# Automatic Detection of Hadal Macro Biological using Machine Learning Method

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With the development of science and technology, human being began to explore manyunknown areas, such as hadal area. The existence of living organisms in the hadal,and the physiological characteristics of these organisms is one of the directionsof human concern. However, due to its unique geographical features, it is difficult to capture the species and the number of species in the hadal. To solve this problem, researchers have developed the ability to work in the hadal of the lander and submersibles, they can shoot the images of the hadal of biological information. But due to the large amount of video data, the probability of the emergence of life is very small, the researchers search for a part of the biological in a large number of videos is very time-consuming.Therefore, in view of the above problems, this work proposed an automatic method for hadal macro biological detection.

For this work, the hypotheisi is that in the deep ocean, the modification of backgroud is slight, thus the matrix or the set of backgound frames is a low rank one. If the biological appeared in the video, it can be considered as sparse part in the frame. Therefore, the detection of hadal macro biological can be discribed as sparse and low rank matrix decompositon problem.

PCA is arguably the most widely used statistical tool for data analysis and dimensionality reduction today. However, in general, training data may contain undesirable artifacts due to occlusion, illumination, image noise. Thus SLRMD was proposed that can be used to construct low-dimensional linear-subspace representations from this noisy data. The cost function of SLRMD can be wrote as:

$$\min_{\mathbf{A},\mathbf{E}} \|\mathbf{A}\|_* + \lambda \|\mathbf{E}\|_1 , s.t. \mathbf{D} = \mathbf{A} + \mathbf{E} \quad (1)$$

Here $\|\mathbf{A}\|_*$ is nuclear norm which equals to trace( $\sqrt{\mathbf{A}^*\mathbf{A}}$ ), and $\mathbf{A}^*$ is conjugate transpose of **A**. To solve this constrained optimization problem, many algorithms have been proposed, including the accelerated proximal gradient method, the augmented Lagrange multiplier (ALM) method, and the alternating direction method (ADM). In this work, matrix **E** represents the macro biological.