual data. The data transfer is found to be applicable for underwater communication.

- Underwater Optical Wireless Communications, Networking, and Localization: A Survey

Underwater wireless communications can be carried out through acoustic, radio frequency (RF), and optical waves. Compared to its bandwidth limited acoustic and RF counterparts, underwater optical wireless communications (UOWCs) can support higher data rates at low latency levels. However, severe aquatic channel conditions (e.g., absorption, scattering, turbulence, etc.) pose great challenges for UOWCs and significantly reduce the attainable communication ranges, which necessitate efficient networking and localization solutions. Therefore, we provide a comprehensive survey on the challenges, advances, and prospects of underwater optical wireless networks (UOWNs) from a layer by layer perspective which includes: 1) Potential network architectures; 2) Physical layer issues including propagation characteristics, channel modeling, and modulation techniques 3) Data link layer problems covering link configurations, link budgets, performance metrics, and multiple access schemes; 4) Network layer topics containing relaying techniques and potential routing algorithms; 5) Transport layer subjects such as connectivity, reliability, flow and congestion control; 6) Application layer goals and state-of-the-art UOWN applications, and 7) Localization and its impacts on UOWN layers. Finally, we outline the open research challenges and point out the future directions for underwater optical wireless communications, networking, and localization research.

- Implementing IoT in Underwater communication using Li-Fi

Internet of Things (IoT) is attracting more research interest as a result of increased interaction of human with underwater world. IoT technology using Light fidelity (Li-Fi) module plays a vital role in Environmental monitoring, underwater exploration, underwater Disaster management and underwater military Applications. In this paper, we implement IoT in underwater communication using Li-Fi module. However Implementing Li-Fi module in underwater pose grand challenges due to the unique features of underwater channel and acoustic systems. We comprehensively investigate these unique features and finally possible solutions are provided. Simulations are done using MATLAB software to find which color of light emitting diode (LED) is suitable for underwater Communication. It is found that Blue – Cyan-Green Spectral range of wavelength 490nm to 560nm is suitable for underwater communication. We obtain low absorption, scattering and attenuation loss in the Blue – Cyan Green Spectral range. An application was developed for the fisherman to identify number and variety of fishes available in particular location.

PROJECT DESCRIPTION

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system.

The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:

What data should be given as input?

How the data should be arranged or coded?

The dialog to guide the operating personnel in providing input.

Methods for preparing input validations and steps to follow when error occur.

OBJECTIVES

1. Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management for getting correct information from the computerized system.

2. It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulates can be performed. It also provides record viewing facilities.

3. When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the user will not be in maize of instant. Thus the objective of input design is to create an input layout that is easy to follow

OUTPUT DESIGN

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

1. Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily.

2. Select methods for presenting information.

3. Create document, report, or other formats that contain information produced by the system.

The output form of an information system should accomplish one or more of the following objectives.

Convey information about past activities, current status or projections of the Future.

Signal important events, opportunities, problems, or warnings.

Trigger an action.

Confirm an action.

FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out.

This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

- ECONOMICAL FEASIBILITY
- TECHNICAL FEASIBILITY
- SOCIAL FEASIBILITY

ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited.

The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources.

This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently.

The user must not feel threatened by the system, instead must accept it as a necessity.

The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it.

CONCLUSION

Communication is a potential technology to realize underwater wireless communication. The experiment of underwater optical communication in the laboratory is different with that in the real water environment because the physical scale is limited. Although since recent several decades, artificial scattering agents are used to recreate underwater optical communication channels under different water quality conditions, but the similarity between experimental water and natural water is not reliable, such as the similarity in frequency domain characteristics. In this paper, several kinds of agents are evaluated to change the optical coefficients of experimental water precisely. Then, seemed as criterion for the reliability of water

Recreation, the frequency domain characteristic of optical communication channel in experimental water is measured and compared. The results show that the type and particle size of the agents will significantly affect its optical properties, and the frequency domain component of the optical communication signal will be affected by the agent’s concentration.

REFERENCE

1. M. Aydinlik, A. T. Ozdemir, and M. Stajanovic, ‘‘A physical layer implementation on reconfigurable underwater acoustic modem,’’ in Proc. OCEANS, Sep. 2008, pp. 1–4.
2. Y. Zhou and F. Tong, ‘‘Research and development of a highly reconfigurable OFDM MODEM for shallow water acoustic communication,’’ IEEE Access, vol. 7, pp. 123569–123582, 2019.

3. H. Yan, L. Wan, S. Zhou, Z. Shi, J.-H. Cui, J. Huang, and H. Zhou, ‘‘DSP based receiver implementation for OFDM acoustic modems,’’ Phys. Commun., vol. 5, no. 1, pp. 22–32, Mar. 2012.
4. J. H. Jeon, H. An, and S. J. Park, ‘‘Design and implementation of bidirectional OFDM modem prototype for high-speed underwater acoustic communication systems,’’ in Proc. Oceans, Apr. 2016, pp. 1–4.
5. E. Demirors, J. Shi, R. Guida, and T. Melodia, ‘‘SEANet G2: Toward a high-data-rate software-defined underwater acoustic networking platform,’’ in Proc. 11th ACM Int. Conf. Underwater Netw. Syst. (WUWNet), 2016, pp. 1–8.
6. D. Lovrec, F. Tašner, T. Tašner, and J. Edler, ‘‘Comparison of LabVIEW and MATLAB for scientific research,’’ Ann. Fac. Eng. Hunedoara-Int. J. Eng., 2012.
7. Y. Tao, P.-B. Zhu, X.-M. Xu, Y. Tao, and X.-M. Xu, ‘‘Dual-mode modulation based research of underwater acoustic modem,’’ in Proc. 6th Int. Conf. Wireless Commun. Netw. Mobile Comput. (WiCOM), Sep. 2010, pp. 1–3.
8. P. Chen, Y. Rong, S. Nordholm, and Z. He, ‘‘An underwater acoustic OFDM system based on NI CompactDAQ and LabVIEW,’’ IEEE Syst. J., vol. 13, no. 4, pp. 3858–3868, Dec. 2019

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