ANALYTIC MESSAGES AND SUPERLUMINAL COMMUNICATION

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ABSTRACT

We present a type of message called an "analytic message" that has entangled symbols (i.e. symbols that are to some extent predictable from one another). We prove a theorem that derives the velocity of an analytic message as superluminal. We show that analytic messages can carry information and thus provide a method of superluminal communication.

KEYWORDS: code theory, codeword, message, quantum entanglement, superluminal

I.INTRODUCTION

Superluminal communication is the hypothetical process by which one might send information at faster-than-light (FTL) speeds. The current scientific consensus is that faster-than-light communication is not possible and to date superluminal communication has not been achieved in any experiment [1].

Some theories and experiments include:
*Group velocity >c experiments
*Evanescent wave coupling
*Tachyons
*Quantum non-locality

According to currently accepted theory, three of those four phenomena do not produce superluminal communication, even though they may give that appearance under some conditions. The third, tachyons, arguably do not exist as their existence is hypothetical; even if their existence were to be proven, attempts to quantize them appear to indicate that they may not be used for superluminal communication, because experiments to produce or absorb tachyons cannot be fully controlled [2].

If wormholes are possible, then ordinary subluminal methods of communication could be sent through them to achieve superluminal transmission speeds. Considering the immense energy that current theories suggest would be required to open a wormhole large enough to pass spacecraft through it may be that only atomic-scale wormholes would be practical to build, limiting their use solely to information transmission. Some theories of wormhole formation would prevent them from ever becoming "timeholes", allowing superluminal communication without the additional complication of allowing communication with the past [3].

The microscopic causality postulate of axiomatic quantum field theory implies the impossibility of superluminal communication using phenomena whose behavior can be described by orthodox quantum field theory [4]. A special case of this is the no-communication theorem, which prevents communication using the quantum entanglement of a composite system shared between two spacelike-separated observers. Some authors argue that using the no-communication theorem to deduce the impossibility of superluminal communication is circular, since the no communication theorem assumes that the system is composite [5].

However, some argue that superluminal communication could be achieved via quantum entanglement that don't rely on cloning a quantum system. One suggested method would use an ensemble of entangled particles to transmit information [6], similar to a type of quantum eraser experiments where the observation of an interference pattern on half of an ensemble of entangled pairs is determined by the type of measurement performed on the other half [7],[8],[9]. In these cases, though, the interference pattern only emerges with coincident measurements which requires a classical, subluminal communication channel between the two detectors. Physicist John G. Cramer at the University of Washington is attempting to perform one type of these experiments and demonstrate whether or not it can perform superluminal communication [10],[11],[12].

In this paper we present a type of message called an "analytic message" that has predictable, entangled symbols (i.e. symbols that are to some extent predictable from one another). We prove a theorem that derives the velocity of an analytic message as superluminal.

II. ANALYTIC MESSAGES

In coding theory, the length of a message is k and the length of a codeword is n. A codeword is a function of a message. The codeword normally contains redundancy in order to allow for recovery of the message when there are errors [13]. An analytic message is a message with a non-zero level of predictability. That is, to a given extent, the symbols can be predicted from one another. The traditional message in coding theory is random with a zero level of predictability. In traditional coding theory, $k < n$, but in the case of analytic messages, $k \leq n$, which allows for some portion of message recovery even when there is no redundancy in the codeword.

A code C is defined as the mapping:
$$C : \sum{}^{k} \rightarrow \sum{}^{n}, k \leq n, \ k,n \in \mathbb{Z}^{+}. \tag{1}$$

$\sum$ is the alphabet. We define β as the rule for predicting symbols in the message. For a completely random message, $\beta = \varnothing$. The code rate [14], that exactly captures the amount of information contained per bit of a codeword, is

$$R = \frac{k}{n}. \tag{2}$$

The number of symbols in a message predictable from $k - \alpha$ symbols is α.

The fractional error tolerance limit for completely random messages ($\alpha = 0$) is [15]

$$\rho = 1 - R.\tag{3}$$

The fractional error tolerance limit for analytic messages is

$$\rho = 1 - R + \frac{\alpha}{n}.\tag{4}$$

Clearly, there is greater message recovery for analytic messages.

THEOREM I.

If the speed of a completely random message is c and the speed of a completely analytic message is infinite, because the completely analytic message is completely predictable and therefore simultaneously present at the point of transmission and the point of reception, then the function that interpolates the two speeds is

$$v = \left(\frac{k}{k - \alpha}\right)c.$$

Proof. For a completely random message, $\alpha = 0$. Thus, $v = c$. For a completely analytic message, $\alpha = k$. Thus, $v = \left(\frac{k}{0}\right)c$ and is undefined at infinity. $\square$

COROLLARY.

If $\alpha \in (0, k]$, then $v > c$. Analytic messages are superluminal.

Define the information [16] of a message as

$$I = (k - \alpha)\log_2 |\Sigma|.\tag{5}$$

We see that a completely analytic message has zero information, while the information of a random message is $I = k\log_2 |\Sigma|$. If information is proportional to the momentum of a message, then the energy of a message is

$$E \sim Iv.\tag{6}$$

Therefore, the messages with less information or more analytic messages have higher velocities, but the kinetic energy is a constant relative to α:

$$E \sim kc\log_2 |\Sigma|.\tag{7}$$

It follows that information can be transmitted by an analytic message if $\alpha \in (0, k)$.

EXAMPLE:

Consider the case for which $\alpha = k - 1$ and $\beta = $ " the symbols are sequential". Then the speed of transmission is $v = \left(\dfrac{k}{k - (k - 1)} \right) c = kc$. If $k = 4$, then when the first symbol of the message is received, the other three are completely predicted. Since the first symbol traveled at speed c, then the total message must have traveled at speed $4c$.

III. CONCLUSION

We presented an "analytic message" that has to a given extent, predictable symbols and the symbols are, to a given extent, entangled. We proved that analytic messages are superluminal and allow for superluminal communication.

CONFLICT OF INTEREST: There is no conflict of interest for this manuscript.

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