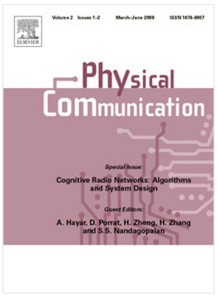
Accepted Manuscript



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PII: S1874-4907(17)30560-8
DOI: https://doi.org/10.1016/j.phycom.2018.07.007
Reference: PHYCOM 573

To appear in: *Physical Communication*

Received date : 21 November 2017
Revised date : 27 May 2018
Accepted date : 5 July 2018

Please cite this article as: G. Qiao, M. Bilal, S. Liu, Z. Babar, M. Tianlong, Biologically inspired covert underwater acoustic communication—A review, *Physical Communication* (2018), https://doi.org/10.1016/j.phycom.2018.07.007

Biologically Inspired Covert Underwater Acoustic Communication – A Review

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Abstract

With the increasing demand of military and marine applications, the requirement for covert underwater acoustic communication is drastically increasing recently. Innovative and inimitable ways are being explored pushing back the traditional methods, augmenting covert characteristics. Our research focuses on biologically inspired covert underwater acoustic communication mimicking marine mammal sounds. The communication signal could be detected by the eavesdropper but it is excluded from the process of recognition due to similarity with cetacean vocals achieving excellent Low Probability of Interception characteristics. The purpose of this study is to provide a comprehensive survey on bionic covert underwater acoustic communication using cetacean vocals since its inception. The works are summarized, compared and future research trends are highlighted.

Keywords: Covert Underwater Acoustic Communication; Cetacean Sounds; Bionic Communication; Masking; Stenography.

1. Introduction

Covert Underwater Acoustic Communication (CUAC) is the most vital requirement for underwater sensor networks, divers' communication and naval defense applications. Its demand has been increased drastically for military, oceanography, underwater oil exploration and marine research and operations [1, 2]. The aim of the covert communication is to communicate clandestinely and keep the location of transmitter and receiver undisclosed.

CUAC is a concept of communicating furtively in underwater acoustic environment. There are two major ways to realize CUAC which includes low Signal to Noise Ratio (SNR) and bionic underwater acoustic communication. In Low SNR technique, the communication signal is transmitted under ocean noise at low SNR. It has a low probability of detection (LPD) feature which means that communication signal has fewer chances to be detected by an eavesdropper. In bionic underwater acoustic communication, the communication signal is mimicked similar to original ocean background noise including marine mammal sounds, natural noise and anthropology noise. The communication signal can be detected by the eavesdropper, but it is excluded during the process of reorganization due to identicalness with original ocean noise. The enemy is tricked that it is a natural sound due to its characteristics. It has low probability of interception (LPI) feature. The data is transmitted in the public underwater channel and is decoded at the receiver through a unique method which is set between transmitter and receiver.

The thought of covert communication is not new, even before forty years scientists used to conceal information by spreading the waveforms [3]. In 1986, J.H. Park conducted experiment in underwater acoustic channel with the transmission distance of 20000 yards. He found that spread spectrum is the most effective method for CUAC [5].Till the past decade, CUAC was achieved by lowering the SNR and spreading the waveform using DSSS [6], OFDM [7] and other modulation schemes. Due to the extremely low SNR, the communication signal is not detected by an eavesdropper, however if the eavesdropper approaches towards transmitter, the signal can be easily detected by a radiometer [8]. Another major

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