AN IMU AND USBL-AIDED BUOY FOR UNDERWATER LOCALIZATION

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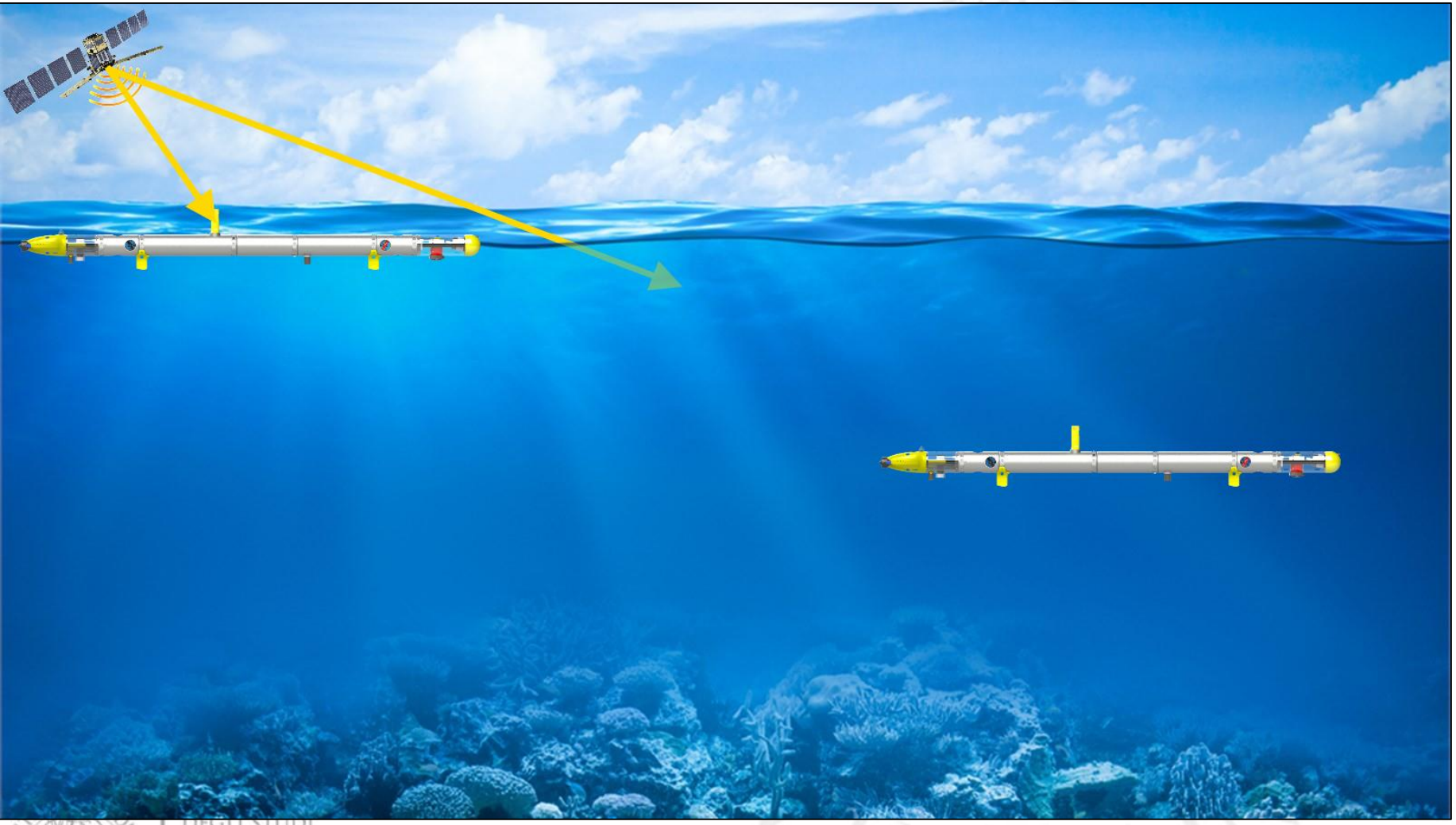
MARINE 2017

THE PROBLEM

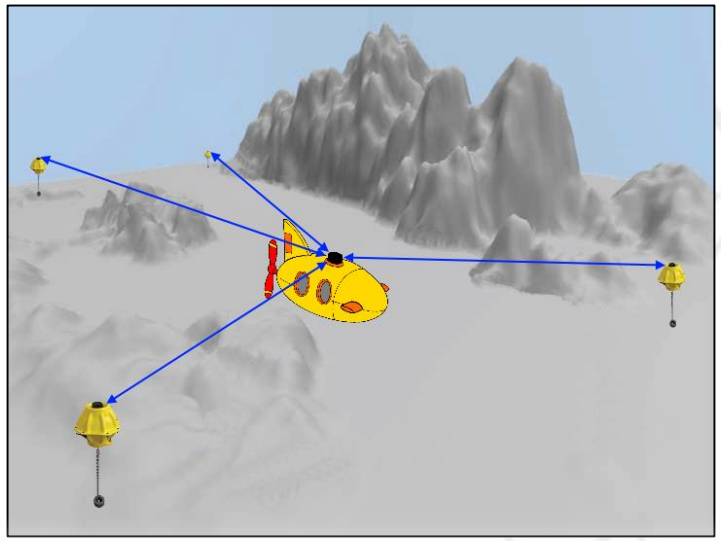


- GPS communication can be used only on surface
- Under the surface an underwater vehicle can not communicate with GPS satellites
- Under the surface a vehicle estimates its position or can be located with acoustic waves (LBL or USBL)

THE PROBLEM

LBL

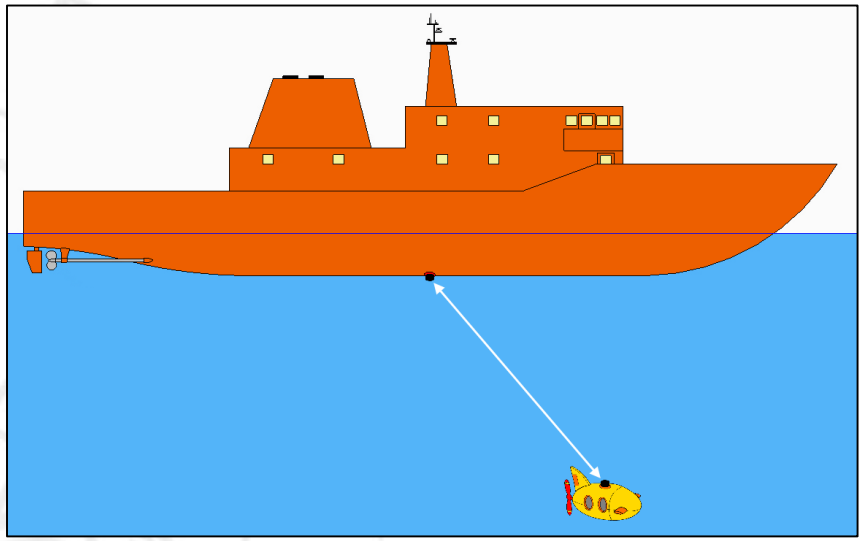
Long BaseLine



- High accuracy and precision (few centimetres)
- Based on triangular or position algorithms
- Requires the installation of the baseline stations

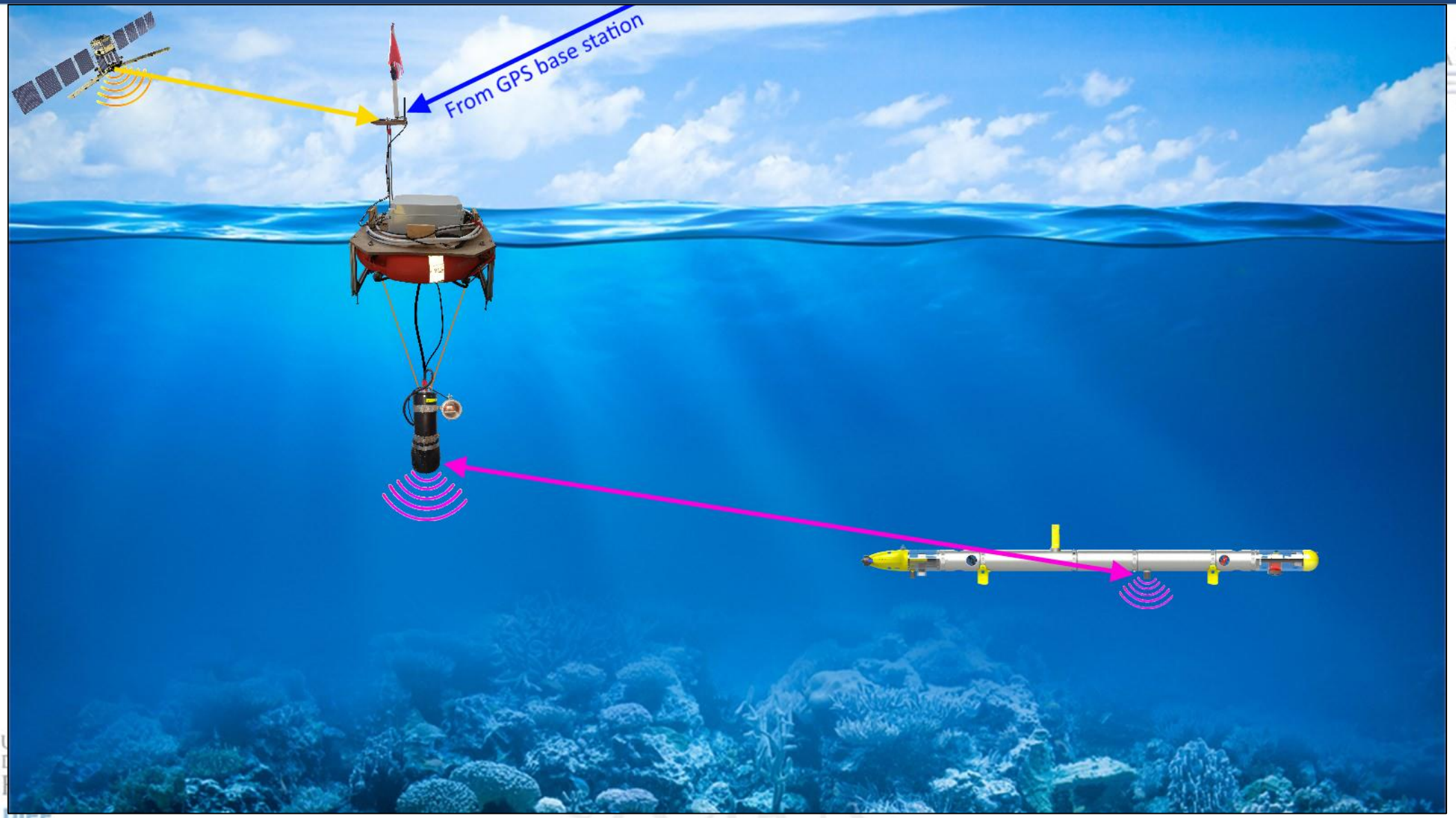
USBL

Ultra Short BaseLine

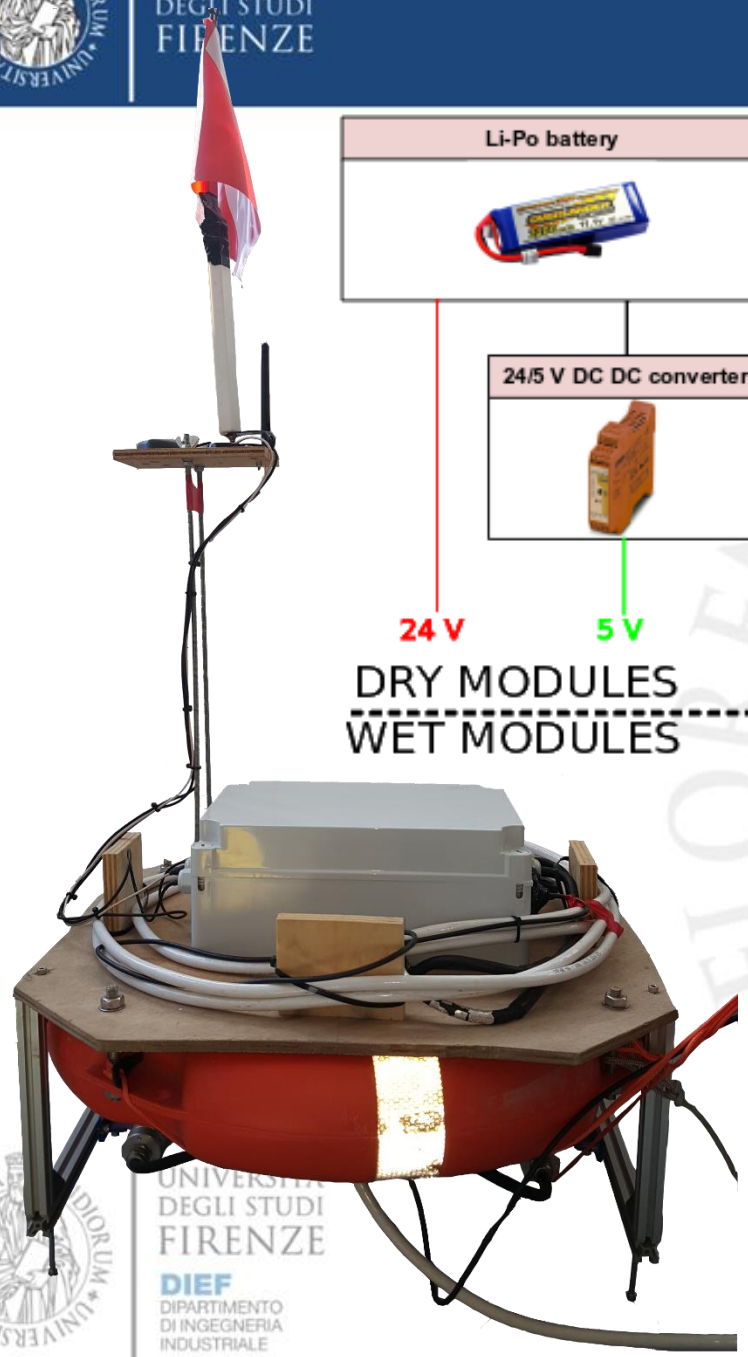


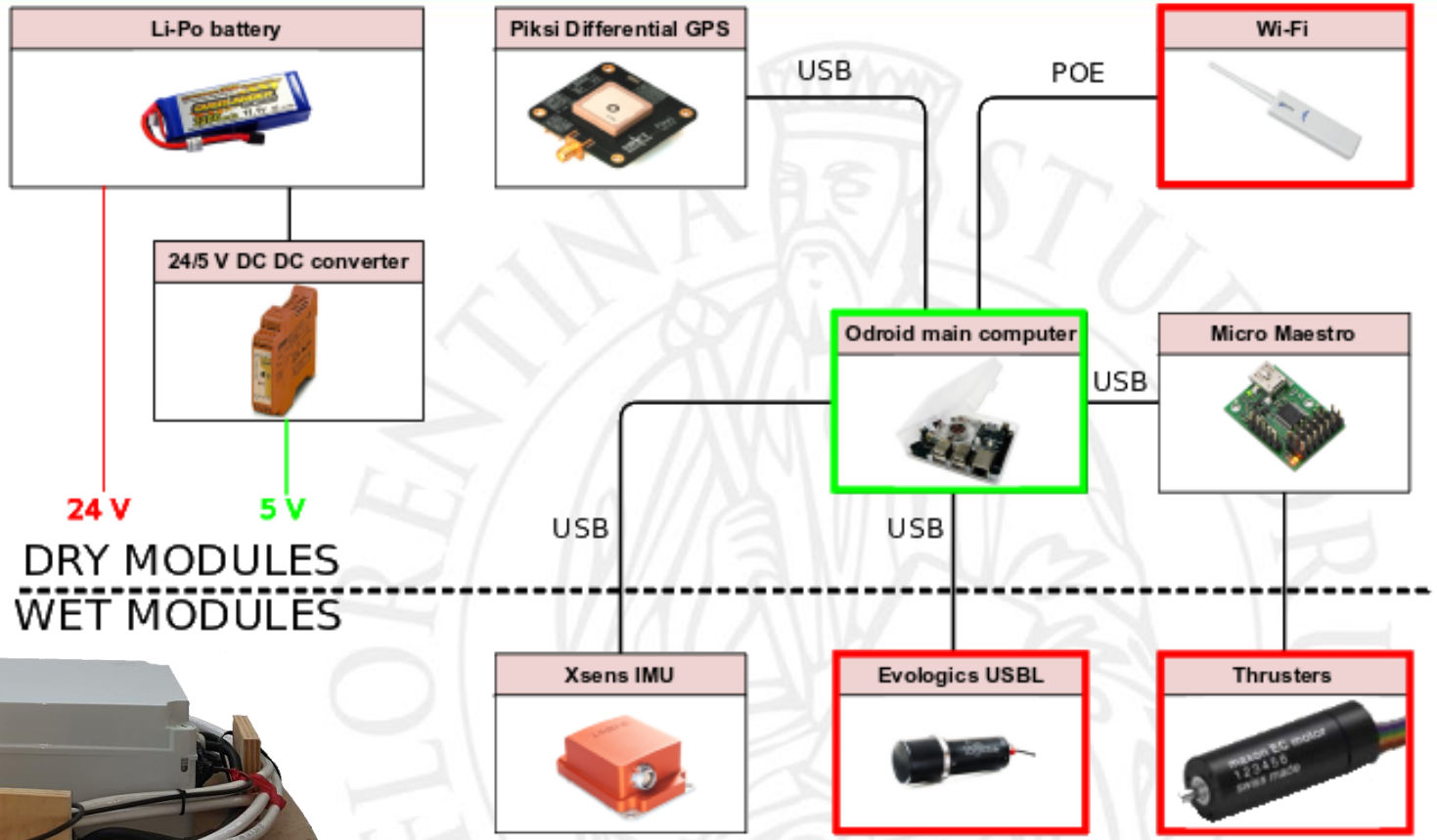
- A single device integrating the acoustic transceiver and an array of transducers is used
- An underwater infrastructure is not required
- Precision and accuracy depend on the distance from the vessel and from the accuracy of the USBL device position

LOCALIZATION



THE BUOY





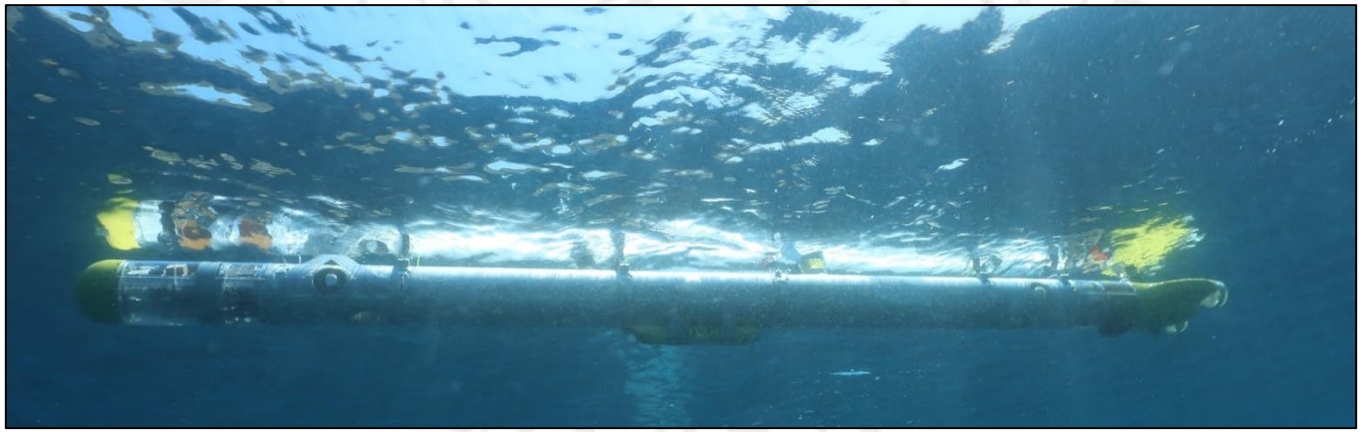
MDM LAB

EXPERIMENTAL TESTS

Two kind of experiments were performed:

1. Stationary target localization (using acoustic modems)
2. Moving target localization (using MARTA AUV)

Satellite image of piers of Roffia Lake (source Google Maps)

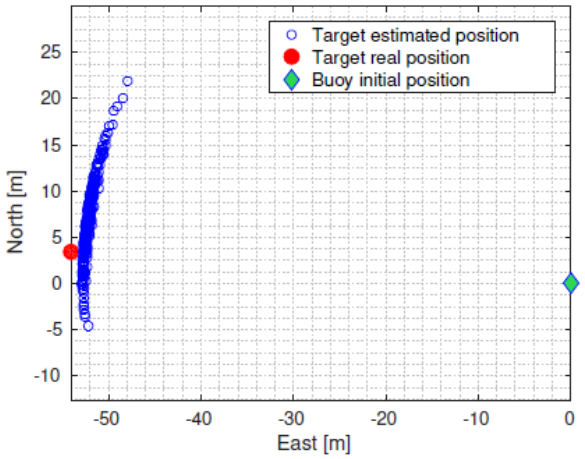


MARTA AUV

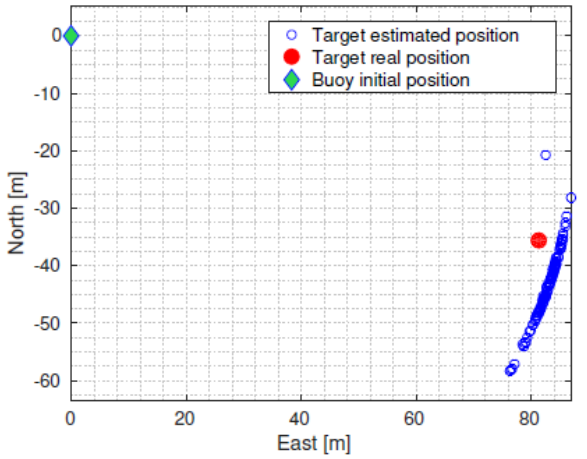
(vehicle developed by the Mechatronics and Dynamics Modelling Laboratory –MDM Lab- of the University of Florence)

STATIONARY TARGET LOCALIZATION

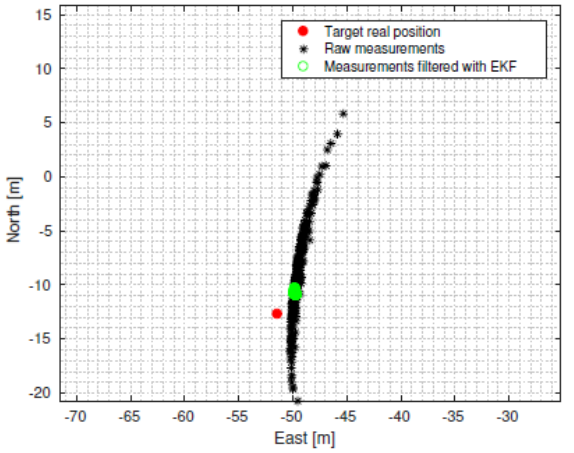
The measurements computed with the buoy have been compared with the position of the target, measured on the surface with GPS



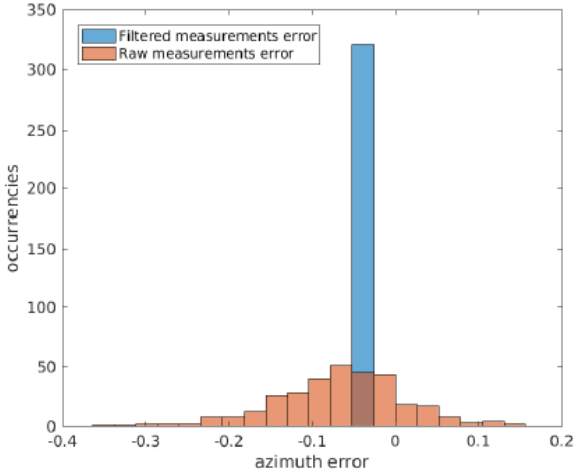
(a)



(b)

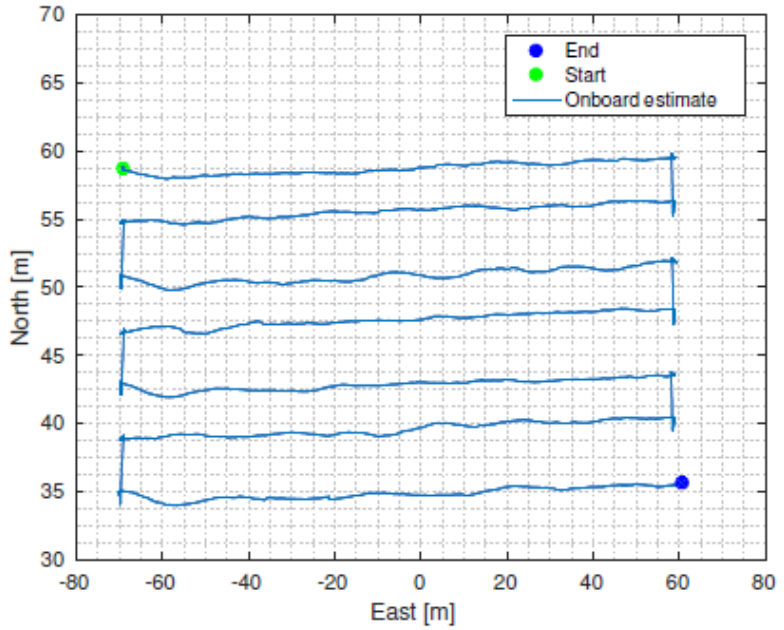


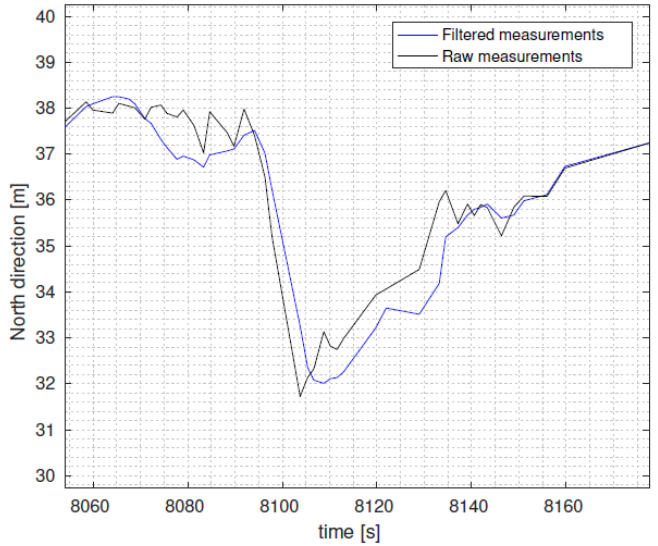
(c)

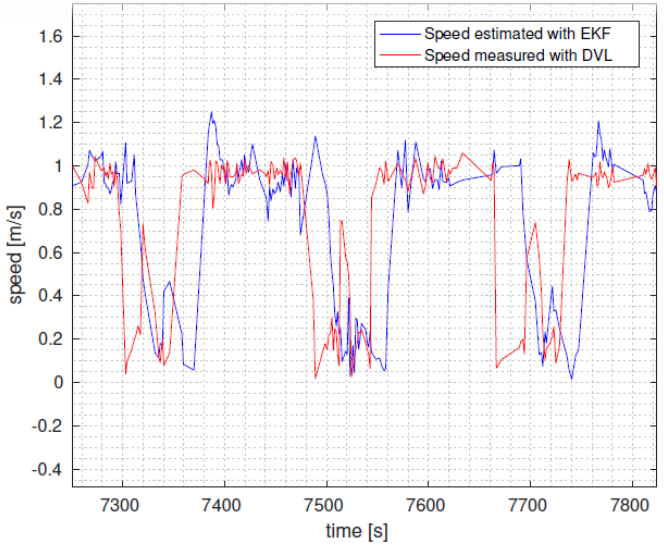


(d)

MOVING TARGET LOCALIZATION





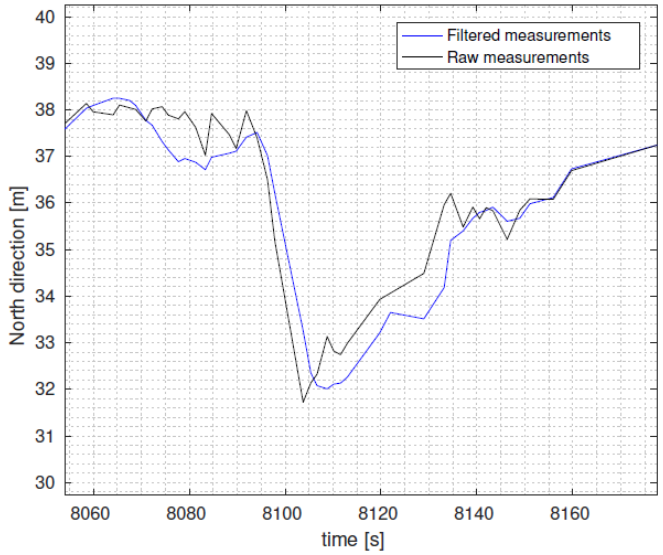


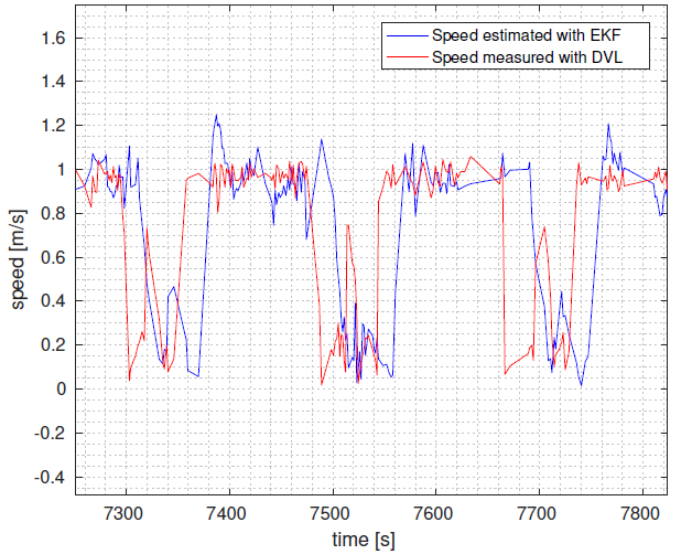
Estimate of the North coordinate in the lawn-mower path

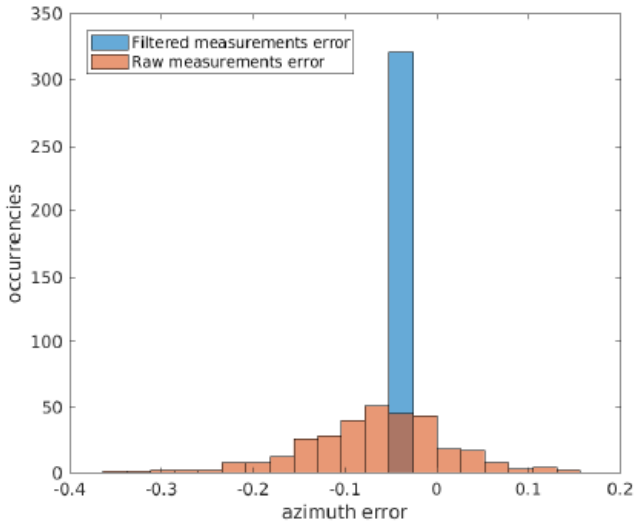
Comparison between the estimated velocities and the ones measured on board the vehicle by the DVL

CONCLUSION

To improve the quality of the measurements computed by the buoy an Extended Kalman Filter has been applied. It has been seen that, by filtering the measurements, the localization is improved, both in terms of stationary targets (reduction of the azimuth error angle dispersion) and moving targets (improved smoothness of the estimated positions)







FUTURE DEVELOPEMENTS

Possible future developments may concern:

- The use of a multiple model filtering, based on both the kinematic and the static models allowing for the outcome of the localization filter to be more robust, especially when complex paths are performed by the underwater vehicle
- The use of a gimbal to connect the USBL device to the buoy, in order to reduce perturbations entailed by sea waves

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DIEF DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

MDM LAB
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