# Fish tracking in underwater videos

# PLAN

- Professional career
- Introduction: Problem and objective
- State of the art
- Required tasks

# Professional career

# PROFESSIONAL CAREER

- Computer and multimedia license, ISAMM, Tunisia

Final project: Interactive virtual tour, maya3d, Unity3d

- International master of **Biometrics**, UPEC, Paris

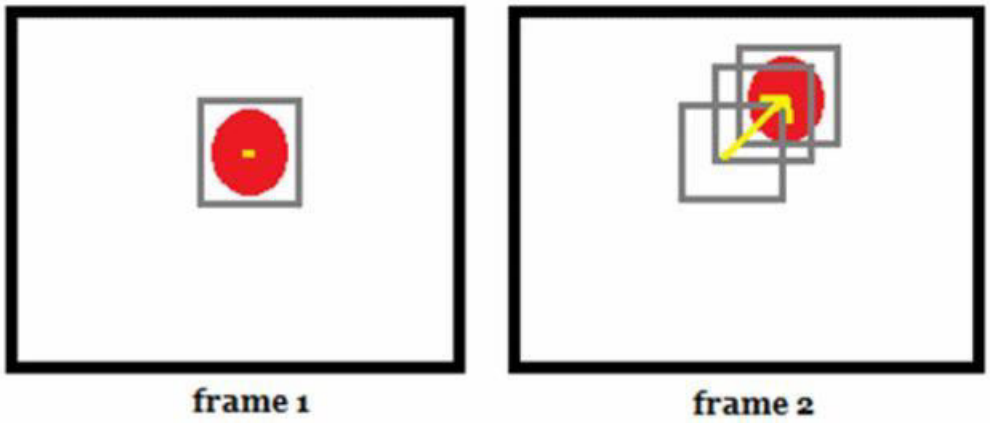
First project: handwritten language recognition, matlab

Second project: static sign language recognition, c++ OpenCV

# Introduction

# TRACKING

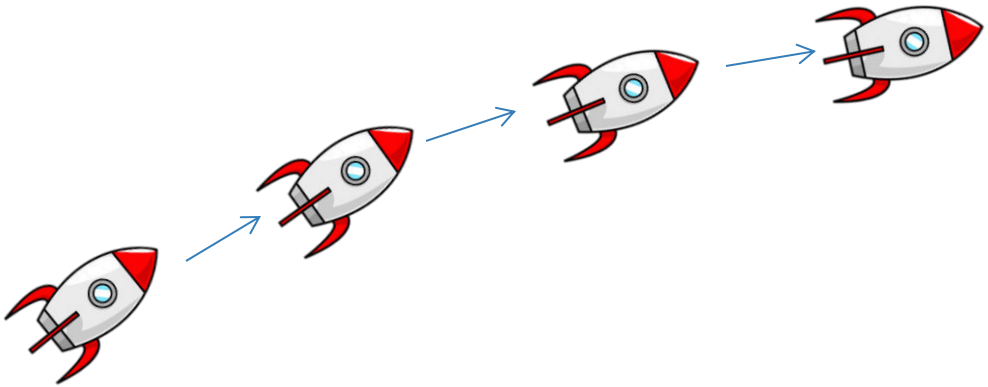
- **Tracking** is the process of locating a moving object over time.
- We need to use object recognition techniques for tracking.



# PREDICTION

What is prediction?

- How can we predict or estimate something we can not see or touch?



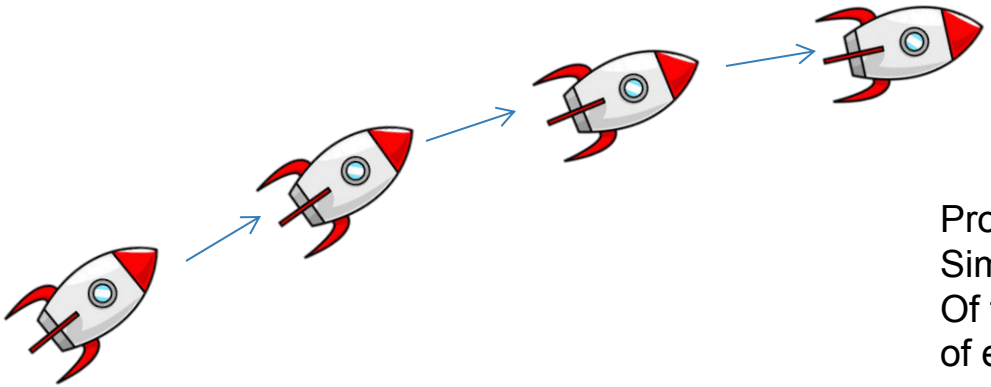
?

You can predict this rocket trajectory
By solving some equations but..

# PREDICTION

What is prediction?

- How can we predict or estimate something we can not see or touch?



?

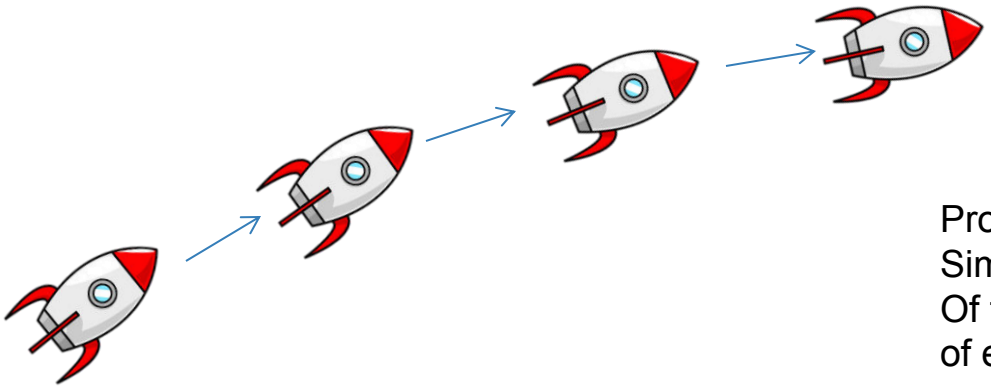
Problem 1
Simulation of long period
Of time might cause accumulation of error

You can predict this rocket trajectory
By solving some equations but..

# PREDICTION

What is prediction?

- How can we predict or estimate something we can not see or touch?



?

You can predict this rocket trajectory
By solving some equations but..

Problem 1
Simulation of long period
Of time might cause accumulation of error

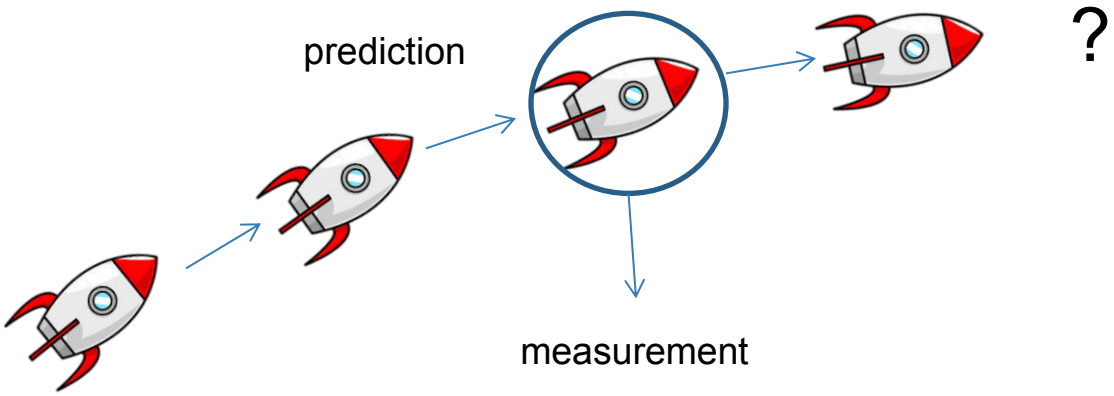
Problem 2
Smallest error of initial value might cause a drastic change of Estimated trajectory

# MEASUREMENT+PREDICTION

- We might think that good measurement could solve the problem
- But single measurement might not be enough to estimate the location of rocket accurately

**Solution**

- Combine prediction and measurement



# INTRODUCTION

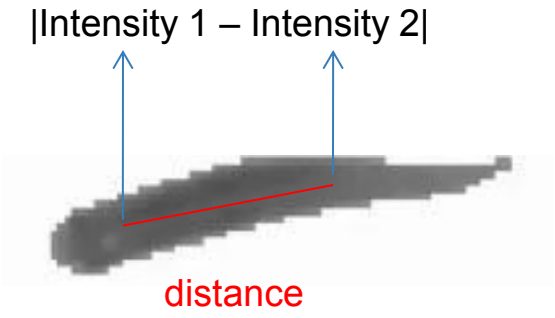
- Underwater videos are quite blurry
- The background is moving
- Fish behavior: high number of fishes with large movement and variation of the shape

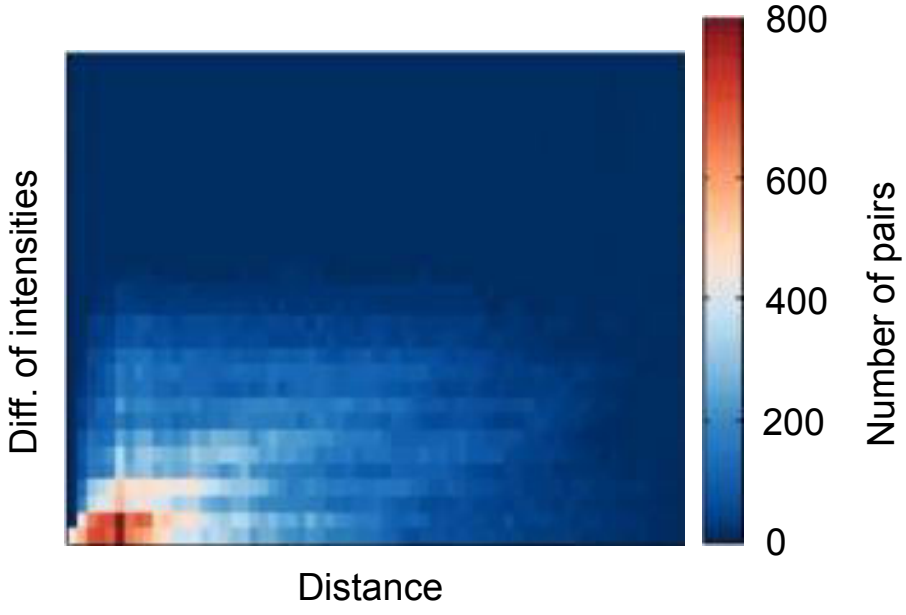
**How to recognize fishes and track them?**

# State of the art

# idTracker

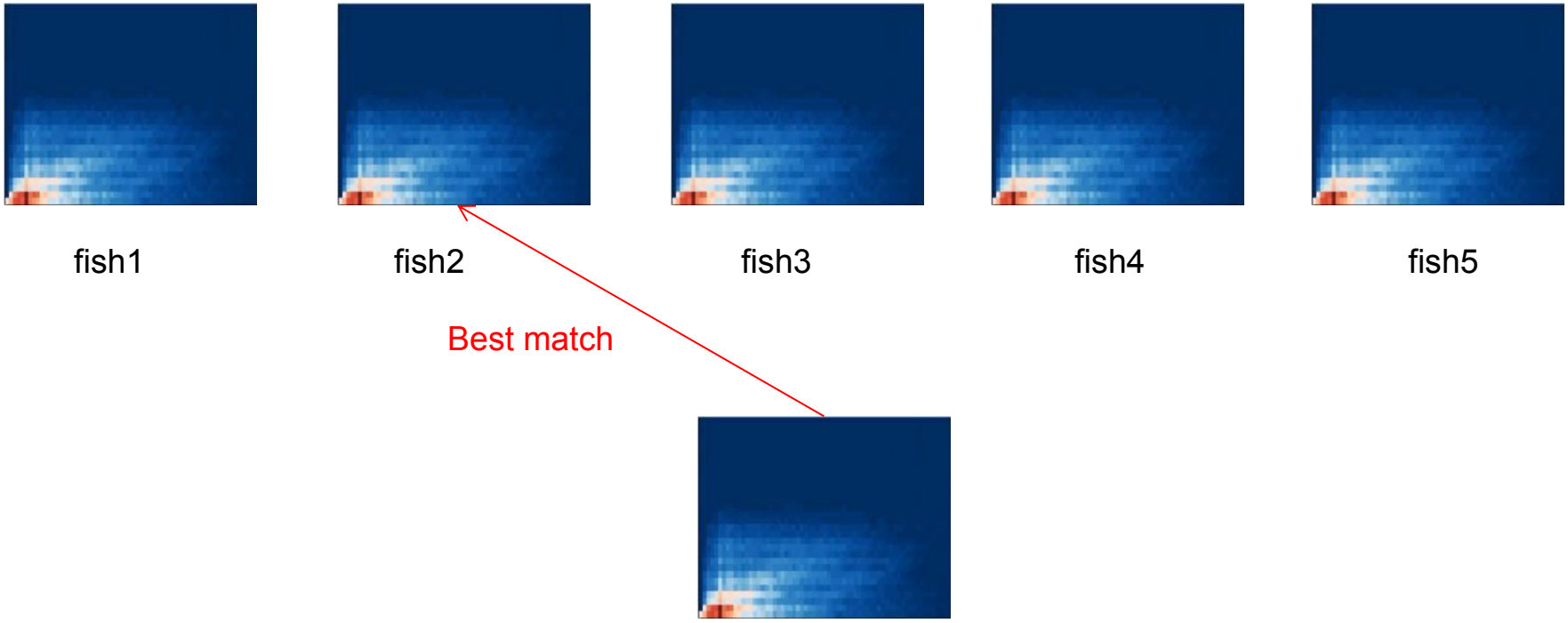
- Multi-tracking algorithm that extracts a characteristic fingerprint from each animal in a video (Tracking by identification)



# idTracker

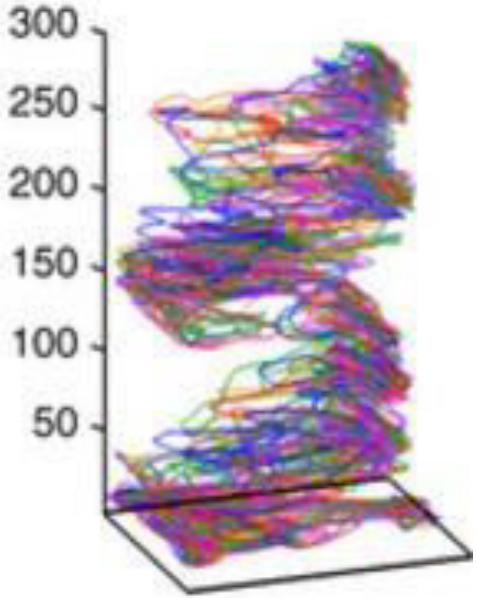
We identify every non-overlapping fish in every frame



# idTracker

Advantages:

- The rate of error propagation is very low
- The system achieves more than 99% frames correctly Assigned
- The program extracts automatically the reference images from the video




"videos"

# idTracker

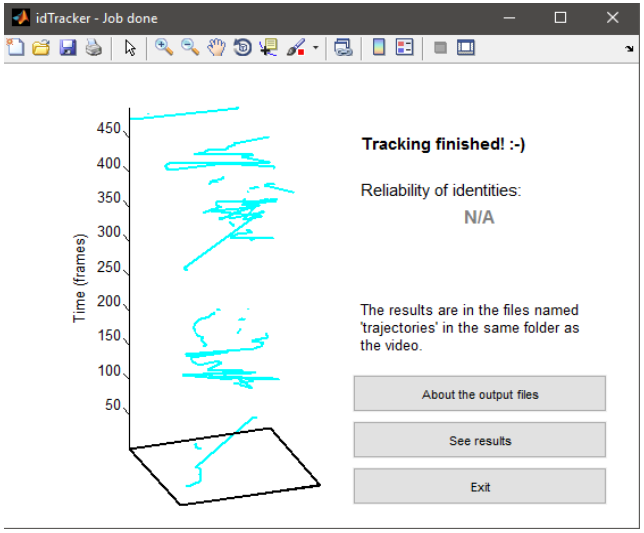
Threshholding:
method used for image segmentation, in order to discriminate foreground from background.

Limitations:

- Difficult to set threshold
- Sensitive to noise

Conditions for the system:

- idTracker doesn't work on short, blurry videos
- Animals should have enough contrast against the background
- The system requires homogeneous illumination
- We have to initialize the total number of fishes that will appear in the video.



# PARTICLE FILTER

Particle: Xt = {x, y, w, h} , weight: Wt

# PARTICLE FILTER

Principle:

- Distribution of particles
- Weight calculation: Bhattacharyya distance

$$D_B(p,q) = -\ln(BC(p,q))$$

*where*

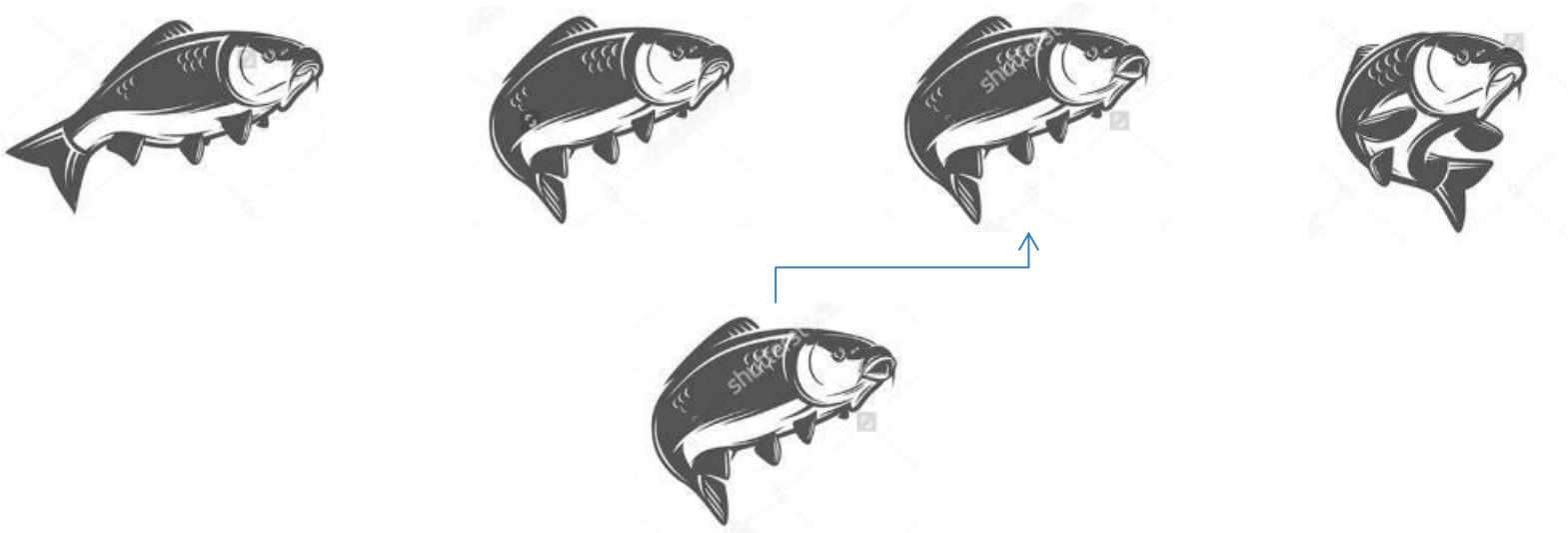
$$BC(p,q) = \sum_{x \in X} \sqrt{p(x)q(x)}$$

- Resampling

# PARTICLE FILTER

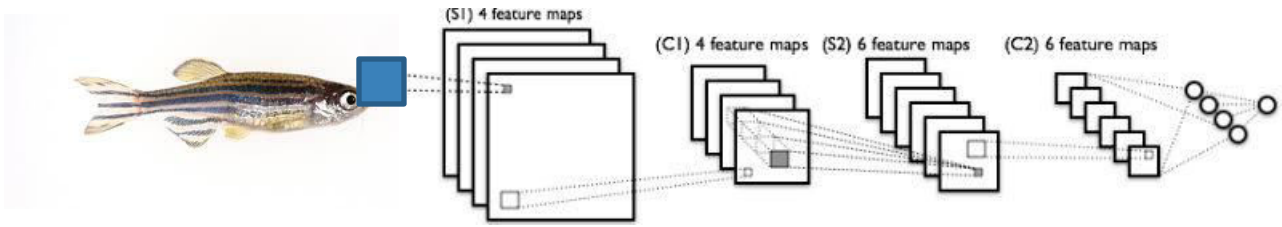
Principle:

- Descriptor updating
  - Transformation of the shape
  - Occlusion
- Template thumbnails



# CONVOLUTION NEURAL NETWORK

- Invariant feature extractor
- Fish could be detected automatically
- No need to template thumbnails
- The CNN feature representation often outperforms hand-crafted features.




| | |
|---|---|
| Mice | 0.01 |
| Fruit flies | 0.04 |
| Zebrafish | 0.94 |
| Medaka fish | 0.02 |

# REQUIRED TASKS

- Embed python in c/c++
- Evaluate the robustness of feature vectors
- Evaluate the particle filter
- Evaluate the battacharyya distance
- Measure the time where the system did not record any error

# THANK YOU!