



Institut de Robòtica
i Informàtica Industrial



UNIVERSITAT POLITÈCNICA
DE CATALUNYA
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Perception in the EU AEROARMS project

Prof. Dr. Alberto Sanfeliu
Institut de Robòtica i Informàtica Industrial (IRI)
<http://www.iri.upc.edu>
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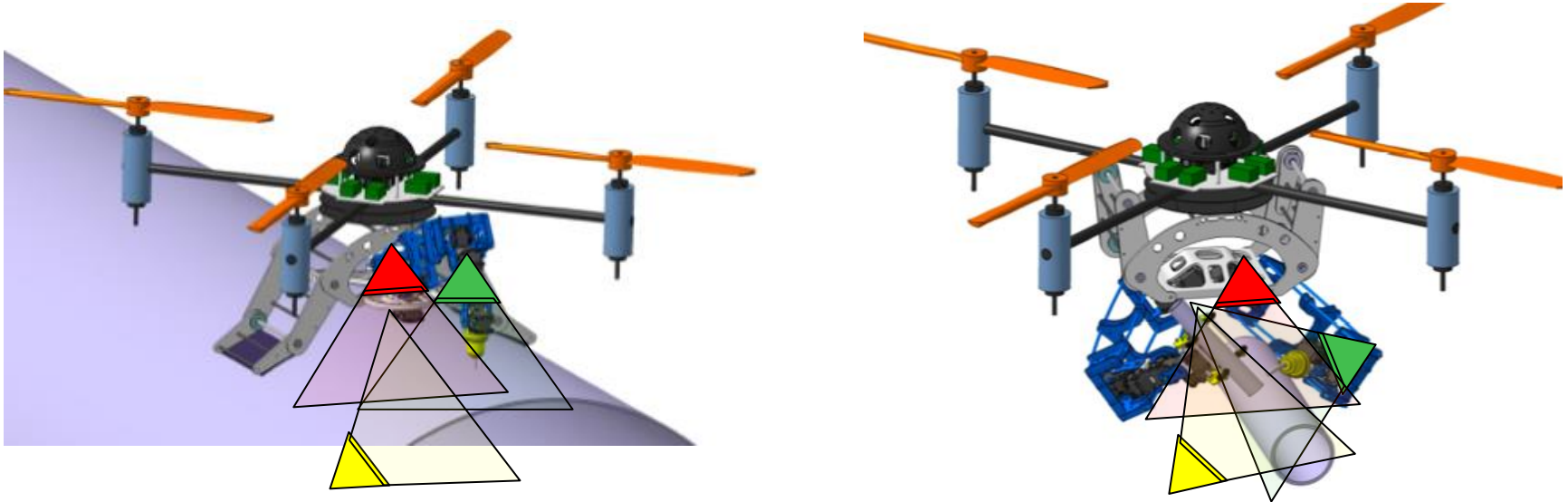
AEROARMS Perception Objectives

The **main objective** of the Perception is to provide the needed perception functionalities to allow a reliable and accurate localization of the aerial robot for grabbing and manipulation.



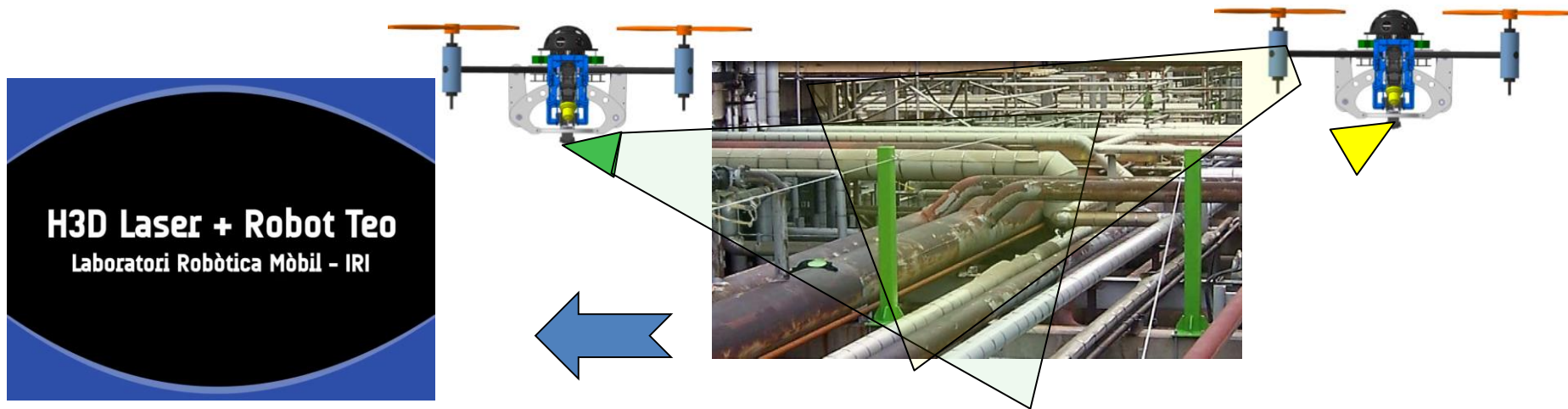
Adaptive vision for accurate grabbing and manipulation

The **objective** is to develop a system which adapts to the changes of illumination conditions and distance to the target each time the robot moves to another pose, due to the different angle of incidence to the viewed point of attention or change of robot arm pose (which implies different incidence of illumination sources) or cast shadows. The new vision system has to adapt to the new situations by combining its own adaptation and prediction.



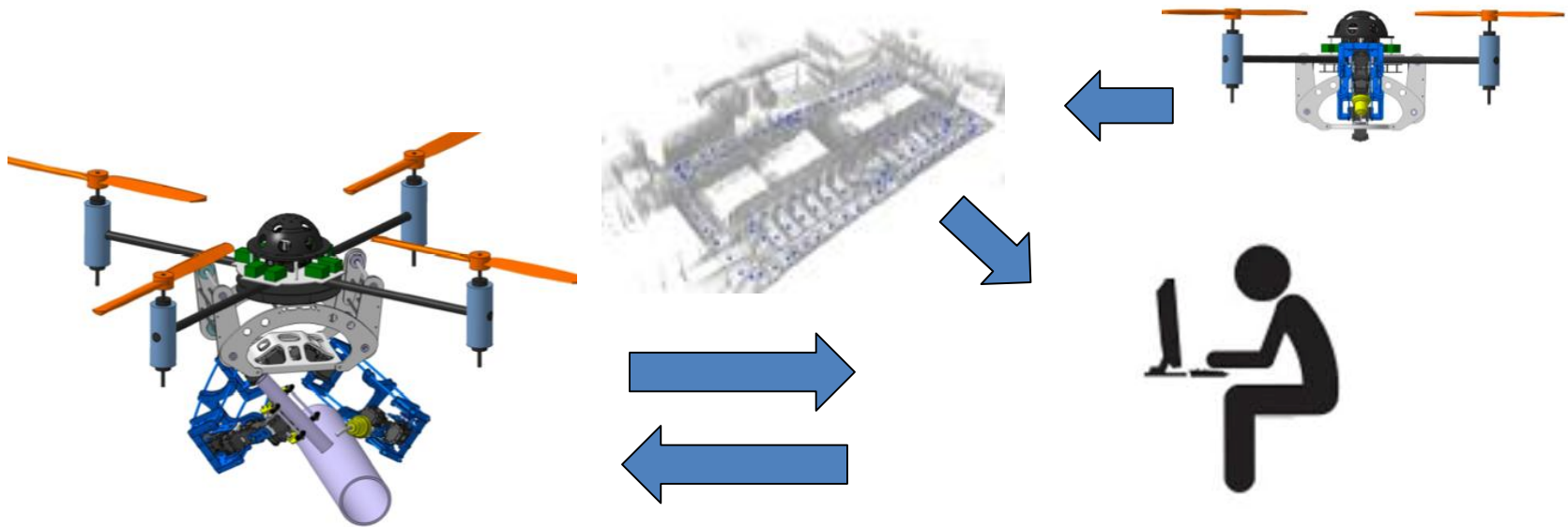
Precise 3D mapping and localization for manipulation

The **objective** will be to build an accurate map of the scenario before the inspection and maintenance tasks are carried out. An augmented map able to integrate information coming from different sources will be developed. Particularly, the integration of visual place recognition, point clouds (provided by 3D cameras or lasers) and range-only sensors will be developed in the project. The augmented map will exploit the synergies of all these sensors, reducing the dependence of a single device for localization and increasing the reliability of the map.



Perception for robot operation

The **objective** is the support of the aerial and ground robot operation. The map computed in the previous task will be used to back to the human operator in the AEROARMS applications: appropriate location to deploy the crawler, appropriate locations to deploy the sensors required for the inspection and maintenance, and the localization of the area to perform the repairing operation. It will also include the determination of the grabbing location for the aerial robot.

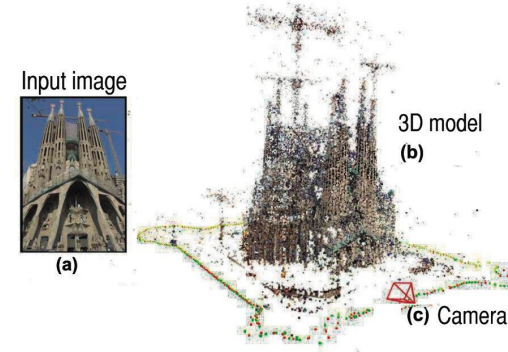


ARCAS Robot localization & pose estimation

GPS Robot
localization
< 2m accuracy



Appearance-based
Robot localization
< 1 m accuracy



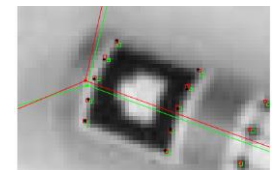
Range Only SLAM
localization
< 0,7 m accuracy



Marker-based
Robot localization
2 to 4 cm accuracy



Marker-based
3D pose estimation
for task execution
0,75 to 1,25 cm accuracy

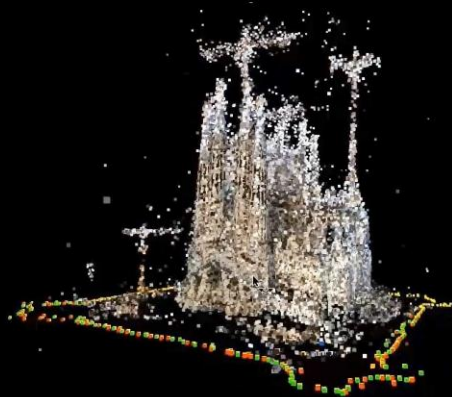
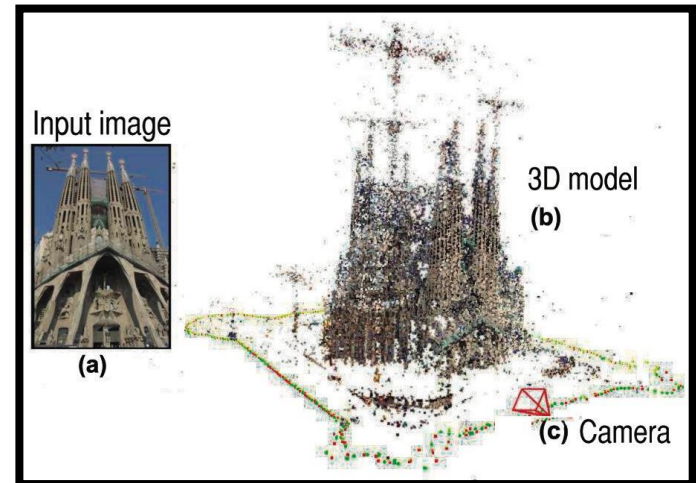


ARCAS

ARCAS Appearance based pose estimation from low resolution images

Approach

- High resolution images of the location to build a 3D map with bundle adjustment.
- Train a pose classifier with these images.
- Using a single low quality image taken from the robot, the classifier uses visibility constraints to compute the the robot pose.
- Low computational cost.

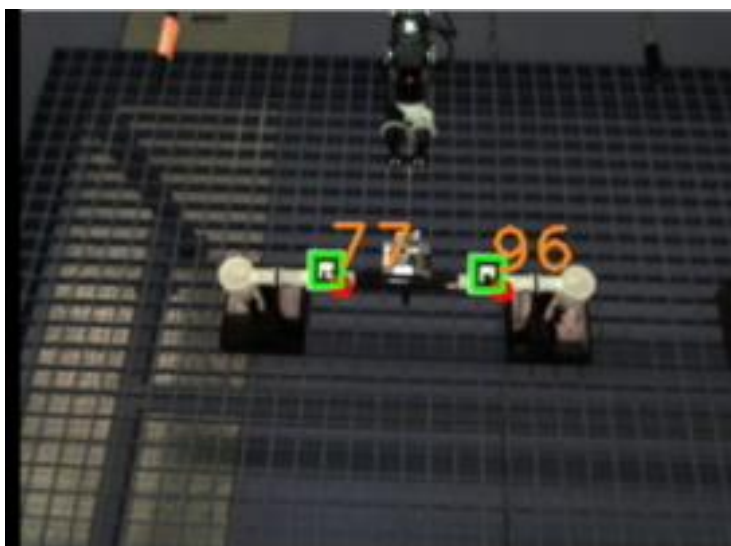
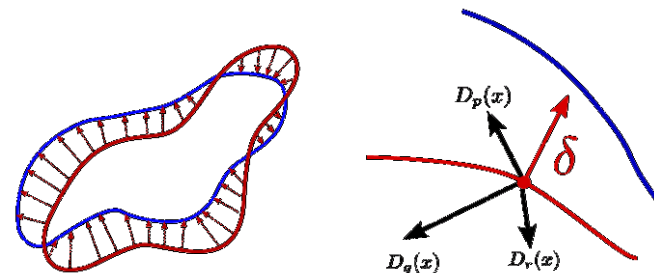


ARCAS Pose detection based on visual markers

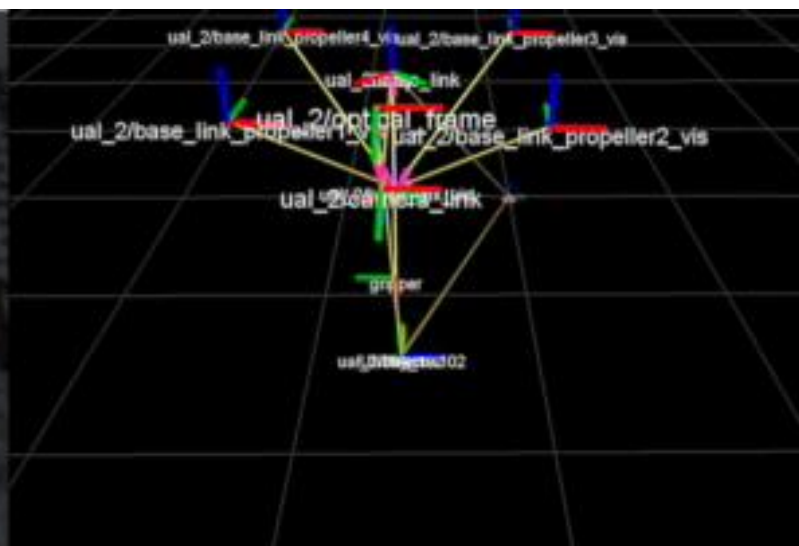
Approach

- Precise positioning of the robot for assembly operations using non-planar (planar) visual markers (precision between 0,5 – 1,2cm) under different illumination conditions and with cast shadows
- Real-time detection performance 10-25 FPS

Pose detection using contour registration



Raw detections



Coordinate systems

Thank You
sanfeliu@iri.upc.edu