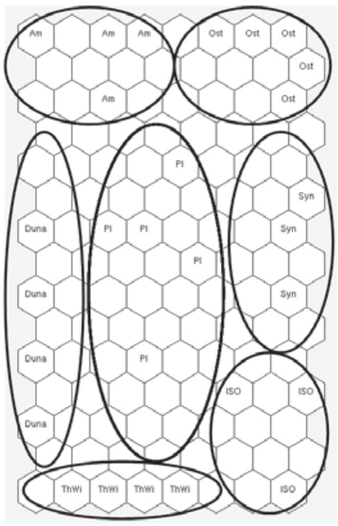

Figure 3. SOM label representation.

3. Conclusions

Excitation spectra from different cultures were measured, and were processed with the Self-Organizing Map. These preliminary results show the SOM methodology as a feasible way to achieve phytoplankton discrimination. Furthermore, they are encouraging enough in order to expand the current work into an automated system for phytoplankton's EEM classification.

4. Acknowledgements

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5. References

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NON WHITE GAUSSIAN NOISE REDUCTION ON MICROSTRUCTURE DATA USING WAVELET DENOISING

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1. Introduction

The characterization of the turbulent flow in the ocean dynamics has many implications in environmental modelling. The biological and physical processes characterization [1] [2] or the turbulent analyses of the energetic part of the vertical microstructure records [3] [4] are some of the fields on which we can focus the turbulent characterization.

A common procedure for detecting turbulent regions from CTD data is by computing the Thorpe displacements (dT) profiles [5].The Turbulent patches are calculated from the density profiles δ (z) and are identified as regions with non-null values of Thorpe displacements.
The presence of noise is a critical problem when processing or analyzing the CTD data profiles. A method was proposed in [6] to improve patch detection at low-density gradients. The method, pointed out the influence of wavelet mother selection and the noise characterization on the final denoising results.

This article introduces a procedure to obtain the optimal wavelet filters selection to reduce noise effects. In the literature the studies based in wavelet denoising are focused on reduce the effects of white Gaussian noise. In turn, in this study, the signal representing the noise is synthetically created and modelled by both flicker and white Gaussian noise.

2. Noise Instrument Model

In this section we present the procedure considered to determine noise features in the Self Contained Autonomous Micro Profiler (SCAMP) measurements. This noise model will be used to optimize the Wavelet family to denoise the field profiles.
A set of laboratory test measurements were carried out for modelling the SCAMP noise. In these tests, the temperature was kept constant providing a reference to link the temperature fluctuations to the instrumental noise.

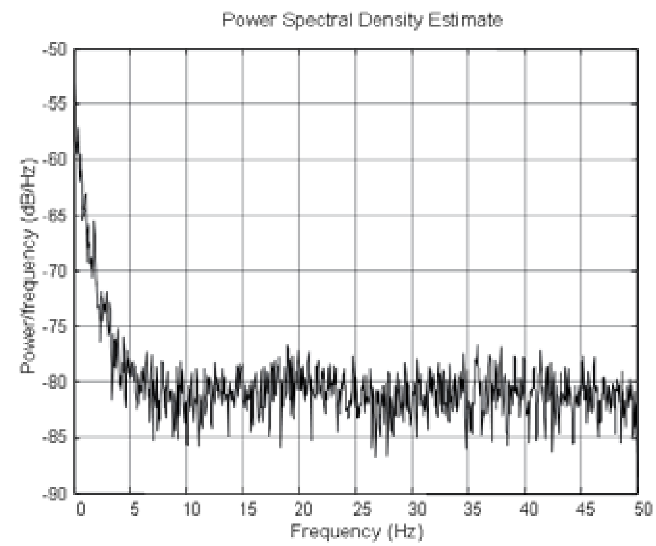

Fig 1. To model the noise present in the data profile we need to know the power spectrum density. This signal is used to obtain the filter coefficients to generate the synthetic noise.

An autoregressive model was applied to the experimental data tests to obtain a noise model. This model provided the filter coefficients to implement a synthetic signal.

The graphics Fig1 and Fig2 show the agreement between the power spectral density estimation of the experimental test signal and the synthetic noise model.

The resultant synthesized noise model is used to simulate the real instrumentation and environmental noise and analyze the denoising process to obtain the improvement for each wavelet family.
To select the optimal mother wavelet, a computed test was developed. This test is a trial and error method which report us a matrix with the RMS error of the Thorpe displacement histogram between

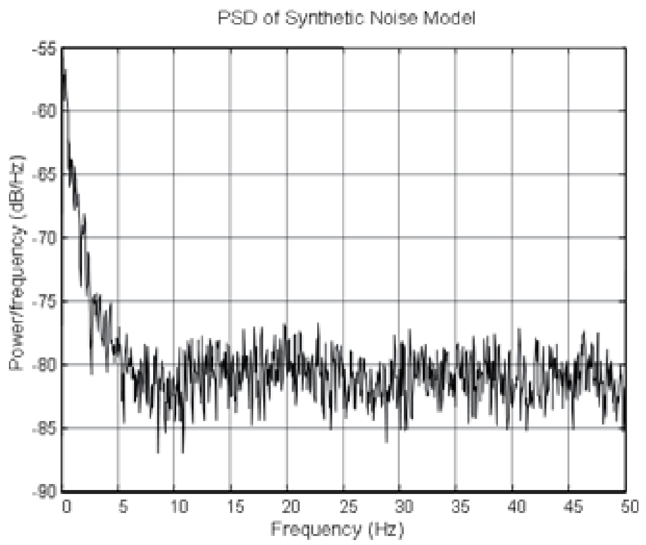

Fig 2. This noise model is computed with the original noise signal and modeled as a white Gaussian noise and the flicker noise contribution.

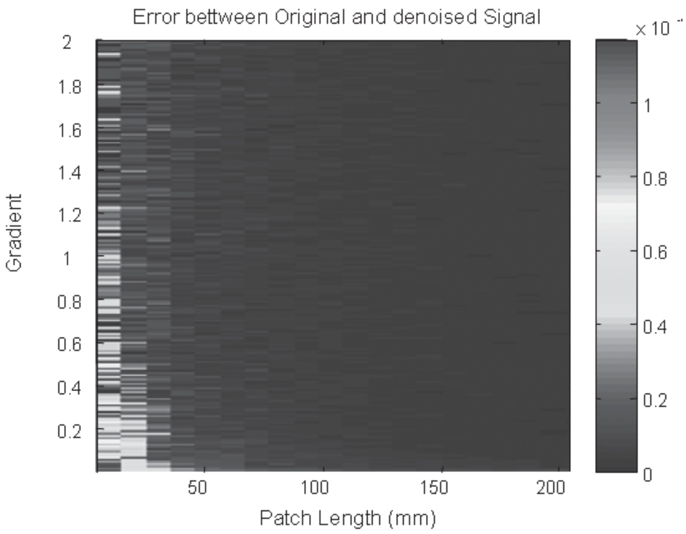

Fig 3. (RMS) Root mean square error calculated between Thorpe displacement histogram of the original patch and the denoised one.

the original signal and the obtained after the denoising process. The output matrix for each family is analyzed to determine the optimal selection.

4. Results

From the obtained results, Battle-Lemarié with order 5 has been selected as a mother wavelet to use for denoising microstructure data. The Daubechies 20 report similar results that Battle-Lemarié 5, but

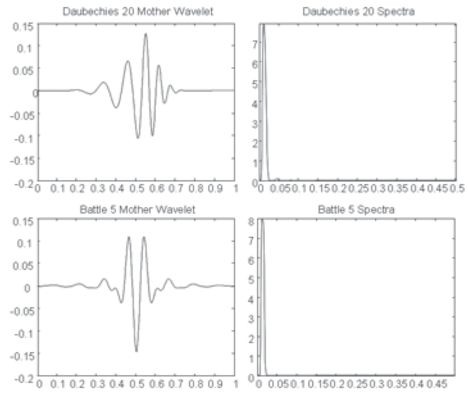

Fig 4 Daubechies 20 and Battle-Lemarie 5 mother wavelet and spectra representation

needs more coefficients (20) than the Battle selected (5). Wavelets with higher order require more computational power and are more problematic when applying in the boundary limits of the data profiles.
In order to analyze the results, the figure 4 shows us the mother wavelet and the spectral representation of dB20 and B-L 5. The spectral Daubechies 20 have a small component near the principal response. The Battle-Lemarié 5 erases all secondary lobes.
When we apply the different wavelet families to the denoising process, the secondary lobes obstruct the scale separation and in consequence on the denoising process.

5. Conclusions

The model described in this article is an experimental procedure to analyze and select the optimal wavelet family to use with denoising technique. The tests applied to obtain the optimal wavelet, are a recursive procedure to test the most common wavelet families. The applied signal to test the method is composed by: (1) theoretical profiles where we can modify the temperature gradient and the turbulent patch size, (2) synthetic noise. A synthetic noise signal is computed from real noise data to emulate.
The preliminary numerical results determine that the Battle-Lemarié 5 is a good selection to denoise microstructure test profiles.
A future tests will be developed to use the synthetically noise model on more complex simulations and real data profiles.

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