

# UMAIR ALI

## The Problem:

*(Please describe the problem / opportunity / gap / need that you want to address/solve. Maximum 300 words.)*

-----  
-----

Pakistan offshore area for Exclusive Economic Zone is 200 NM (nautical mile) with the addition of 50,000sq KM of continental shelf claimed by Pakistan its area has extended to 350 NM in March 2015. With the extension of the continental shelf, there are high chances for economical increment from 1.2 billion dollars to almost double because of seafood, and minerals in it. Pakistan is going to become the center for trading with the establishment of China-Pakistan economic corridor and defensive sea boundary of Pakistan also requires advancement in Technology for monitoring and detection purposes. Now there is a need for scientific exploration and in some of these applications such as oil drilling, target or animal tracking and disaster prevention, the sensed data should be tagged with location information. There is need of a system which would be able to collect data with array of sensors. Fusion of sensory data with minimum effect of noise is a challenging and important research question.

=====

**Following are some of the well-known (identify the best known if possible) existing solutions to this problem. Their known strengths and weaknesses are also provided.**

*(Maximum 200 words.)*

1. Instruments used for target localization are acoustic imaging sensor, TASAs and UWSNs.
  - A) **imaging sensors** has poor visibility and limited range but acoustic systems like TASAs are better.
  - B) **Sound pressure hydrophones** unable to determine position of target on its own so array of these hydrophones work under algorithm. TASAs are not good dealing with noise.
  - C) **Micro electro mechanical devices and wireless technologies** lead toward small sensors having capabilities of sensing processing and communication. Most of underwater tracking algorithm are based on these underwater wireless sensor networks (UWSNs) which have huge structure and high financial cost at the same time limited communication ability and less secure.
2. There are two mode-based method which are given below
  - A) **Passive tracking** is based upon calculations and performs finely in case of linearity but in non linear signals it is still a challenge. Predictions, estimations, data fusion, preprocessing of noise technologies are used in passive tracking.
  - B) **Active tracking** is based upon echo and receive technology which usually consists on

transmitter and receiver. Like 3D underwater technology with algorithm. But there are high propagation error due to severe propagation loss in underwater environment.

3. Similarly, there are some optimization-based methods like Kalman filters and particle filters. Kalman filters are very good with fusion of data but perform poorly in the presence of noise. Particle filters are good at dealing with noise but have a high computational cost.

=====

**Our solution will address the following weaknesses of above-mentioned solutions.**

*(Maximum 200 words.)*

Our purpose is to receive signal from the source and make it optimum enough to localize the source. In the above-mentioned techniques, hydrophone sensors are good for receiving signals from the source but a single hydrophone does not do anything on its own. It requires multiple hydrophones to localize the presence of an object accurately. GPS and inertial sensors work above the surface of water but do not work underwater accurately, so there is a need of adding some sensors like USBL, DVL, etc. Multi-sensory fusion can be done using Kalman filter, but KF performs poorly in the presence of unmodelled noise of the underwater environment. Our solution will address such weaknesses of receiving and optimizing the signal for source localization. We shall first solve the problem of receiving the signal from the source, then we shall estimate its position with respect to earth to localize the sound source.

=====

**We will use the following techniques to achieve improvements mentioned above.**

*(Maximum 200 words.)*

-----

For Sea Exploration, it is the plan to use SONAR, which is an acoustic imaging sensor. SONAR transmits the signal to the underwater area and receives back-scattering echoes. So, Acoustic imaging techniques will be used for sea exploration that will create acoustic-based images.

Our plan is to receive signal and make it optimum enough so it may be able to localize the sound source. Initially, it is the plan to use the neural network techniques and Basis functions. There are so many types of neural networks and we have a plan to use PCBC-DIM. A neural network has an input layer and output

layer. In middle there is a hidden layer. A hidden layer will contain our algorithm of localization. In PCBC dim neural network hidden layers consists on error, prediction and reconstruction layer. PCBC-DIM performs multisensory integration even with the presence of noise.

In this sense SONAR for sea exploration and PCBC-DIM for multisensory integration.

=====

### **Synopsis:**

*(A brief description of the idea, in non-technical language, explaining product benefit, target market, basic technology, commercial partners, investors, and potential customers. **Maximum 200 words.**)*

-----

Pakistan has almost 1000km of boundary from sir creek to jiwani with Sea. Initially there was the area of 200 NM for Pakistan due to Exclusive economic zone. With the addition of Continental shelf of 50,000 square km claimed by Pakistan in 2015 now this area has become 350 NM which is equal to the 240,000 square Kilometers. Pakistan used to earn 1.2 billion dollars from sea food and 240 million dollars from foreign exchange and now due to addition of continental shelf there are chances of more than 2 times boost in its earnings. World is trending toward sea exploration because of its significance like oil inspection and locating marine resources but water environment is very challenging so there is need of using best available methods. With economic benefits there are also defensive benefits of this project for example detection of unusual activities. As the Sea Area is very large so it requires huge cost for exploration and defense. So, there is need of smart systems which will have very low cost relatively and no man power to drive such vehicle. This underwater robot will explore below and above the surface at the same time. It will be able to tell the location even underwater where GPS does not work. It will be able to judge, where is what, in deep blue sea is even in night. There are Autonomous underwater vehicle manufacturer like BAE system, ocean Aero etc. we are going to implement the latest technologies and new techniques for our project. This project is important for government and military at the same time it has values for those companies who bear huge cost for sea exploration to collect the data.

=====

### **Scope of the Project:**

---

This project of "Underwater acoustic source localization using PCBC-DIM" is naval related project which has benefits of exploration underwater and also has value due to defensive point of view. Underwater situation is completely different from territorial conditions due to its dynamic and dense environment. In last few decades with discovery of new mathematical tools Underwater research is turning to one of emerging and challenging topics. The following are some points describing the project's scope internationally and specially with respect to Pakistan

1. New and better Techniques are going to implement for multisensory fusion with reduction of unstructured noise, which will be helpful for locating a target and exploring marine resources underwater.
2. For Pakistan 1000 Km sea boundary and 240,000 square kilometers of area requires huge cost and man power to explore and to obtain data but this project will do same work more efficiently, with much lesser cost and no human error possibility.
3. This project is helpful for locating the area of dense population of fishes at the same time collected data will be helpful for locating Oil and other marine resources.

Similarly, there are many more benefits which can be avail with our project which is consisted on Autonomous underwater vehicle (AUV) with all required sensors and our Algorithm of Multisensory fusion with reduction of noise.