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UASN Localization and Tracking Approach for An Underwater Medium

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ABSTRACT:- Communication with underwater remote operated vehicles (ROV) is usually done by using umbilical cables. This paper describes the prototype of an ultrasonic communications system that can transmit colour, still and video, pictures from such an ROV. The system uses Multicarrier Modulation for underwater acoustic communications, and has been successfully tested at a data rate up to 10kbps over 1km. It is designed for operating in multipath fading environments. The transmitter and receiver use Digital Signal Processors which control the modulation and transmission and synchronization and demodulation respectively. The system algorithm generates 48 frequencies for transmitting 48 parallel bits of data in each packet. A long transmitted signal sequence is combined with synchronization, zero gap and information packets. To acquire the starting point of the transmitting sequence, the Linear Frequency Modulation (LFM) signal is used for synchronization. In order to reduce noise, the adaptive threshold packets are used to set up a suitable signal.

I. INTRODUCTION

In recent years, underwater communication has become an active research area as there is still a big gap between the communication technology for terrestrial and underwater massive effort exploring the underwater world. The advancement in underwater technology helps human to understand better about a place that has totally different environment in terms of its nature, creatures, composition and physics. The growing research for underwater application has drawn interests of many sectors and industries around the world; government- based or private sector. Among the sectors that benefited much from the advancement of this technology are military, oil and gas industries, fisheries, underwater instrumentation companies, research agency etc. Works such as seismic monitoring, underwater robot operation, underwater surveillance and detection, sea exploration, ocean mapping and research data collection are also getting easier due to this advancement.

Communication is the most important process in underwater technology. The process enables the data transfer between two or more groups/entities. These data are used for navigation, tactical strategies, monitoring, identification etc. Communication can be established either by wired or wireless connection. Both methods have their own advantages and disadvantages, depending on the application. Current trend has opted wireless communication as the preferred way especially when it comes to deal with the depth that wired connection is not practical or impossible.

A. Basic rules for underwater communications

1. Before beginning the dive, if there are more than two divers on the system, a communications sequence must be established (who speaks first, second, and so on). Everyone needs to know who comes before them and who is next in the conversation. This sequence is important to prevent communications from multiple divers overlapping when two or more start speaking at the same time.

2. Press the button to begin transmitting. After hearing the activation beep, wait a few seconds before speaking. The purpose of the beep is to attract the attention of other divers and/or people on the surface. If you speak over the beep you may not be understood because others are not paying attention or because a portion of the conversation overlaps the beep itself.

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3. Speak slowly and pronounce your words carefully. Speaking into the nose/mouth pocket (when wearing a mask) causes reflections and changes in the tone of your voice. Try putting your hands around your mouth like a shell and then speaking. Anyone who hears you will immediately notice the change in tone. Your speech is less clear. Underwater, this obstacle is joined by the element of water surrounding you, which "compresses" your tone of voice downward. That means that you should speak at a normal level, but speak slowly and pronounce each word very clearly. Otherwise your words will get jumbled together and be difficult to understand. This is fairly common even in conversations on dry land with people who speak quickly, or who have accents and pronounce words inaccurately and as a result are difficult to fully understand. This is why you will notice that the voice of the person on the surface is much clearer than those of the divers. Keep in mind that in order to hear as well as possible, divers will preferably hold their breath for short periods or breathe more slowly after hearing the beep that announces communications will begin. It is therefore advisable for people on the surface to speak in short sentences, using brief and clearly pronounced communications.

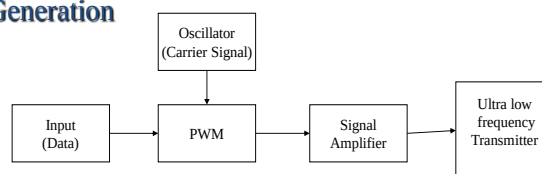
4. Every communication should end with the word "over". This alerts all participants (by clearly defining the end of the communication) and gives them confirmation that they can begin their turn speaking. 5. After the end of a transmission, it's a good idea to leave 5 to 10 seconds of silence so that anyone who urgently needs to step into the conversation may do so. After the 5 to 10 seconds of silence, the next person in order speaks.

II. METHODOLOGY

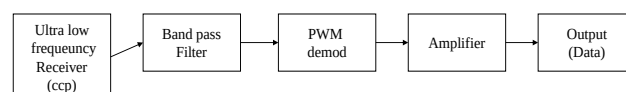
Unfortunately, hams in the USA do not have an allocation in the LF (30-300 kHz) region. However, the FCC has licensed a few experimental stations at 136-138 kHz. Canada and several European countries have opened up this small RF space for Amateur CW and digital communications. A half-wave dipole at this frequency is 3,416 feet long! However, most experimenters use short, inefficient antennas with very large loading coils. Propagation in this RF region is by surface wave, using vertically polarized antennas. The radio waves follow the surface of the Earth. To communicate further, you simply increase power, similar to daylight AM broadcasting in the MF (300-3000 kHz) region. In ITU region 1 and 3, broadcasters use the 150 to 280 kHz region to cover entire countries. European broadcasters in this spectrum can be heard on the East Coast of the US occasionally just after sunset. A good outside antenna is recommended for reception of long wave broadcasters.

Block Diagram

Digital Signal Generation



Digital Signal Reception



An LF band does exist in the US, but it's not an Amateur Radio allocation. A lot of "lower" (Low Frequency Experimental Radio) activity occurs in the 160 to 190-kHz region--the so-called 1750-meter band, authorized under Part 15 of the FCC regulations. Right now, you don't need a license to operate on 1750 meters, but there are severe legal

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restrictions on what you can put on the air there. For starters, you can't run more than 1 W *input* to the transmitter's final stage, and the entire length of the transmission line and antenna combined cannot exceed 15 meters (approximately 50 feet). That's not much antenna for a band where a half-wavelength antenna would be more than one-half mile long! Hams that operate on 1750 meters sometimes use just their call sign suffix as an ID.

Right now, a few hundred experimenters occupy the band in the US, and several of them have set up CW beacons on 1750 meters (many between 180 and 190 kHz), so you might take a listen if you have a receiver that tunes those nether regions. A lot of equipment for the band is homebrew, but commercial equipment is becoming more available.

Several HF/VHF transceivers have general coverage receivers which tune down to 100 kHz or lower, Recent QST Product Reviews now include sensitivity performance at 137 kHz.

A look at a powerful technique for controlling analog circuits with a microprocessor's digital outputs.

Pulse width modulation (PWM) is a powerful technique for controlling analog circuits with a microprocessor's digital outputs. PWM is employed in a wide variety of applications, ranging from measurement and communications to power control and conversion.

Analog circuits

An analog signal has a continuously varying value, with infinite resolution in both time and magnitude. A nine-volt battery is an example of an analog device, in that its output voltage is not precisely 9V, changes over time, and can take any real-numbered value. Similarly, the amount of current drawn from a battery is not limited to a finite set of possible values. Analog signals are distinguishable from digital signals because the latter always take values only from a finite set of predetermined possibilities, such as the set {0V, 5V}.

Analog voltages and currents can be used to control things directly, like the volume of a car radio. In a simple analog radio, a knob is connected to a variable resistor. As you turn the knob, the resistance goes up or down. As that happens, the current flowing through the resistor increases or decreases. This changes the amount of current driving the speakers, thus increasing or decreasing the volume. An analog circuit is one, like the radio, whose output is linearly proportional to its input.

As intuitive and simple as analog control may seem, it is not always economically attractive or otherwise practical. For one thing, analog circuits tend to drift over time and can, therefore, be very difficult to tune. Precision analog circuits, which solve that problem, can be very large, heavy (just think of older home stereo equipment), and expensive. Analog circuits can also get very hot; the power dissipated is proportional to the voltage across the active elements multiplied by the current through them. Analog circuitry can also be sensitive to noise. Because of its infinite resolution, any perturbation or noise on an analog signal necessarily changes the current value.

Digital control

By controlling analog circuits digitally, system costs and power consumption can be drastically reduced. What's more, many microcontrollers and DSPs already include on-chip PWM controllers, making implementation easy.

In a nutshell, PWM is a way of digitally encoding analog signal levels. Through the use of high-resolution counters, the duty cycle of a square wave is modulated to encode a specific analog signal level. The PWM signal is still digital because, at any given instant of time, the full DC supply is either fully on or fully off. The voltage or current source is supplied to the analog load by means of a repeating series of on and off pulses. The on-time is the time during which the DC supply is applied to the load, and the off-time is the period during which that supply is switched off. Given a sufficient bandwidth, any analog value can be encoded with PWM.

Figure 1 shows three different PWM signals. Figure 1a shows a PWM output at a 10% duty cycle. That is, the signal is on for 10% of the period and off the other 90%. Figures 1b and 1c show PWM outputs at 50% and 90% duty cycles, respectively. These three PWM outputs encode three different analog signal values, at 10%, 50%, and 90% of the full strength. If, for example, the supply is 9V and the duty cycle is 10%, a 0.9V analog signal results.

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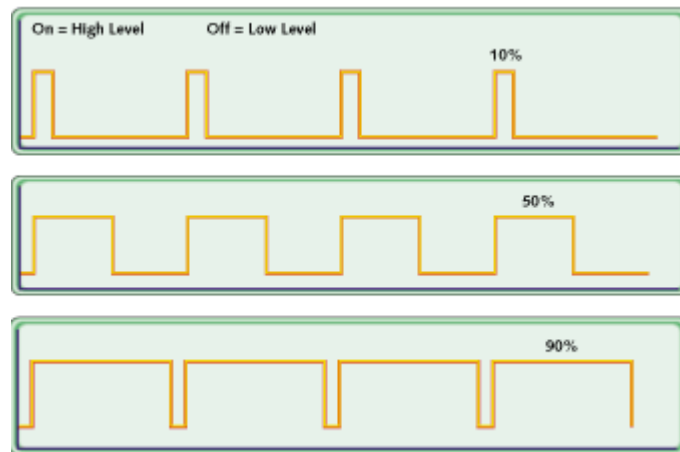


Figure 1: PWM signals of varying duty cycles

Figure 2 shows a simple circuit that could be driven using PWM. In the figure, a 9V battery powers an incandescent lightbulb. If we closed the switch connecting the battery and lamp for 50ms, the bulb would receive 9V during that interval. If we then opened the switch for the next 50ms, the bulb would receive 0V. If we repeat this cycle 10 times a second, the bulb will be lit as though it were connected to a 4.5V battery (50% of 9V). We say that the duty cycle is 50% and the modulating frequency is 10Hz.



Figure 2: A simple circuit

Most loads, inductive and capacitive alike, require a much higher modulating frequency than 10Hz. Imagine that our lamp was switched on for five seconds, then off for five seconds, then on again. The duty cycle would still be 50%, but the bulb would appear brightly lit for the first five seconds and off for the next. In order for the bulb to see a voltage of 4.5 volts, the cycle period must be short relative to the load's response time to a change in the switch state. To achieve the desired effect of a dimmer (but always lit) lamp, it is necessary to increase the modulating frequency. The same is true in other applications of PWM. Common modulating frequencies range from 1kHz to 200kHz.

Hardware controllers

To start PWM operation, the data sheet suggests the software should:

- Set the period in the on-chip timer/counter that provides the modulating square wave.
- Set the on-time in the PWM control register.
- Set the direction of the PWM output, which is one of the general-purpose I/O pins.
- Start the timer.
- Enable the PWM controller.

Although specific PWM controllers do vary in their programmatic details, the basic idea is generally the same.

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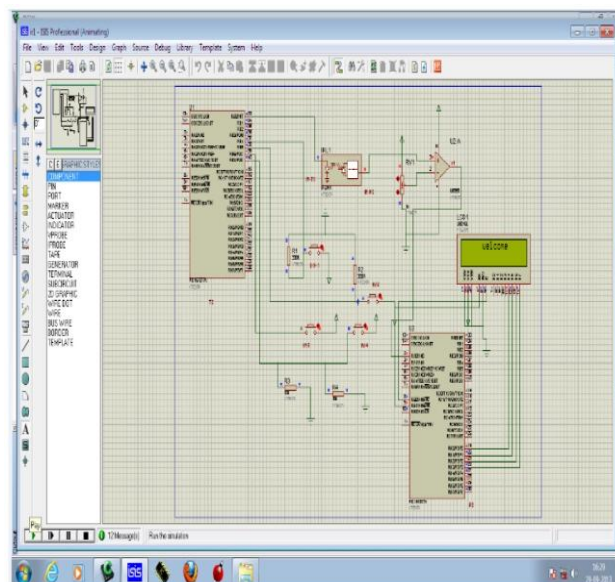
Communication and control

One of the advantages of PWM is that the signal remains digital all the way from the processor to the controlled system; no digital-to-analog conversion is necessary. By keeping the signal digital, noise effects are minimized. Noise can only affect a digital signal if it is strong enough to change a logical-1 to a logical-0, or vice versa.

Increased noise immunity is yet another benefit of choosing PWM over analog control, and is the principal reason PWM is sometimes used for communication. Switching from an analog signal to PWM can increase the length of a communications channel dramatically.

PWM finds application in a variety of systems. As a concrete example, consider a PWM-controlled brake. To put it simply, a brake is a device that clamps down hard on something. In many brakes, the amount of clamping pressure (or stopping power) is controlled with an analog input signal. The output of a PWM controller could be connected to a switch between the supply and the brake. To produce more stopping power, the software need only increase the duty cycle of the PWM output. If a specific amount of braking pressure is desired, measurements would need to be taken to determine the mathematical relationship between duty cycle and pressure. (And the resulting formulae or lookup tables would be tweaked for operating temperature, surface wear, and so on.)

III. RESULT



III. CONCLUSION

Infrared wireless systems based on free space optics technology. Free space optical communications is a Line Of Sight (LOS) technology that transmits a modulated beam of infrared or visible light through the atmosphere or as in our study concerning on wireless system underwater for data communications. It represents one of the most promising approaches for addressing the emerging data access market. It offers many features, principal among them being low start up and operational costs, rapid deployment and high fiber link bandwidth. Wireless infrared communications under water primarily deployed where performance, security, rapid deployment, and cost-savings are critical issues. It is theoretically found that the decrease operating infrared signal wavelength, transmission distance, and transmitter lens diameter, also the increased transmitted signal power, and receiver aperture diameter resulting in the increased received signal power for different ocean water types under the same operating conditions. As well as it is achieved that SNR increases and BER

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decreases with the increased transmitter signal power, transmitter lens diameter, operating optical signal wavelength, and receiver aperture diameter and the decreased transmission distance. Moreover it is indicated the transmitted signal bandwidth and transmission bit rates increases with the decreased operating optical signal wavelength and transmission distance for different ocean water types. Therefore it is concluded that pure ocean water has presented the highest received signal power, transmitted signal bandwidth, transmission bit rates, and signal to noise ratio, and the lowest bit error compared to other ocean water types under the same operation considerations.

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