1. Core research themes and interests

Our team works in the research and development of intelligent AUVs for field operations
where the imagery (both optical and acoustic) plays an important role. During the last years
the team has work on the development of advanced image processing techniques for the 2D and 3D optical mapping of
the seafloor, as well as with the fusion of these techniques with navigation data coming from state of the art navigation sen-
sors (DVL, gyro, USBL, LBL) together with global optimization techniques to face large scale maps. Map based navigation and
Simultaneous Localization and Mapping of underwater robots using both acoustics and/or video images has also been inves-
tigated. In the context of intelligent control architectures, work has been done in learning robot behaviors using reinforcement
learning techniques. A list of ongoing phd works follows: Path Planning (scan matching improved dead reckoning, grid map-
ping & homotopic guided path planning); Pose Based SLAM with probabilistic Sonar Scan Matching using Mechanical Scan-
ing Sonars; Bathymetry based SLAM (currently we are surveying
range registration methods in 2D & 3D); Mission Control and
supervision based on Petri Net formalism; Reinforcement Learn-
ing of Robot guidance behaviors (application to pipe tracking); Terrain based Navigation using Multibeam sonar; Global opti-
mization of Large Scale 2D mosaics using Bundle Adjustment; 3D image mosaicing through Structure From Motion; 3D im-
age mosaicing through stereo (temporal & spatial registration); Image blending with application to 2D mosaicing; Temporal change detection in 3D optical maps; 3D surface extraction for
large 3D mapping; Image polarization for underwater image en-
hancement.

2. Current maturity of our technology

AUV prototypes: All our vehicles run Linux an the custom O2CA2
software architecture. Mission programming is done using MCL, a mission programming language developed in our team which
compiles into a Petri Net allowing for verification and mission supervision.

• ICTINEU: 50 Kg low cost, hovering, open-frame ROV/AUV (DVL, MEMS IMU, mechanical scanning imaging sonar, forward &
down looking cameras, echo-sounder, USBL transponder). [deployed, update to 100m with a new Battery pack under develop-
ment, mainly used as a research testbed]

• SPARUS: 30Kg low cost, hovering/survey AUV (DVL, MEMS IMU, mechanical scanning imaging sonar, forward & down looking

• GIRONA500: 200Kg hovering/survey I-AUV (DVL, MEMS IMU+1 axis FOG, mechanical scanning profiling sonar, forward/down
looking camera, sound speed sensor, depth cell, Bathymetric Multibeam sonar profiler, acoustic modem, USBL transponder).
[under development, application oriented]

Navigation

• DVL+IMU+USBL+acoustic modem integrated navigation [De-
ployed offline, under research to do it online accounting for the transmission delays].

3. Projects and funding

Spanish funded Projects:

• RAUVI: AUV endowed with a robotic arm for underwater inter-
vention.

• AIRSUB (Dam inspection AUV): Spanish funded project to de-
velop an AUV system for building geo-referenced optical maps of
dam walls.

• FOTOGEO: Large area geo-referenced photomosaics

• AREM: Change detection over georeferenced photomosaics. European funded Projects & Networks:

• FREESUBNET: Marie Curie RTN Network about intervention
AUV Technologies.

• MOMARNET: Marie Curie RTN Network about marine science in
hydrothermal vent sites in the Mid Atlantic ridge.

• TRIDENT: Marine Robots and Dexterous Manipulation for En-
abling Autonomous Underwater Multipurpose Intervention
 Missions. Cooperation of Heterogeneous marine robots

4. Most relevant citations

Our publications relevant for marine robotics are available at:

http://eia.udg.es/~pere; http://eia.udg.es/~rafa;

http://www.viplcorob.es