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AN INTEGRATED CO-OPERATIVE OPPORTUNISTIC ROUTINE PROTOCOL FOR UNDERWATER ACOUSTIC SENSOR NETWORK IN GEOPHYSICAL EXPLORATION

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Abstract
Acoustic signals in underwater, acoustic sensor networks have impediment of limited energy due to problems of batteries. For enhancing network lifetime fuzzy logic-based mechanism of energy consumption ratio and packet delivery probability is necessary in the context of acoustic waves, emanating rock fractures. In these paper, the establish fuzzy concept are extended to the waves of circumferential waves so that a comprehensive study of routine protocol can be evolved the results have significant in many practical applications of geophysical interest.
Keywords: Aco, Fuzzy, Sensor.

1. Introduction

Acoustic propagation of signals by underwater sensor networks (UW-ASNs) is constrained by energy limits of sensors. Replacement and recharging are difficult for the underwater batteries. This situation necessitates energy efficient routing can help to improve reliability of transmission and throughput of network by cooperation of neighboring nodes can decide a forward type of node depending for deep dimension and later the best one can be selected in hop based transmission. Due to the uncertainties of depth and other allied factors. Fuzzy logic-based selection can be resorted to in both of these above-mentioned processes [1,2].

UW-ASN are useful in seismic imaging, exploration prevention of disaster, detection of mines and surveillance. these are characterized by long propagational delay, attenuation of radio waves in saline water, improvement by multipath and fading, different energy conservation, susceptibility towards failures due to corrosion fouling.

A promising application for underwater sensor networks is in monitoring for oil extraction seismic survey can be done in special occasion [3].

The challenges are:

1) Reliable data execution
2) Localization to decide the place of each node
3) Clock synchronization
4) Energy management approval to extend lifetime.

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Solutions are in low acoustic communication. Underset seismic monitoring of all oil is an all or notchy application. The issues are regarding a) low of efficiently reconfigure the network after a prolonged sleep period and b) low power listening with flooding.

2. Network Description

Data link layer:

The challenges are a) limited band width b) high varying time gap. Frequency based accessing is not advisable for underwater because of narrow with of band.

TDMA has the problem of less efficiency in bandwidth requiring long time guarding. CSMA restrains collision with ongoing transmission [4,5].

Network Layer:

It determines the link of source to sensor and destination code. Underwater acoustic channels can be managed by other layer physical and data link while destination link propagation delays can be addressed by network layer.

The existing protocols are divided at 3categories:

a) proactive b) Reactive c) geographical routing protocol.

Transport Layer:

For reliability in transport of event feature and congestion control. TCP does not come as the flow control works on a window base mechanism rely on RTT.

Application Layer:

a) Limited bandwidth
b) High and variable delay

Examples of sensor Nodes:

Aqua comm underwater nodes

Sink quest underwater source nodes

1) Two – dimensional underwater network to monitor ocean.
2) Three – dimensional underwater network to monitor ocean.
3) 3 – D networks of adaptive sampling.

Adaptive sampling: this covers control strategies of commending the mobile vehicles.

Sensor network protocol:

a) Physical layer: -.

Multipath was suppressed by insertions time guards for ensuring vanishing for reverberation pulses .

Data Layer: FDMA is not suable due to warm between the multipath/ factor.

TDMA: limited BW as by time guards are required in UW-A classified Long-time guards: due to project delay on variation of underwater paths .

b) Localization:

Loc algorithms are based on the signal strength or the time of arrival (TOA). These estimate distances between nodes by measuring the propagation time. o

Application-level data scheduling :

Acoustic networks have a limited bandwidth. There is a great need for coordinating nodes transmission is every efficient technique. Acoustic radio is at 20kb/second raw transfer for one node 16.

Unmanned or autonomous under water vehicle are equipped with underwater used for exploration of natural underwater resources.

The communication module ensures less energy during sleep compared to the idle and transaction states. The nodes have been put in clusters routing protocol so that communicating devices is in sleep.

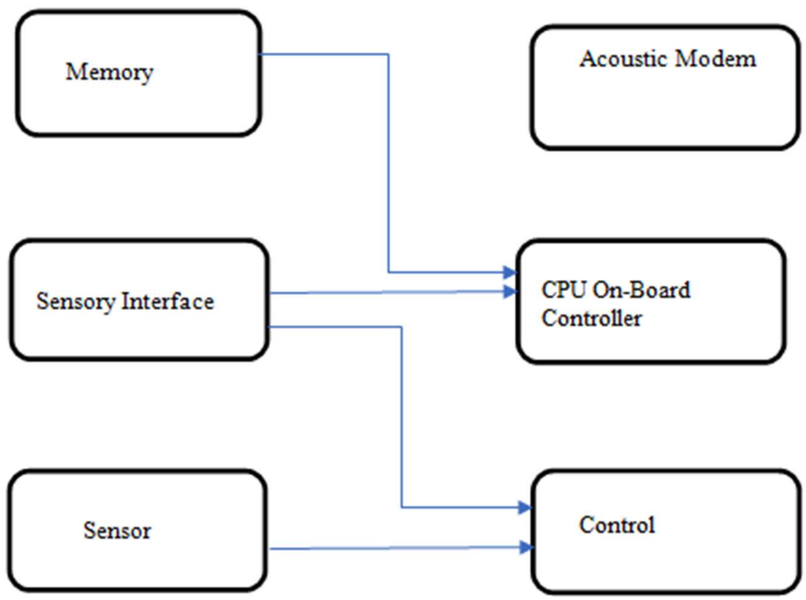

Figure 1. schematic

3. Fuzzy inference system

For selection of the best relay, too fuzzy input variables can be taken in the fuzzification phase. These are a) energy consumption ratio (ratio between reduced & initial energy of the sensor nodes & b) parent delivering probability. The output is the probability factor P which gives the selected is the relay node to forward the parameters. Highest value of P implies that the neighbor node in the forwarding relay has a chance of being best for the present in transmitting round [6,7,8].

Membership functions:

Input: - energy Ratio LOW MED HI PDP small med large

Output P

Very LOW, LOW MEDIUM LOW, MEDIUM, MED HIGH, HIGH, VERY HIGH

IFTHEN rules:

ER	PDP	P
High	large	very high
High	small	MED HIGH
MED	large	MED HIGH
MED	MED	MED
MED	small	MED Low
LOW	large	MED low
LOW	MED	LOW
LOW	small	V LOW

UW – WSNs are having wide application in oil fields. For detection of oil, these are kept near fracture areas.

The peripherial or circumferential waves are acoustic areas. There can be existence at sharp points and intersection. In such ,K-waves moves front to near break into seismic P-waves and S-waves.

4. K-wave/stoneley wave/ crack wave

1) Acoustic waves propagate through fracture causing the movement of elastic walls in each facture. Contraction of factories walls give rise to strong and depressive fluid-guided wave.
   Such fluid waves have different names:
   SLOW wave (Kraulss 1962, Ferrazini and Aki 1987)
   CRACK Wave (chouet 1986)
   Stoneley wave (Tang and Chag, 1988)
   Stoneley guided wave (Korneev, 2008)

2) Body wave, P and S can initiate Kraulis wave at any tip of fracture (Frehner, 2013) [4]
3) K-wave can originate in facture intersection similar to tube waves (Ionov,2007)
   Nakagawa and Korneev have modified the classical model of two straight parallel elastic walls and viscous fluid layer. (Tri layer) to a more realistic model with roughness & irregularity of the walls having granular filling of the fracture space (poppant like filling) with parameters of permeability and facture connectivity. It may be noted that asymphotatic solution of the generalized model can lead to classical approach.
   As per the laws of fracture distribution, some of fractures have a size comparable to length of K-wave at certain seismic frequencies. Such case give rise to resonance within finite structure [3].

Resonance:

The resonance energy may be expressed as the energy of amplitude squares.

$$E(w) = \frac{1}{e}\int_0^l \{A\ (w_i x)\}^2\ dx$$

Here l is the length of the fracture.

K-Wave propagates back and forth along the fracture. On the tips or intersection body waves arise and are scattered into the surrounding rock. (Frehner). K-wave has maximum energy in the first node. Resonance energy calculated by Krylova: l = 2m, l = 3m, l = 4m with h=10 -3m PH=800kg/m3 N fl =1cP, G=15.109Pa, Vp = 400m/sec Vs = 2361m/sec.
Resonance energy is larger for less viscous fluids. Normally resonance is seen when a fracture length is comparable to wavelength. However, the length of fracture is greater than length of K-wave [5].

5. Circumferential Model

Firstly, there is no doubt regarding the existence of K-waves. Literally, these have been physically observed in laboratory by Tang and Chang amongst others. Acoustic waves propagate through fracture which gives strong and dispersive fluid guided waves [K/slow/crack/stoneley]
Secondly, the K-wave propagates back and forth along the fracture, on the time of intersection body waves arise and are scattered into the surrounding rock (Frehner). K-wave has maximum energy in the first mode. Resonance takes place depending of fracture size matching with length of K-wave. K-wave can also originate in fracture interaction similar to tube waves. [Ionov].
Thirdly, Nakagawa & Korneev (2016) have modified the classical model of Tri-layer to a more realistic model with roughness and irregularity of walls having granular filling of the fracture space.

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It is obvious that all above are possible if the circumferential position can be the place where acoustic waves are changing to body waves at tips and intersection where scope exists for anisotropic multilayer irrergularities filled with poppant like material. Considering a layerwise structure having same length, the model gives rise to propagate of circumferential waves in multilayer annular pattern. Such a structure can explain properly the phenomenon of Frehner.

Relay set:

Sensor nodes are such that they know the present depth from embedded areas. Moreover, each sensor node may get remnant energy. The relative distance between the nodes is found from received signal strength. It is assumed that the horizontal movements are negligible. Without considering energy consumption, best neighbour relay node can be selected by maximizing the point delivering probability. The neighbour relay node which is being selected for packet forwarding in each step by the packets received from the source.

It may be noted that layer the size of the cluster means heavier the data. Load on the cluster head node and higher the energy consumption rate are important. The requirement is to control the cluster size and balance the energy consumption between the cluster head nodes. This is the basis of ASN based as clustering structure routing protocol.

6. Result

The Fuzzy inference system has been applied after processing through neural networks to improve the choice of parameters .

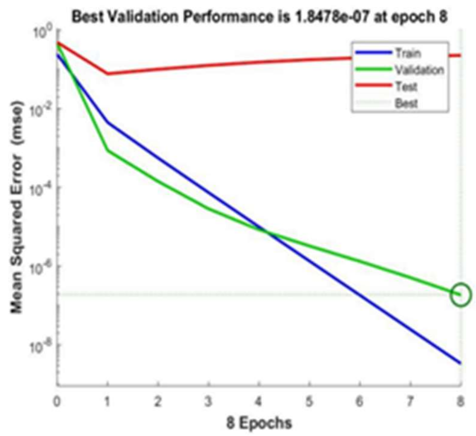

Figure 2. Validation

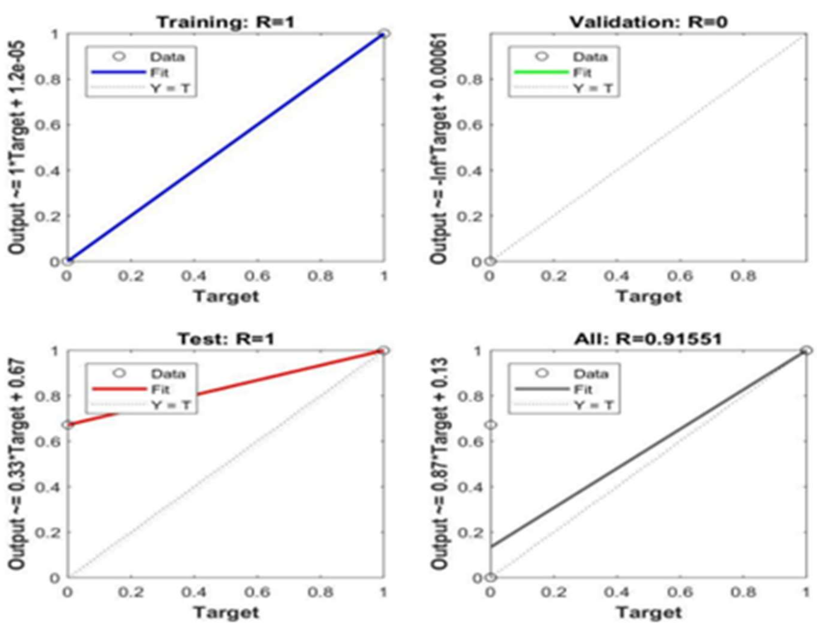

Figure 3. Training

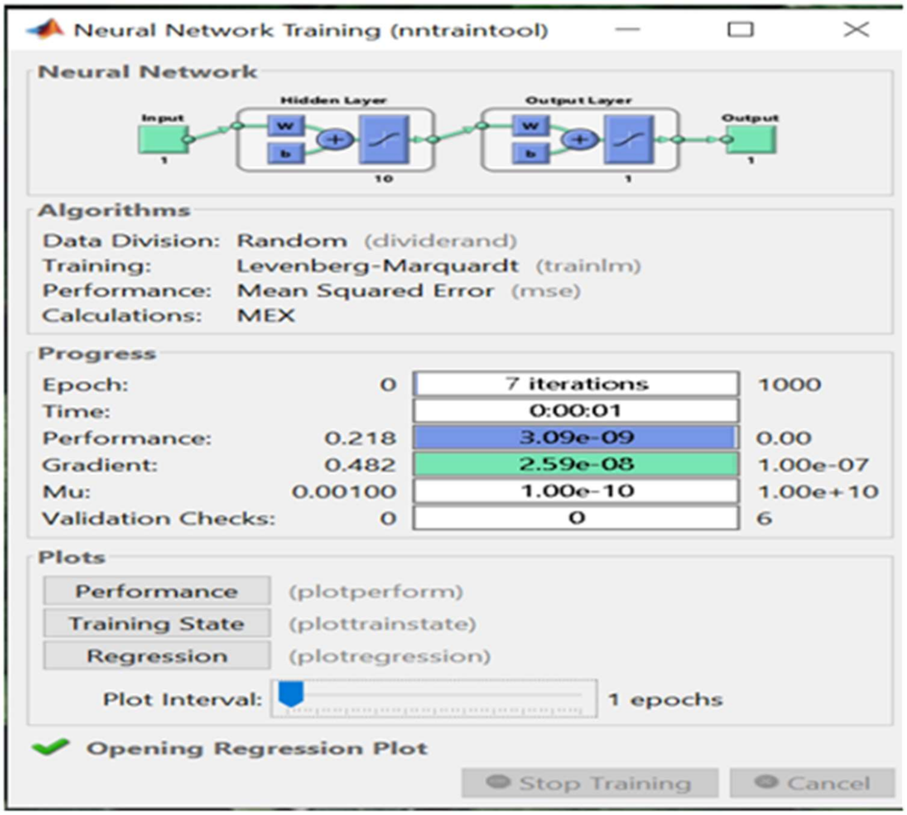

Figure 4. Neural Network

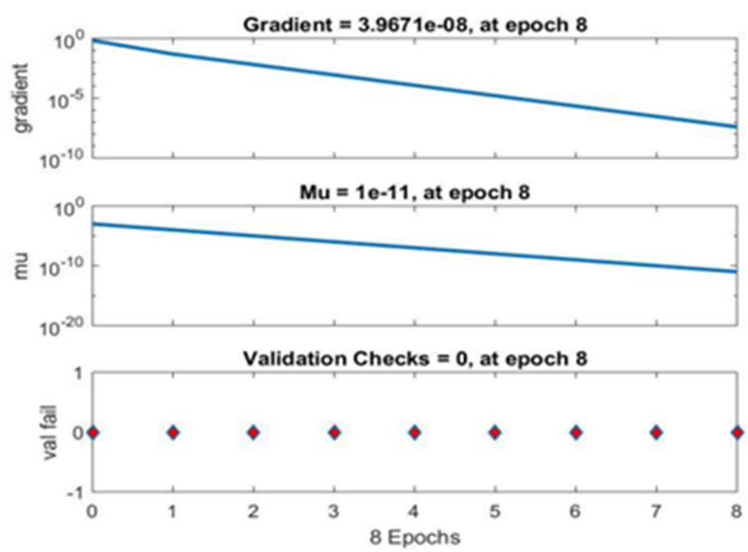

Figure 5. Gradient Validation

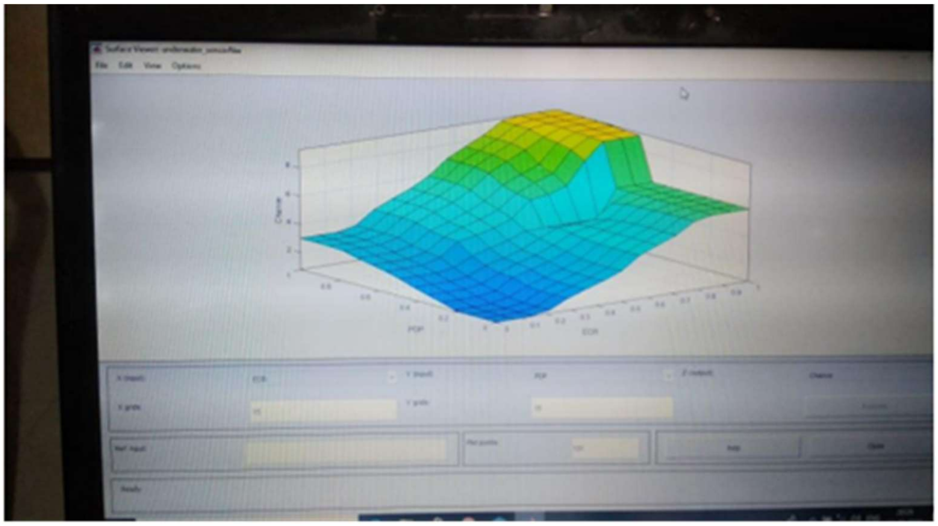

Figure 6. Surface Viewer

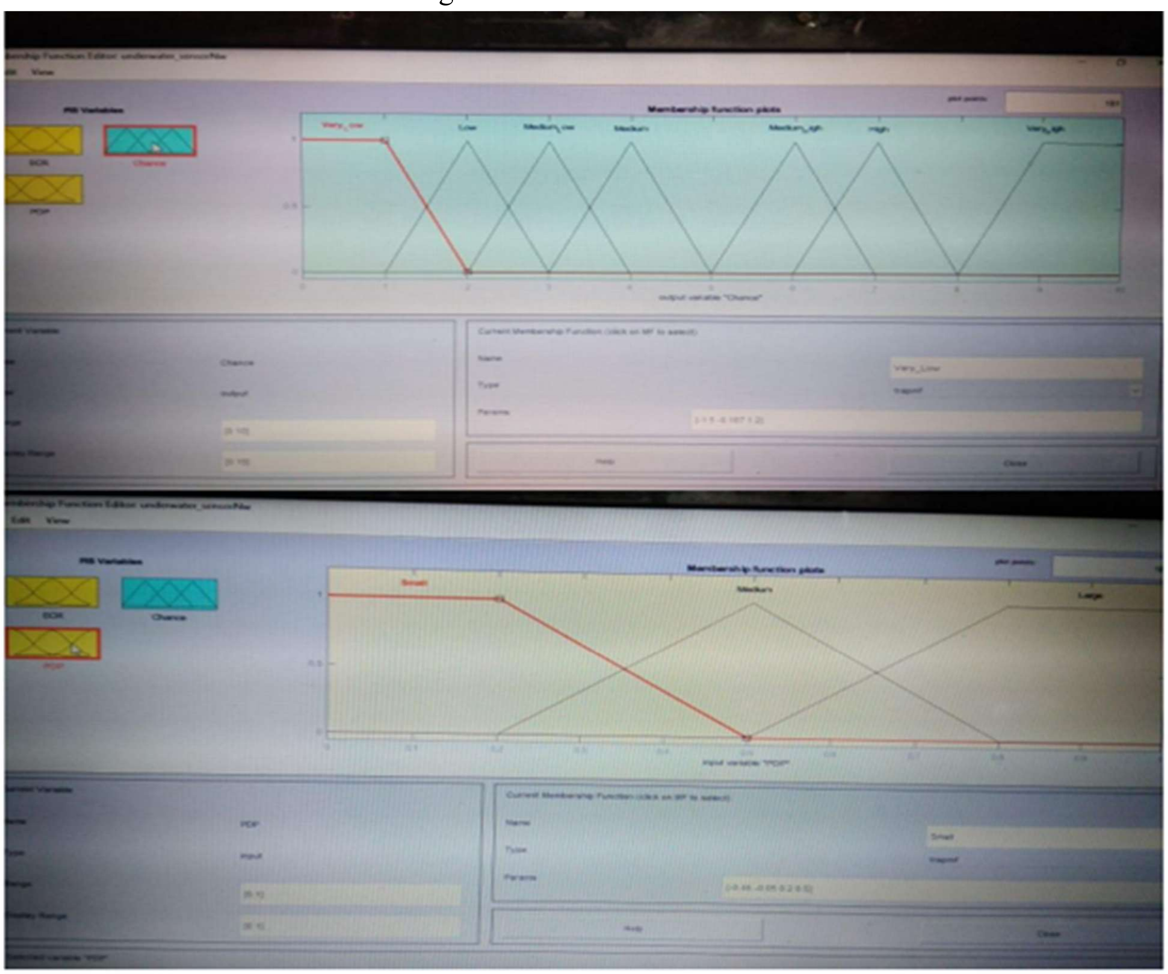

Figure 7. Fuzzy Membership

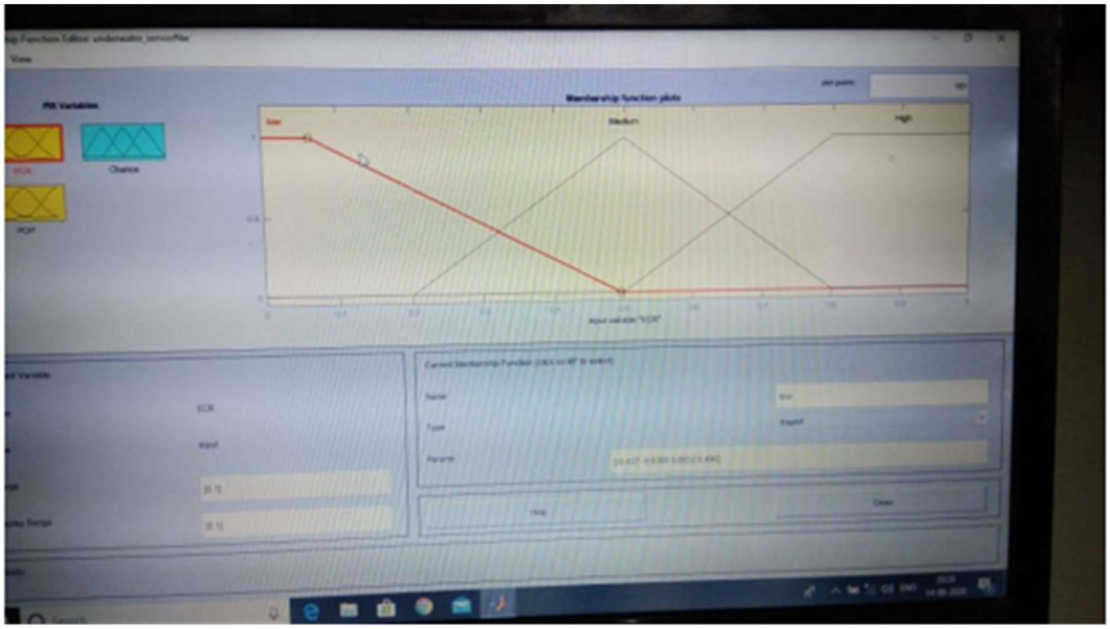

Figure 8. Fuzzy Membership

7. Conclusion

The integration of fuzzy logic concepts of co-operative opportunistic protocol has been extended to the scenario odd acoustic wave emanating from circumferential propagation. These concepts have universal validity in the cases of oil prospecting and many geos physical exploration.

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