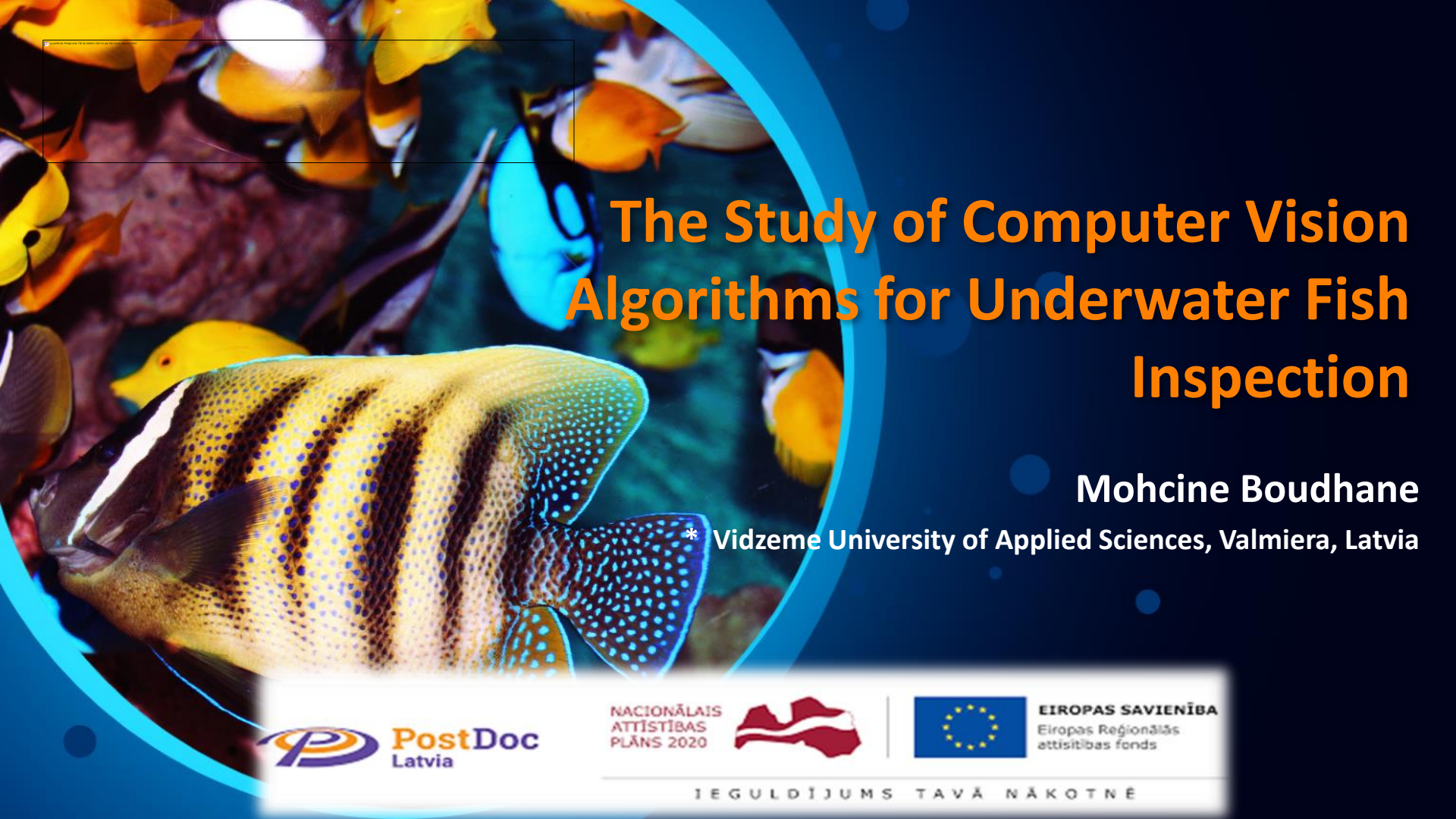


The Study of Computer Vision Algorithms for Underwater Fish Inspection

Mohcine Boudhane

* Vidzeme University of Applied Sciences, Valmiera, Latvia

PostDoc Latvia

NACIONĀLAIS ATTĪSTĪBAS PLĀNS 2020

EIROPAS SAVIENĪBA
Eiropas Reģionālās attīstības fonds

IEGULDĪJUMS TAVĀ NĀKOTNĒ

Exploring the underwater world (issues)

Oceans cover about 70% of the earth's surface. It contains animal, mineral and raw material resources. Exploring its resources is a key topic around the world.

Problem:

Fish production is getting decreased year by year*:

- **Intensive fishing (No respect of COTA system)**
- **Disappearance of certain fish species**

Reference: http://www.fao.org/fi/oldsite/FCP/en/LVA/profile.htm

Exploring the underwater world (issues)

- fishing regularization (rules)

Reference: http://www.fao.org/fi/oldsite/FCP/en/LVA/profile.htm

- Exploring underwater resources

Net casting

Fish sampling

Divers

Exploring the underwater world (issues)

Computer vision is the field that allows a machine to simulate the operation of human vision through the use of sensors (example: camera)

Divers:
- Not safe
- Divers can not reach a certain depth.
- Divers can not stay in the water for a long time.

Fish sampling/ Net casting:
- Kill many fish
- No exact accuracy

-> Effect
No real access of underwater resources

->Proposed solution:
Use of Computer vision techniques

Why we want to detect fish ?

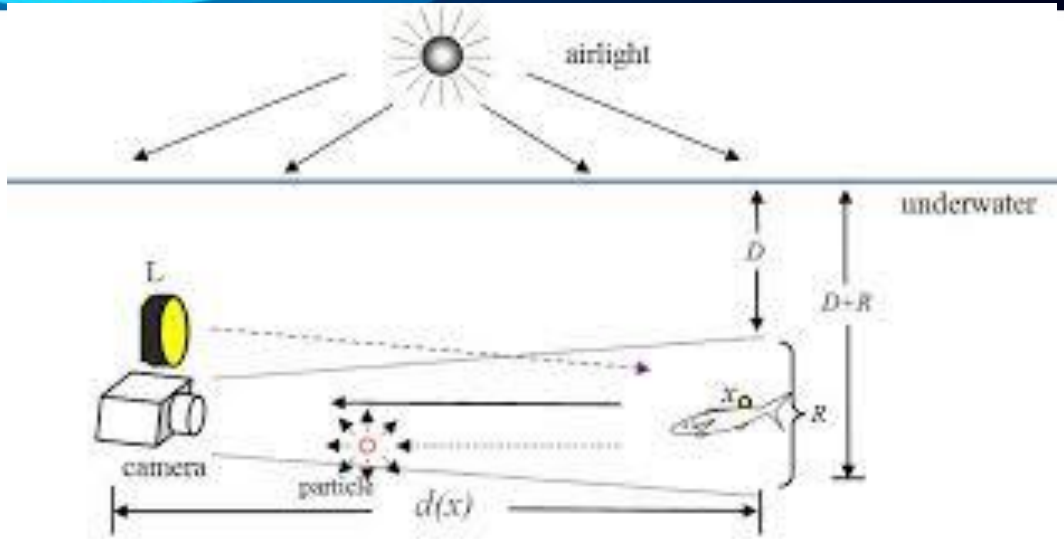
- Fish identification in real environment
- Fish assessment
- Underwater inspection
- Long term supervision

-> Fish preservation

Data collection

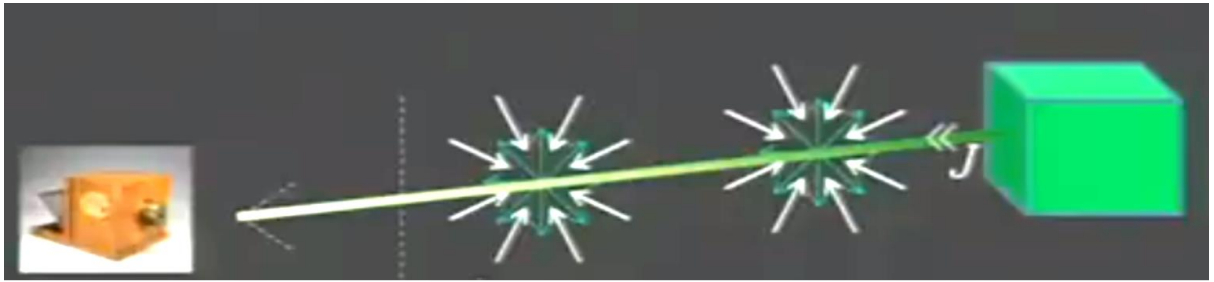
- **Purpose**: Data recording
- **Location**: Gauja river
- **Duration**: 7 days

Problem



- **Light reflected by an object undergo scattering along its way to the camera.**

Problem

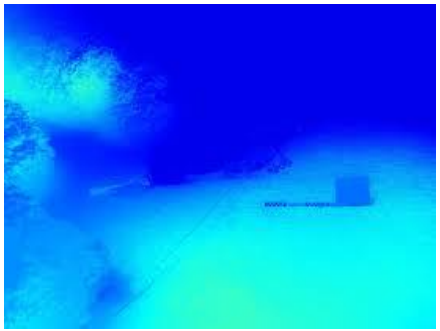


J is the original light
B scattering effect

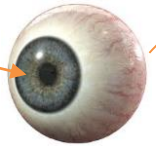
Effects : light produce a distinctive gray or bluish hue and affects visibility

From where ? And what is the cause of those effects?

Problem

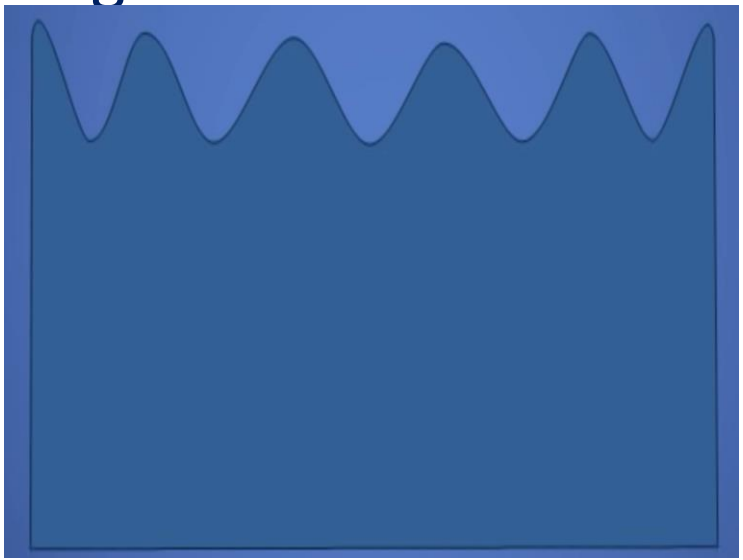


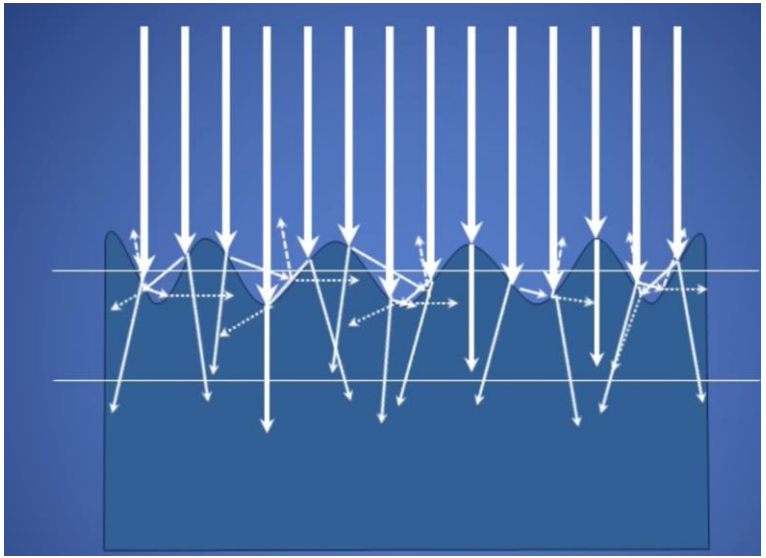
What we, fish and cameras see



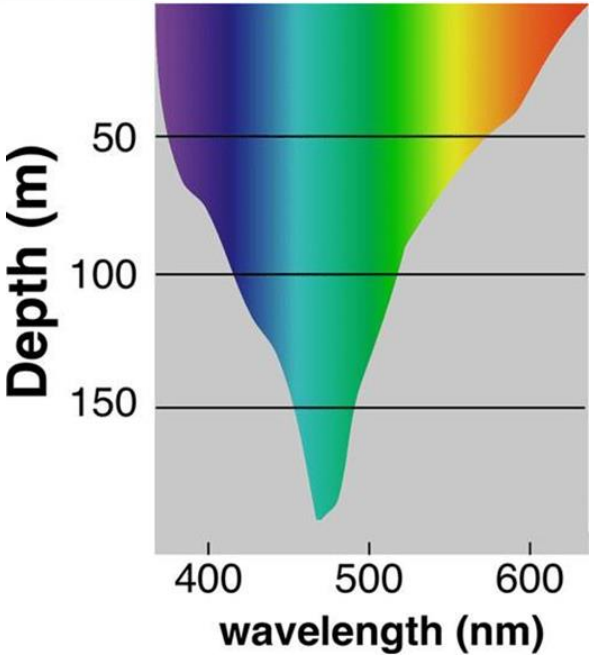
Underwater issues

- Water absrobtion and scatering effects
- Light reflexion

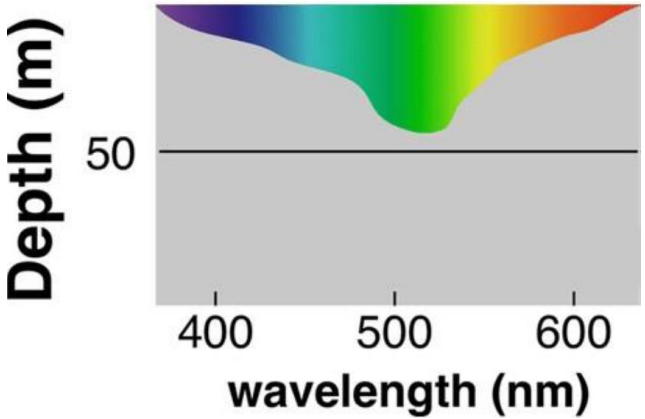




Light penetration underwater



Open Sea



Costal water

Light penetration underwater

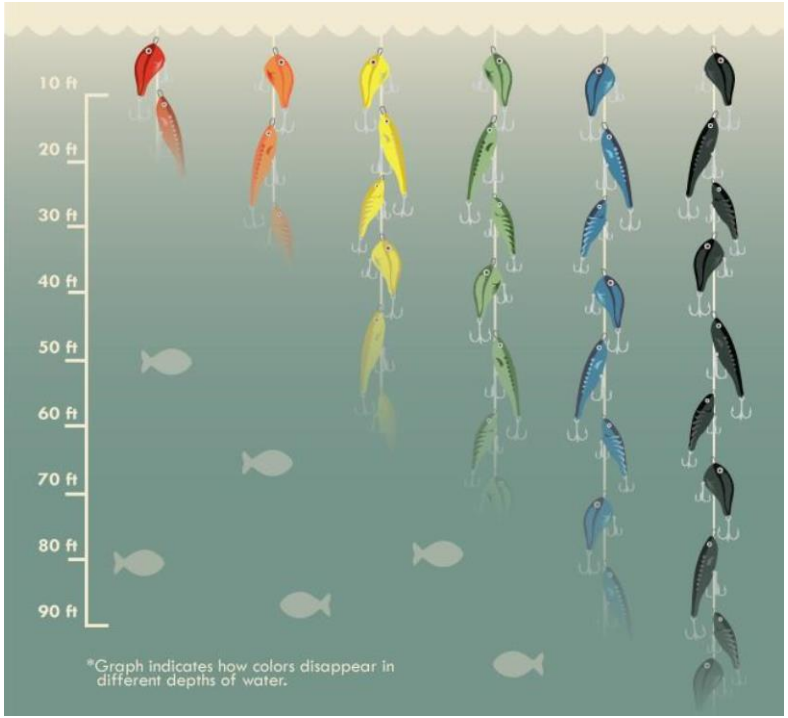


Image enhancement

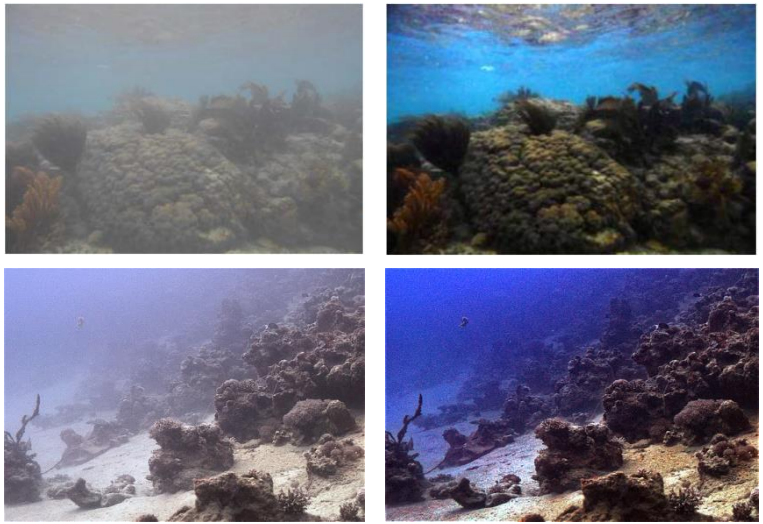
- **Image enhancement using Dark Channel Prior**

$$I(x) = J(x)t(x) + (1 - t(x))\,A \qquad (1)$$

where, t is the transmission rate, A is the scattering factor of the atmosphere, and d is the depth of the scene. After obtaining the transmission rate, we can use this formula to find the depth of the scene.

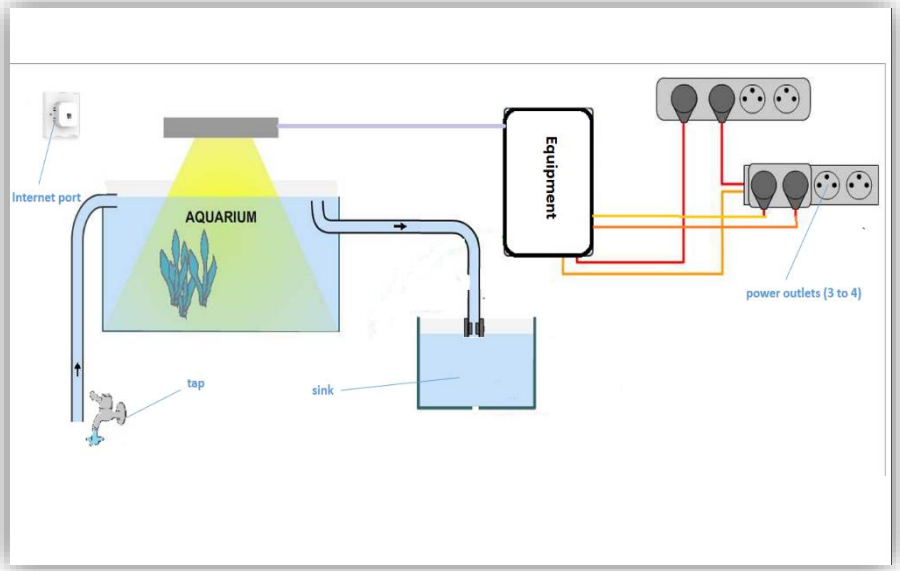
$$J^{dark}(x) = \min_y \left(\min_{\{r,g,b\}} min(J^c(x))\right) \qquad (2)$$

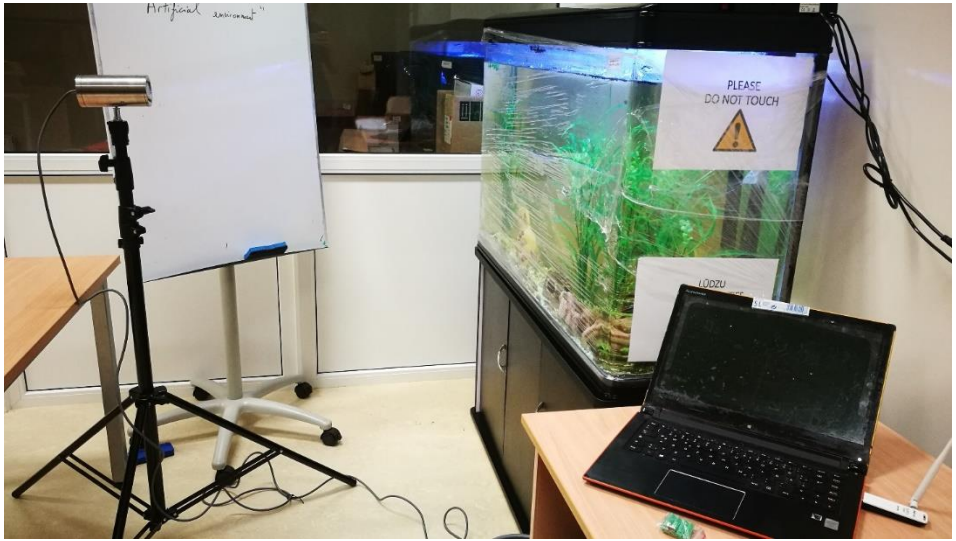
where is the scattering coefficient of the atmosphere and d is the scene depth. The equation reveals the relationship between scene depth and medium transmission.



Orginal **Enhanced (*Boudhane et.al**)*

Artificial environment





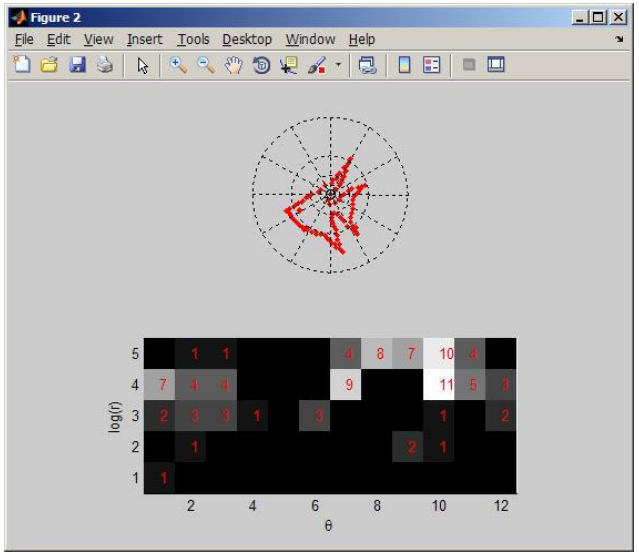
Data Analysis: Shape modelling

Two methods:

- **Shape context (In progress)**
- Toplogical data analysis. (future work)

Objectif: Shape context is a feature descriptor used in object recognition.

Description: The shape context is intended to be a way of describing shapes that allows for *measuring shape similarity* and the recovering of point correspondences. The basic idea is to *pick n points* on the contours of a shape. *For each* point p_i on the shape, *consider the n − 1 vectors* obtained by connecting p_i to all other points. The set of all these vectors is a rich description of the shape localized at that point but is far too detailed. The key idea is that the distribution over relative positions is a robust, compact, and highly discriminative descriptor.

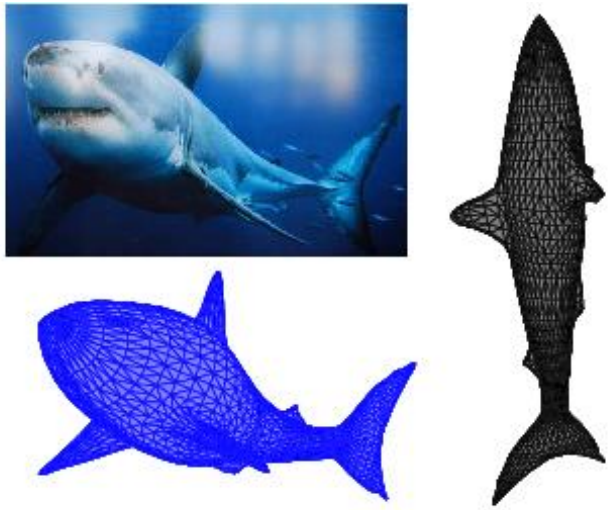


Data Analysis: Shape modelling

Two methods:

- Shape context (In progress)
- **Toplogical data analysis. (future work)**

Objectif: Representation of a unified model for fish in topological space (non geometric).



Issues

Problems:

- Sonar system
- Fish feeding!

Future work:

- Make a Computer-aided design CAD of the AUV robot prototype.
- Data analysis (Artificial environment)
- Theoritical modelling for fish shape

References

- **Mohcine Boudhane**, Ojars Balcers, «*Underwater Image Enhancement Method Using Color Channel Regularization and Histogram Distribution for Underwater Vehicles AUVs and ROVs*», International Journal of Circuits, Vol:13, pp:571-578, August 2019. (***scopus indexed***)

- **Mohcine Boudhane**, Ojars Balcers, Benayad NSIRI, «*Underwater Exploration Issues, Deep Study on Optical Underwater Vision for an Effective Traditional Fishing*», ACM digital library, International Conference on Watermarking and Image Processing, ICWIP 2019. (***scopus indexed***)

THANK YOU