CRASH LIBERAL WITH IMPACT FREE PACKET ARRANGEMENT FOR BELOW THE SURFACE AURAL LOCALIZATION

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Abstract: This article considers the matter of packet planning for localization in associate underwater acoustic sensing element network wherever sensing element nodes are distributed haphazardly in associate in operation space. Our goal is to attenuate the localization time, and to try and do therefore we have a tendency to think about 2 packet transmission schemes, specifically collision-free, and collision-tolerant. The required localization time is formulated for these schemes, and through analytical results and numerical examples their performances are shown to be generally comparable. the packet duration is short (as is the case for a localization packet), the operating area is large (above 3 km in at least one dimension), and the average probability of packet-loss is not close to zero, the collision-tolerant scheme is found to require a shorter localization time. This is a reasonable assumption because anchors are usually located on the surface and can be equipped with a GPS. An iterative Gauss-Newton algorithm is employed by each sensor node for self-localization, and the Cramér Rao lower bound is evaluated as a benchmark.

Keywords: Underwater acoustic networks, localization, packet scheduling, collision tollerant.

I.INTRODUCTION

After the emergence of autonomous underwater vehicles (AUVs) in the 70s, developments in computer systems and networking have been paving a way toward fully autonomous underwater acoustic sensor networks (UASNs) [1], [2]. Modern underwater networks are expected to handle many tasks automatically. The data packets are usually meaningless if they are not labeled with the time and the location of their origin. In this sense, localization is an indispensable task for the network. the challenges of underwater acoustic communications such as low data rates and long propagation delays with variable sound speed [4], a variety of localization algorithms have been introduced and

analyzed in the literature [5] [6]. For instance, in the terrestrial WSNs, a sensor node can be equipped with a GPS module to determine its location. On the other hand, GPS signals (radio-frequency signals) are highly attenuated underwater, and cannot propagate more than a few meters. In addition, radio signals experience negligible propagation delays as compared to the sound (acoustic) waves. An underwater sensor node can determine its location by measuring the time of flight (ToF) to several anchors with known positions, and performing multilateration. In contrast, acoustic signals propagate very slowly in comparison with light speed, and that introduces long propagation delays between the underwater nodes. a great deal of research exists on underwater localization algorithms, little work has been done to determine how the anchors should transmit their packets to the sensor nodes. In long base-line (LBL) systems where ers are fixed on the sea floor, an underwater node interrogates the transponders for round-tri delay estimation. . The size a single sensor node can vary from shoebox-sized nodes down to devices the size of grain of dust. The cost of sensor nodes is similarly variable, ranging from hundreds of dollars to a few cents, depending on the size of the sensor network and the complexity required of individual sensor nodes.

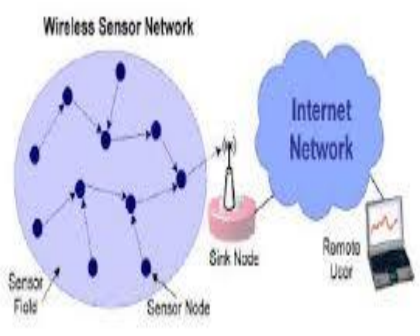

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Figure1: Wireless sensor network structure

Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and bandwidth.

II.RELATED WORK

Most of the available localization algorithms[1] require pair-wise ranging between the nodes. The more accurate the ranging, the more precise the localization. In this paper, the problem of accurate ranging between sensor nodes in an underwater environment is considered. It is assumed that the underwater medium is composed of layers with an isogradient depth-dependent sound speed profile (SSP). For the range estimation, we first show how the pair-wise time of flight (ToF) measurement between the nodes is related to the nodes' positions. Then, based on this relation, we propose a novel ranging algorithm for an underwater acoustic sensor network (UASN). The proposed algorithm is based on the ToF measurement of the first arrival ray which may be reflected from the surface or the seabed. Through several simulations we show that the algorithm performs superb, and meets the Cram´er Rao bound (CRB) for different values of the measurement noise power. Underwater acoustic communications systems[2] are challenged by the characteristics of acoustic propagation through the underwater environment. There are a wide range of physical processes that impact underwater acoustic communications and the relative importance of these processes are different in different environments. The speed of sound and channel latency, absorption and spreading losses, waveguide effects and multipath, surface scattering, bubbles, and am- bient noise are all briefly discussed. We extend one of our recently proposed anchorless[4] mobile network localization algorithms (called PEST) to operate in a partially connected network. To this aim, we propose a geometric missing link reconstruction algorithm for noisy scenarios and repeat the proposed algorithm in a local-to-global fashion to reconstruct a complete distance matrix. This reconstructed matrix is then used in the PEST to localize the mobile network. We compare the computational complexity of the new link reconstruction algorithm with existing related algorithms and show that our proposed algorithm has the lowest complexity, and hence, is the best extension of the low complexity PEST. Simulation results further illustrate that the proposed link reconstruction algorithm leads to the lowest reconstruction error as well as the most accurate network localization performance. the degree of multipath strongly affected ranging accuracy, although differently for DS-UWB versus MB-OFDM. When incorporating a correlation receiver structure as well as an Early Late gate synchronizer in the model, ranging performance proved to be related to features of the synchronization sequence. For specific synchronization sequences, in particular, the best ranging accuracy was obtained with MB-OFDM.

III. PROBLEM DEFINITION

The problem of packet scheduling for localization in an underwater acoustic sensor network where sensor nodes are distributed randomly in an operating area. Our goal is to minimize the localization time, and to do so we consider two packet transmission schemes, namely collision-free, and collision-tolerant. Through analytical results and numerical examples the performances of these schemes are shown to be comparable. In general, for small packet length (as is the case for a localization packet) and large operating area (above 3km in at least one dimension), the performances of the collision tolerant protocol is superior to its collision-free counterpart. At the same time, the anchors work independently of each other, and this feature simplifies the implementation process.

3.1. Self-Localization Algorithms :

Localization algorithms are assumed to be based on ranging, whereby a sensor node determines its distance to several anchors via TOF or round-trip-time (RTT). Each sensor node can determine its location if it receives at least K different localization packets from K different anchors.

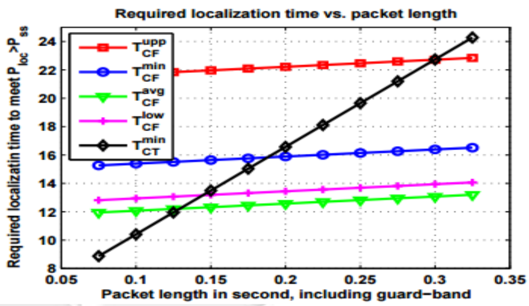

Figure2: Effect of packet length on the minimum required time for localization

The value of K depends on the geometry (2D or 3D), and other factors such as whether depth information of the sensor node is available, and whether the sound speed estimation is required or not. The value of K is usually 3 for a 2D operating environment with known sound speed and 4 for a 3D one. In a situation where the underwater nodes are equipped with pressure sensors, three different successful packets would be enough for a 3D localization algorithm.

IV.LITERATURE REVIEW

4.1 Accurate Ranging In A Stratified Underwater Medium With Multiple Iso-Gradient Sound Speed Profile Layers

Most of the available localization algorithms require pair-wise ranging between the nodes. The more accurate the ranging, the more precise the localization. In this paper, the problem of accurate ranging between sensor nodes in an underwater environment is considered. It is assumed that the underwater medium is composed of layers with an isogradient depth-dependent sound speed profile (SSP). For the range estimation, we first show how the pair-wise time of flight (ToF) measurement between the nodes is related to the nodes' positions. Then, based on this relation, we propose a novel ranging algorithm for an underwater acoustic sensor network (UASN). The proposed algorithm is based on the ToF measurement of the first arrival ray which may be reflected from the surface or the seabed. Through several simulations we show that the algorithm performs superb, and meets the Cram´er Rao bound (CRB) for different values of the measurement noise power.

4.2 Acoustic Propagation Considerations ForUnderwaterAcoustic Communications Network Development

Underwate racoustic communications systems are challenged by the characteristics of acoustic propagation through the underwater environment. There are a wide range of physical processes that impact underwater acoustic communications and the relative importance of these processes are different in different environments. In this paper some relevant prop- agation phenomena are described in the context of how they impact the development and/or performance of underwater acoustic communications networks. The speed of sound and channel latency, absorption and spreading losses, waveguide effects and multipath, surface scattering, bubbles, and am- bient noise are all briefly discussed.

4.3 Angle Of Arrival Localization For Wireless Sensor Networks

Awareness of the physical location for each node is required by many wireless sensor network applications. The discovery of the position can be realized utilizing range measurements including received signal strength, time of arrival, time difference of arrival and angle of arrival. In this paper, we focus on localization techniques based on angle of arrival information between neighbor nodes. We propose a new localization and orientation scheme that considers beacon information multiple hops away. The scheme is derived under the assumption of noisy angle measurements. We show that the proposed method achieves very good accuracy and precision despite inaccurate angle measurements and a small number of beacons.

4.4 Cooperative Localization In Partially Connected Mobile Wireless Sensor Networks Using Geometric Link Reconstruction

We extend one of our recently proposed anchorless mobile network localization algorithms (called PEST) to operate in a partially connected network. To this aim, we propose a geometric missing link reconstruction algorithm for noisy scenarios and repeat the proposed algorithm in a local-to-global fashion to reconstruct a complete distance matrix. This reconstructed matrix is then used in the PEST to localize the mobile network. We compare the computational complexity of the new link reconstruction algorithm with existing related algorithms and show that our proposed algorithm has the lowest complexity, and hence, is the best extension of the low complexity PEST. Simulation results further illustrate that the proposed link reconstruction algorithm leads to the lowest reconstruction error as well as the most accurate network localization performance.

4.5 Design And Capacity Analysis Of Cellular-Type Underwater Acoustic Networks

The design of a cellular underwater network is addressed from the viewpoint of determining the cell size and the frequency reuse pattern needed to support a desired number of users operating over a given area within a given system bandwidth. By taking into account the basic laws of underwater acoustic propagation, it is shown that unlike in the terrestrial radio systems, both the cell radius and the reuse number must satisfy a set of constraints to constitute an admissible solution (which sometimes may not exist). The region of admissible ( ), which defines the possible network topologies, is determined by the user density and the system bandwidth ( ), and by the required signal-to-interference ratio and per-user bandwidth (SIR0 0). The system capacity is defined as the maximal user density max that can be supported within a given bandwidth, and it is derived analytically. Numerical examples are used to illustrate the results. It is shown that capacity-achieving architectures are characterized by , which grows with max. The capacity, as well as the range of admissible solutions, is heavily influenced by the choice of frequency region to which the bandwidth is allocated. Moving to a higher frequency region than that dictated by signal-to-noise ratio (SNR) maximization improves the SIR and yields a greater capacity. Although higher frequencies demand greater transmission power to span the same distance, they also imply a reduction in the cell size, which, in turn, provides an overall reduction in the transmission power. While complex relationships are involved in system optimization, the analysis presented offers a simple tool for the design of future ocean observation systems based on cellular types of network architecture for wide area coverage.

V.PROPOSED SYSTEM

Collision-free localization packet transmission is analyzed in, where it is shown that in a fully-connected (single-hop) network, based on a given sequence of the anchors' indices, each anchor has to transmit immediately after receiving the previous anchor's packet. Furthermore, it is shown that there exists an optimal ordering sequence which minimizes the localization time; however, to obtain that sequence a fusion center and the positions of the anchors are required. In a situation where this information is not available, we may assume that anchors simply transmit in order of their ID numbers as illustrated.We have considered two classes of packet scheduling for self-localization in an underwater acoustic sensor network, one based on a collision-free design and another based on a collision-tolerant design. In collision-free packet scheduling, the time of the packet transmission from each anchor is set in such a way that none of the sensor nodes experiences a collision. In contrast, collision-tolerant algorithms are designed so as to control the probability of collision to ensure successful localization with pre-specified reliability.

Advantages Of Proposed System:

- Collision-tolerant algorithms are designed so as to control the probability of collision to ensure successful localization with pre-specified reliability.
- When the ratio of the packet length to the maximum propagation delay is very low, the collision-tolerant protocols require less time for localization in comparison with the collision-free ones for the same probability of successful localization.
- There is no need for a fusion center, and the anchors do not need to be synchronized.

VI .SYSTEM METHODOLOGY

6.1 System Model

In the First module, we develop the System Model. We consider a UASN consisting of M sensor nodes and N anchors. The anchor index starts from 1, whereas the sensor node index starts from N + 1. Each anchor in the network encapsulates its ID, its location, time of packet transmission, and a predetermined training sequence for the time of flight estimation. The so-obtained localization packet is broadcast to the network based on a given protocol, e.g., periodically, or upon the reception of a request from a sensor node. The system structure is specified as : Anchors and sensor nodes are equipped with half-duplex acoustic modems, i.e., they cannot transmit and receive simultaneously. Anchors are placed randomly on the surface, and have the ability to move within the operating area. The anchors are equipped with GPS and can determine their positions which will be broadcast to the sensor nodes. We consider a single-hop network where all the nodes are within the communication range of each other. The received signal strength (which is influenced by pathloss, fading and shadowing) is a function of transmission distance. Consequently, the probability of a packet loss is a function of distance between any pair of nodes in the network.

6.2 Collision-Free Packet Scheduling

In this module, we develop the Collision-free localization packet transmission module, where it is shown that in a fully-connected (singlehop) network, based on a given sequence of the anchors' indices, each anchor has to transmit immediately after receiving the previous anchor's packet. Furthermore, it is shown that there exists an optimal ordering sequence which minimizes the localization time. However, to obtain that sequence, a fusion center is required to know the positions of all the anchors. In a situation where this information is not available, we may assume that anchors simply transmit in order of their ID numbers. In the event of a packet loss, a subsequent anchor will not know when to transmit. If an anchor does not receive a packet from a previous anchor, it waits for a predefined time (counting from the starting time of the localization process), and then transmits its packet.

6.3 Collision-Tolerant Packet Scheduling

In this module we develop the Collision-Tolerant Packet Scheduling. To avoid the need for coordination among anchor nodes, in a collision-tolerant packet scheduling, anchors work independently of each other. During a localization period or upon receiving a request from a sensor node, they transmit randomly, e.g., according to a Poisson distribution with an average transmission rate of λ packets per second. Packets transmitted from different anchors may now collide at a sensor node, and the question arises as to what is the probability of successful reception. The average received signal strength is thus different for different links (this signal strength, along with a given fading model, determines the probability of packet loss).

6.4 Self-Localization Process

In this module we develop the Self-Localization process. We have seen that a sensor node requires at least K distinct packets (or time-of-flight measurements) to determine its location. However, it may receive more than K different packets, as well as some replicas, i.e., qj packets from anchor j, where j = 1, . . . ,N. In this case, a sensor uses all of this information for self-localization. Note that in the collision-free scheme, qj is either zero or one; however, in the collision-tolerant scheme qj can be more than 1. Packets received from the jth anchor can be used to estimate the sensor node's distance to that anchor, and the redundant packets add diversity (or reduce measurement noise) for this estimate.

In the next two subsections, we show how all of the correctly received packets can be used in a localization algorithm, and how the CRB of the location estimate can be obtained for the proposed scheduling schemes. After the anchors transmit their localization packets, each sensor node has Q measurements. Each measurement is contaminated by noise whose power is related to the distance between the sensor and the anchor from which the measurement has been obtained. The lth measurement obtained from the jth anchor is related to the sensor's position x.

VII.CONCLUSION

We have considered two classes of packet scheduling for self-localization in an underwater acoustic sensor network.The one based on a collision-free design and another based on collision-tolerant design. In collision-free packet scheduling, the time of the packet transmission from each anchor is set in such a way that none of the sensor nodes experiences a collision.. Furthermore, in the collision-tolerant approach there is no order in the anchors' packet transmissions, and they work independently of each other. As a result, there is no need for a fusion center, and the anchors do not need to be synchronized. In the future, we will analyze the localization accuracy under the collision-tolerant packet transmission scheme, and extend this work to a multi-hop network.

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