seminar

Flavien Briendo

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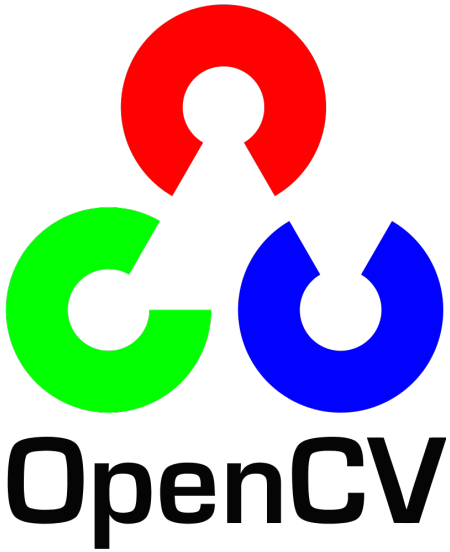
Goals

- Subject: 3D reconstruction and image mosaics: data analysis for mapping or navigation

State of the art - openCV

OpenCV :

- Open source
- Usable in real-time
- Dedicated to AI



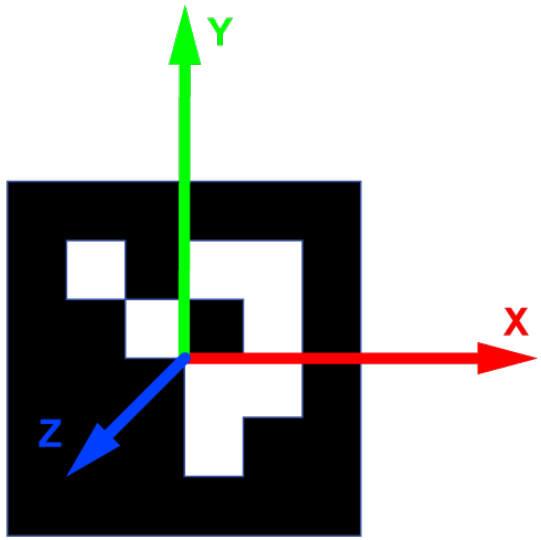
State of the art - arUco

Goal :

- Determine the relative position of an ArUco marker

Why ? :

- Have a verification of the results produced by the AI



State of the art - SuperPoint

- Determine the *keypoints*

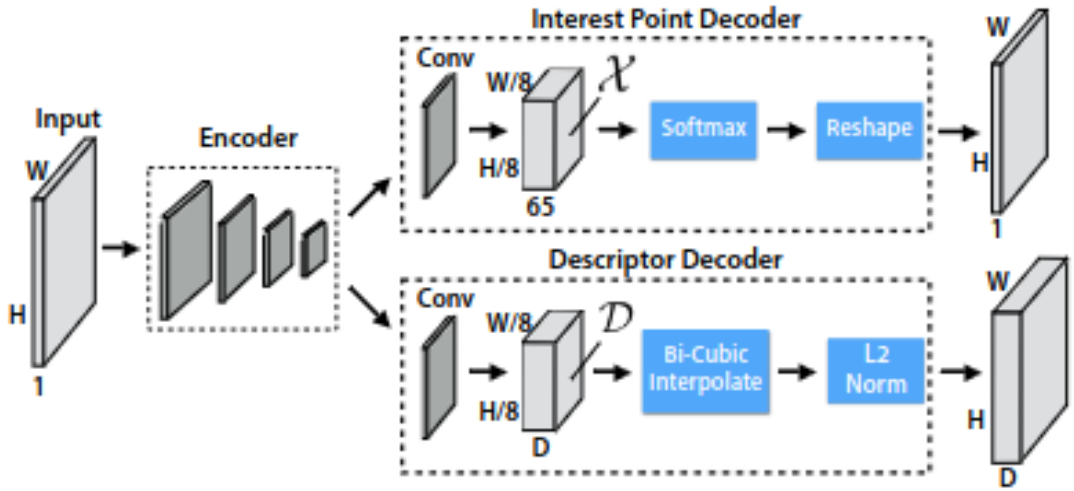


Figure: SuperPoint Architecture - extract from the SuperPoint paper

State of the art - SuperGlue

- *Match* points between two images

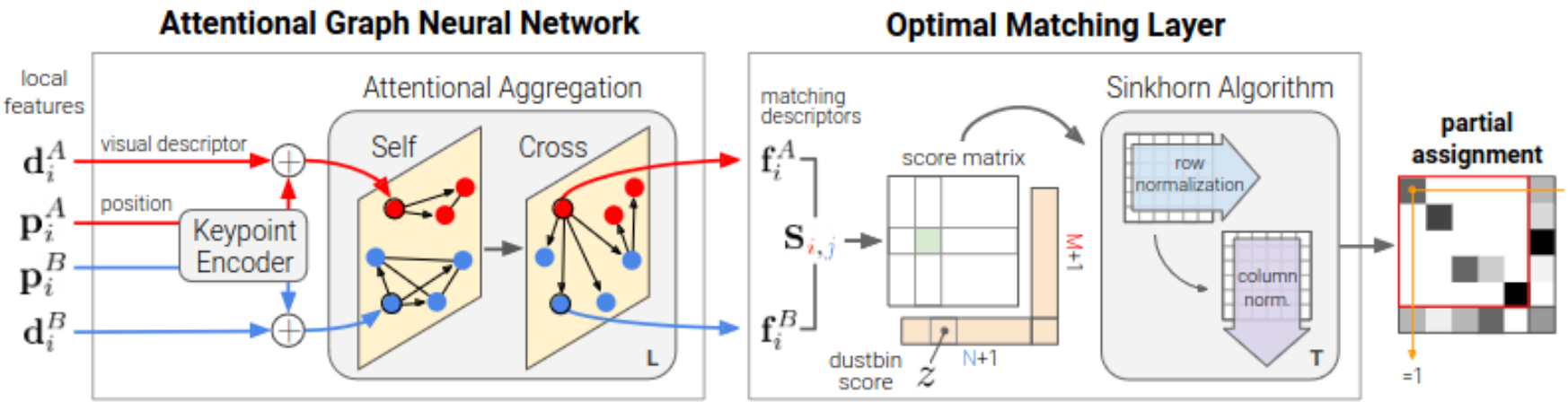


Figure: SuperGlue Architecture - extract from the SuperGlue paper

State of the art - SuperPoint + SuperGlue

Local features	Matcher	Pose estimation AUC @5°	@10°	@20°	P	MS
ORB	NN + GMS	5.21	13.65	25.36	72.0	5.7
D2-Net	NN + mutual	5.25	14.53	27.96	46.7	12.0
ContextDesc	NN + ratio test	6.64	15.01	25.75	51.2	9.2
SIFT	NN + ratio test	5.83	13.06	22.47	40.3	1.0
	NN + NG-RANSAC	6.19	13.80	23.73	61.9	0.7
	NN + OANet	6.00	14.33	25.90	38.6	4.2
	SuperGlue	**6.71**	**15.70**	**28.67**	**74.2**	**9.8**
SuperPoint	NN + mutual	9.43	21.53	36.40	50.4	18.8
	NN + distance + mutual	9.82	22.42	36.83	63.9	14.6
	NN + GMS	8.39	18.96	31.56	50.3	19.0
	NN + PointCN	11.40	25.47	41.41	71.8	25.5
	NN + OANet	11.76	26.90	43.85	74.0	25.7
	SuperGlue	**16.16**	**33.81**	**51.84**	**84.4**	**31.5**

Figure: Comparison of efficiency between multiple matchers - extract from the SuperGlue paper

Project Implementation - Axe 1 - arUco - protocole

Prerequisites:

1. Calibrate the camera
2. Produce two markers of the same size and from the same dictionary
3. Measure the size of the markers

Project Implementation - Axe 1 - arUco - protocole

1. Fix the markers
2. Determine the distance between the two markers
3. Place the camera
4. Take a capture
5. Determine the relative position of the markers
6. If needed, return to step 3
7. Determine the distance between the two markers
8. Compare the evolution of the distance

Project Implementation - Axe 1 - arUco

Figure: Example from an experiment

Project Implementation - Axe 1 - arUco

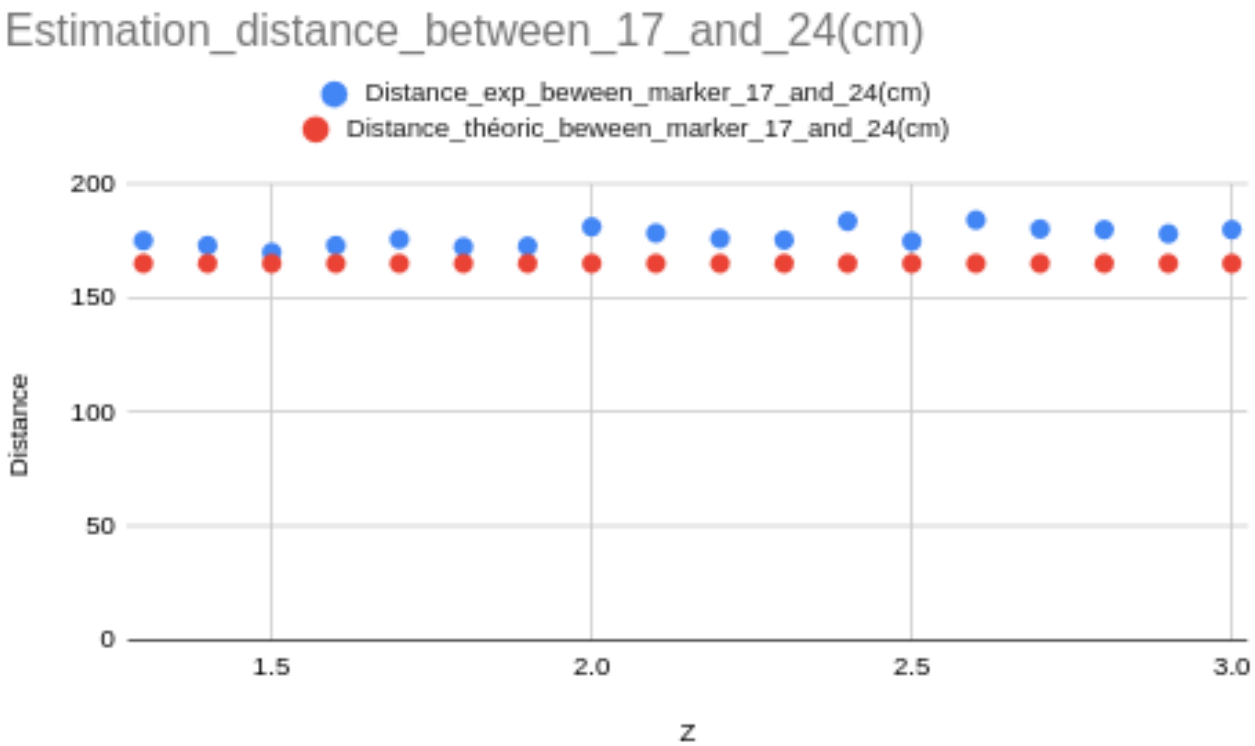


Figure: Distance between the two markers as a function of the camera distance

Project Implementation - Axe 2 - SuperPoint/SuperGlue - protocole

1. Initialize a database containing a series of images
2. Take two consecutive images
3. Get the number of keypoints and the number of matches

Project Implementation - Axe 2 - SuperPoint/SuperGlue

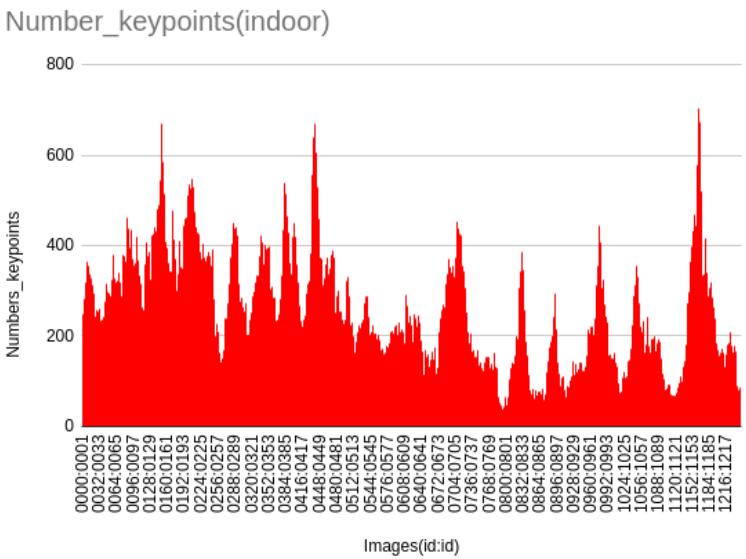


Figure: Keypoints

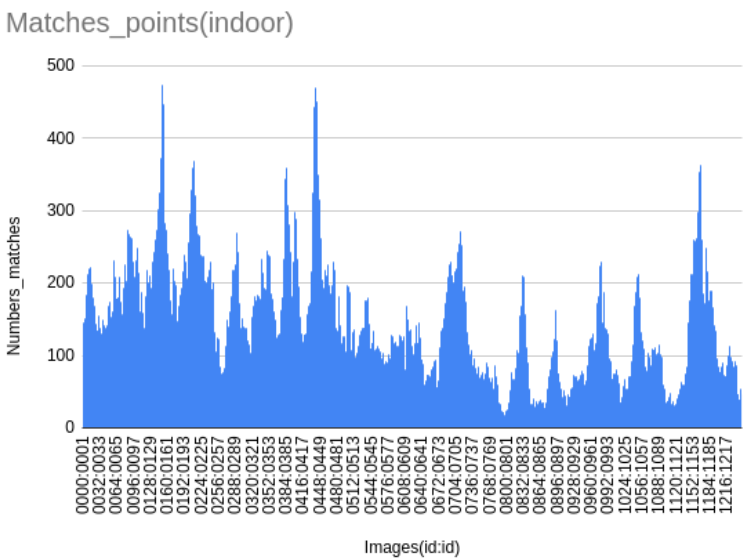


Figure: Matches

Project Implementation - Axe 2 - SuperPoint/SuperGlue

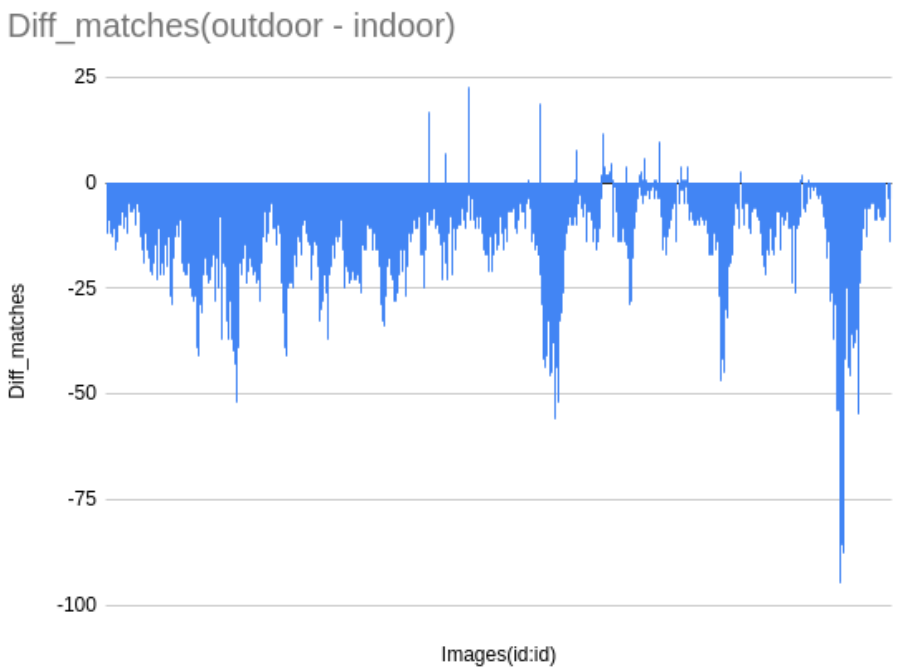


Figure: Diff matches indoor - outdoor

Project Implementation - Axe 2 - SuperPoint/SuperGlue

Stats(matches)		Stats(keypoints)		Stats(diff keypoints matches)	
Min	0	Min	25	Min	16
Max	474	Max	703	Max	349
Moy	138,4	Moy	248,3	Moy	109,8
Med	126	Med	232	Med	103

Figure: Stats indoor

Conclusions et Perspectives

- ArUco: inaccuracies
- SuperPoint/SuperGlue
- Train SuperPoint with Harris Detector

Questions ?

Résumé : On pourra s'intéresser dans ce sujet aux méthodes de reconstruction 3D dense ou éparse, online (SLAM) ou offline, à la comparaison et à l'analyse des résultats obtenus, à leur certification, et au traitement des données brutes recueillies pour permettre leur utilisation. Des outils de traitement d'images classiques ou basés IA seront mis à profit pour ces travaux.

Project Implementation - Axe 2 - SuperPoint/SuperGlue

Figure: Example Sirene databse

Project Implementation - Axe 2 - SuperPoint/SuperGlue

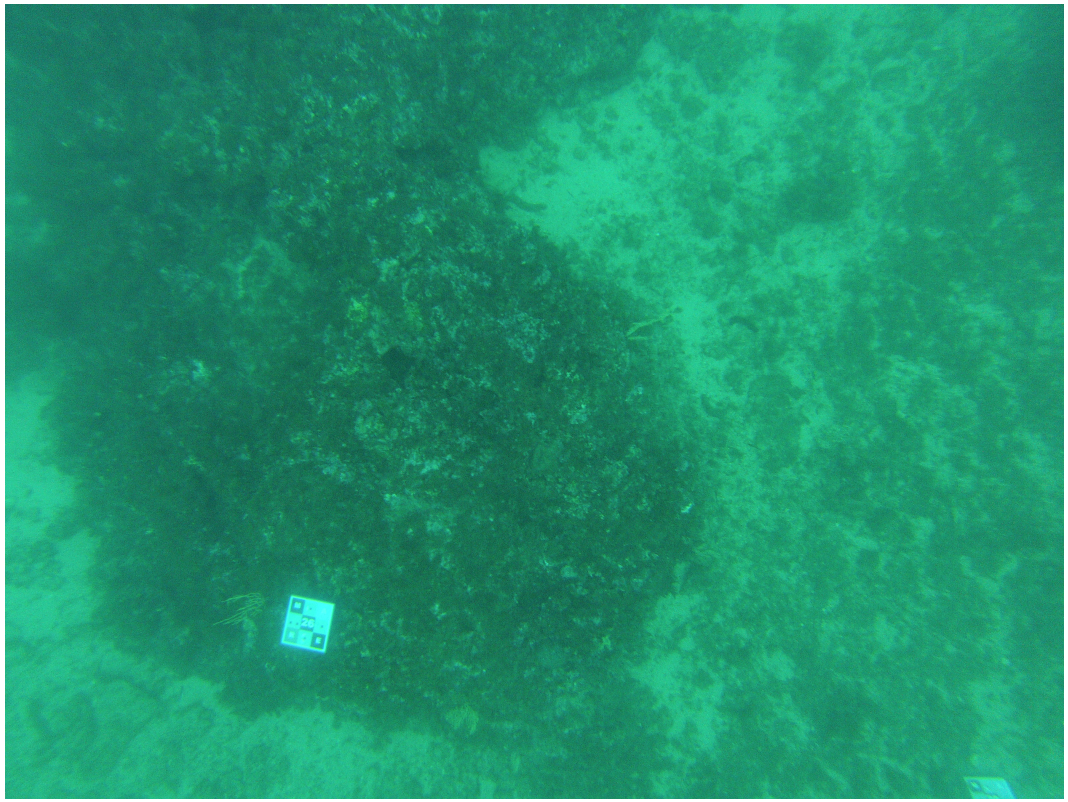


Figure: Example Sirene database

Project Implementation - Axe 2 - SuperPoint/SuperGlue

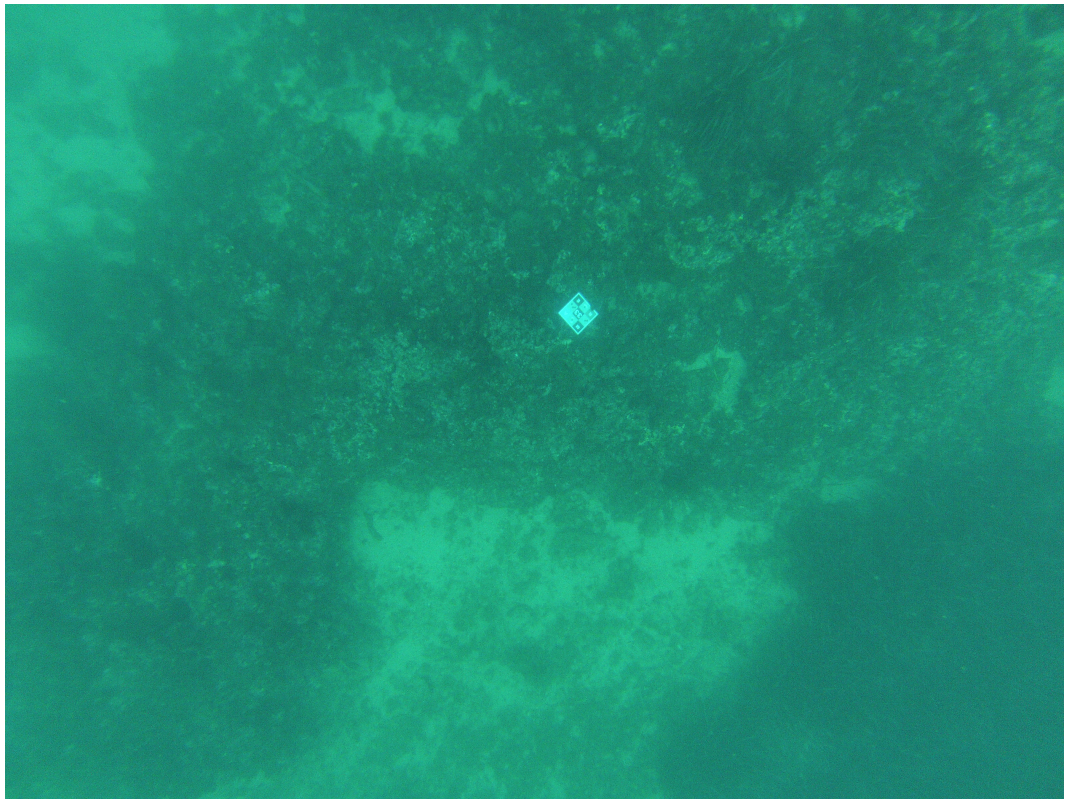


Figure: Example Sirene database

Bibliography

- Article SuperPoint: https://arxiv.org/abs/1712.07629
- Article SuperGlue: https://arxiv.org/abs/1905.00537