**Planning of Presentation: Time Delay Estimation and acoustic source localization**

The actual problem

* Necessity to implement and use algorithms of localization and tracking of Whales to avoid the collision between them and the SHIPS

[Statistics of collisions, number of whales, impact of the collisions in the animals and people] and to track the animals in real time and their behaviour in determined areas (check introduction of my paper Space-time and hybrid methods for…. )

* Known about the underwater environment (objects, animals,...)

The solution

* Estimate the whale localization by TDOA
  + - What is TDOA?
    - Sensors used?
    - Necessity of noise reduction?
    - Actual algorithms?
* Benefits of TDOA vs Beamforming in the underwater environment.
* Why?
* Particularities of underwater environment

Goals of the project (Enunciate)

1. Implement with MATLAB and compare the performance of various **time-delay estimators** (CC, Generalized-Cross-Correlation (GCC), LMS-filter or the very interesting Adaptive-eigenvalue analysis) **and noise reduction algorithms** with both simulated and real underwater acoustic data.

* Advantages
* Disadvantages
* Peculiarities of each method

1. Localization of the Whale from the Time delay Estimations obtained from the Simulations with our algorithms and real data.

Deepen the goals

1. Implement and compare algorithms (95% of the spent time)

First, read the papers about the different time-delay estimation algorithms in different environments and papers about Minke Whales and their kind of sounds.

* Deal with real data
* Minke whales (History and curiosities of Minke whales and the sound characteristics)
* Our Real Data provided by Ludwig : describe data where does it comes from, why is this case particular compared to the data we have used in class ( species, distance between sensors, duration od signals and distance between minke whales sounds compared to sperm whales, etc)
* Duration of the data
* Number of sensors
* Events taken into account
* True delay of the two events
* Sampling rate (Enunciate the future problems with LMS and AED due to the Hight sampling rate, the problem is not really the sampling rate (it's better to have more samples !) but the distance between the sensors)
* TDE Algorithms (algorithms using delay between two sensors)
* Why two sensors?
* Better with more sensors?
* **cc:** Short Theory + Implementations (Problems and solution with the implementations and integration with real data)
* **gcc (phat and scot):** Short Theory + Implementations (Problems and solution with the implementations and integration with real data)
* **LMS**: Short Theory + Implementations (Problems and solution with the implementations and integration with real data). Remember to compare well LMS and AED. AED is indeed from 2000 by Benesty, but LMS for time-delay estimation is much older, see articles by Reed or Feintuch
* **AED:** Short Theory + Implementations (Problems and solution with the implementations and integration with real data)

**\* Photos about the correlations**

* Algorithms used to reduce the noise

(Introduction of why we have to implement this algorithms)(Little preview of the First error simulations). For each algorithm please explain what they are actually doing and try to compare them. you should measure the change in SNR to have an objective value of the enhancement

* **Filter:** Short Theory + Implementations (Problems and solution with the implementations and integration with real data)
* **Time Gain Normalization:** Short Theory + Implementations (Problems and solution with the implementations and integration with real data)
* **Percentile Noise Removal**: Short Theory + Implementations (Problems and not at all solutions with the implementations and integration with real data)
* **Spectral subtraction:** Theory + Implementations (Problems and solution with the implementations and integration with real data). Try to explain the relationship between spectral substraction and Percentile Noise Removal-

**\*Photos of the spectrogram of real data after the processing**

* Simulations
* Explain the procedure and the **GUI** implemented to facilitate the simulations
* Times choosing and what kind of events (1-Without interference 2- With Interference)
* Sensors elected to do the simulations

* Results without pre-processing
* **cc,gcc** with test signals------ Photo :)
* **cc, gcc** with real data-------- Photo :( Tell why it doesn't work and explain the solutions
* Results with pre-processing

With **Time gain, Filter + Time Gain, PNR, Filter+ PNR, Spectral subtraction, Filter+ Spectral subtraction** preprocessing algorithms

* **gcc, cc, AED, LMS**
* Photos (Correlations)
* Data of the results with ground truth (%relative error and error samples compared to the Real delay samples)
* Interpretation of the results (What is wrong? Why some algorithms do not estimate the signal correctly? Solutions
* Best Algorithm and why, Worst algorithm and why, These results agree with the expected behavior of the algorithms? (Theoretical)(Why?)
* Comparison of cost of calculation. It is relevant?
* Demonstration of our procedure of estimation with the GUI on live!

1. Localization of the Whales

* The way we use to localize the whale from the previous results of Time Delay estimation:
* What kind of algorithms
* What kind of code
* With how many sensors
* Results (Are they agree with the real localization of the whales and with the TDE? Why? Why not?)

**\*Show the graphic**

Conclusion

* Main problems (code), why? how to fix it?
* Best Noise reduction algorithms? Why?
* Best TDE algorithms? Why?
* Worst TDE Algorithms? Why?
* Goals achieved?

Future Work

* Improve the code implementation of:
* AED, LMS, PNR, Time Gain
* Compare and enforce the Localization of the Whale using TDOA with:
* Entropy Algorithm
* Algorithms using more than 2 sensors, you already combine more than two sensors but indeed you could make it using all the pairs jointly.
* Tracking of the whale while it is moving. In our case yes you would need a specific tracker.