JERICO-NEXT

Proposal for Transnational Access

to Coastal Observatories

2nd Call

20 February 2017 – 10 April 2017

Description of the project to be sent in pdf format to jerico.tna@ismar.cnr.it
on 10 April 2017 23:59 HOURS (CET) the latest
Please consult access rules at http://www.jerico-ri.eu and contact the manager of the infrastructure/installation you wish to use before writing the proposal

The JERICO-NEXT project is funded by the European Commission's
H2020 Framework Programme under grant agreement No. 654410
Project coordinator: Ifremer, France.

PART 1

1. GENERAL INFORMATION

Title of the project (255 characters max.)	Long term Underwater localization in extreme conditions
Acronym (20 characters max.)	EvoLUL
Applying Institution	EvoLogis
Host Institution	UPC
Host facility(ies)	Obsea

Have you or other members of your user group previously used the requested facility(ies)?			X	No
If yes, please indicate the EU Program(s), the name of the project(s) and year(s) you or other members of your user group have used such facility(ies)	---------------			
If you have received transnational access support by the JERICO FP7 project, please list resulting publications, conference contributions, patents. List only the ones that acknowledge the support of the European Commission and JERICO				

2. USER GROUP DETAILS

Indicate if the proposal is submitted by

[x] an individual

[ ] a user group

Principal Investigator (user group leader)

First and last name	Konstantin Kebkal, Dr. Sc.					
Gender	X	Male		Female	**Nationality**	
Institution	EvoLogics GmbH					
Address	Ackerstraße 76 D-13355 Berlin					
Country	Germany					
Email address	kebkal@evologics.de					
Telephone	+49 30 4679 862-0					
Fax	+49 30 4679 862-01					
Previous user		Yes	X	No		

User group members

Member # 1

First and last name	Pierre-Jean Bouvet, Dr. Sc.					
Gender	X	Male		Female	**Nationality**	French
Institution	ISEN					
Address						
Country	France					
Email address						
Telephone						
Fax						
Previous user		Yes	X	No		

Member # 2

First and last name	Ivan Masmitja					
Gender	X	Male		Female	**Nationality**	Spain
Institution	UPC Politechnical University of Catalunya					
Address	Ramble Exposició 61, Vilanova I la Geltrú					
Country	Spain					
Email address	Ivan.masmitja@upc.edu					
Telephone						
Fax						
Previous user		Yes	X	No		

(duplicate below for each member of the user group)

3. HOST INFRASTRUCTURE

Indicate the JERICO-NEXT host facility(ies) offered in Chapter 1 (Observing systems) you are interested in

(Tick more than one boxes if it is useful for your project)

		Short name	***Requested access time (UA*)***
	cabled observatory	OBSEA	180 days
	ferrybox		
	fixed platform		
	fishing vessel		
	glider		

**UA: please refer to the Infrastructure description in the JERICO-NEXT website*

Modality of access

	remote	*the measuring system is implemented by the operator of the installation and the presence of the user group is not required*
X	partially remote	*the presence of the user group is required at some stage e.g. installing and un-installing*
	in person/hands on	*the presence of the user group is required/recommended during the whole access period*

If you wish to avail also of a support facility from Chapter 2, please fill in the table below

		Short name	***Requested access time (UA*)***
	Supporting facilities and specialized equipment		

**UA: please refer to the Infrastructure description in the JERICO-NEXT website*

Modality of access

	remote	*the measuring system is implemented by the operator of the installation and the presence of the user group is not required*
	partially remote	*the presence of the user group is required at some stage e.g. installing and un-installing*
	in person/hands on	*the presence of the user group is required/recommended during the whole access period*

Explain briefly why you think your project will be best carried out at the specified host facility(ies)	The project has to be executed in shallow water and short range. The obsea shallow water observatory offer a real time access to the deployed instruments and modems and will allow a real time evaluation of the experiment
If possible, list other JERICO-NEXT facility(ies) where you think your experiment could alternatively be carried out	

Is there a facility similar to one/all those you wish to utilize in your country?		Yes	X	No
If yes, please indicate your reasons for requesting access to the JERICO-NEXT facility(ies) you have chosen and also exist in your country				

4. REQUEST FOR A JERICO-NEXT GRANT

(tick the box)

X	**Travel grant** (*)
X	***Shipment of your equipment, if applicable***

(*) travel, hotel and meals

Please provide a detailed and realistic budget for the expenses you expect to incur, including the number of people and days required. Explain clearly the role of each person for which a travel grant is requested.

Please note that a base amount of 3000 € has been set for each facility involved in a TNA project. The effective grant assigned to a project will be considered case- by-case depending on the type of access, the types and number of facilities requested, the length of stay, and the costs in the visited country.

2 travels of 3 days for 2 persons from Berlin to Vilanova I la Geltru (Barcelona). Travel Costs per person including trip, hotel and meals: 600: Total Travel cost: 2400eur Equipment shipment : *600eur* *Total requested: 3000eur*
First person is the hardware engineer of the device under test (DUT), who has the knowhow of how to refurbish instrument’s connector to be capable to be plugged to OBSEA platform. Second person, is software designer of the DUT, who will be on-board the boat at the moment of the sea trials, to verify proper functionality of the system before starting long term tests.

PART 2

Note: This part contains material for the evaluation

1. SCIENTIFIC EXCELLENCE OF USER GROUP
(maximum score: 5)

Short biography of the PI ***(half a page)***

Konstantin G. Kebkal received an engineering degree from the Technical University Sevastopol, Sevastopol, Russia, in 1995 and the Ph.D. degree in electronic engineering from the Technical University Berlin, Berlin, Germany, in 2000. He has been the Chief Executive Officer (R&D) at EvoLogics GmbH, Berlin, Germany, since 2000. His field of expertise ranges from underwater acoustics to applied mathematics and signal processing. He studied the mechanisms of dolphin communications and laid the groundwork for EvoLogics' sweep spread carrier (S2C) technology for underwater acoustic data transmissions. He has over 14 years of experience in developing and implementing innovative signal processing techniques that improve underwater communications in challenging underwater acoustic environment

Expertise of the user group in the domain of the application ***(half a page)***

Konstantin G. Kebkal has over 15 years of experience in developing and implementing innovative signal processing techniques that improve data transmissions in challenging underwater environments.
He has participated in development of novel protocols for acoustic communication and positioning systems (physical and media access control layers).

A list of 5 recent, relevant publications of the user group in the field of the project

1) Kebkal K.G., Kebkal A.G., Kebkal V.K., Petroccia R. Synchronization Tools of Acoustic Communication Devices in Control of Underwater Sensors, Distributed Antennas, and Autonomous Underwater Vehicles // Gyroscopy and Navigation, 2014, vol. 5, issue 4, pp.257-265, doi 10.1134/S2075108714040063.)
2) Kebkal K.G., Kebkal V.K., Kebkal O.G., Petroccia R., "Underwater Acoustic Modems (S2CR Series) for Synchronization of Underwater Acoustic Network Clocks During Payload Data Exchange," *IEEE Journal of Oceanic Engineering,* 2015, Volume PP, no.99, pp.1-12, doi: 10.1109/JOE.2015.2431531.
3) Kebkal O.G., Kebkal V.K., Kebkal K.G. EviNS: A Framework for Development of Underwater Acoustic Sensor Networks and Positioning Systems. *Proc. MTS/IEEE OCEANS'15 Conference*, Genova, Italy, May 18-21, 2015.
4) Kebkal K.G., Kebkal A.K., Kebkal O.G., R.Bannasch, "Modelling and Validation of Underwater Acoustic Telemetry: Shallow Water Experiments with Modems built upon S2C Technology", in Proceedings of the 3rd Underwater Acoustics Conference and Exhibition **on Underwater Acoustics (UACE 2015),** 21-26 June 2015, Platanias, Crete, Greece, HELLAS: 2015. ISSN: 2408-0195, pp. 359-372.
5) Carlson D.F., Ostrovskii A.G., **Kebkal K.**, Gildor H. Moored Automatic Mobile Profilers and their Applications // Advanced in Marine Robotics. LAP LAMBERT Academic Publishing: 2013,

pp. 169-206. ISBN-13: 978-3-659-41689-7, ISBN-10: 3659416894, EAN:9783659416897.

2. SCIENTIFIC AND TECHNICAL VALUE OF THE PROJECT (maximum score: 5)

Description of the project

Main objectives *(half a page)*

Main objectives of the project will be the evaluation of underwater acoustic localization tools deployed in shallow waters. The applications will cover both: static and moving targets.
A long term deployment experiment will offer the possibility to ensure robustness of the equipment and quality of the data along time. Variability of the measurements will be studied and correlated with sea conditions since Obsea platform is measuring waves, currents and water properties.

Scientific background and rationale *(one page)*

Electromagnetic waves suffers a high attenuation through the water [1], for this reason, the Global Positioning System (GPS) is not feasible and can not be used, therefore a global solution for underwater positioning is nowadays non-existent. Besides the dead-reckoning used in several underwater vehicles, acoustic positioning is the most common method for the main underwater positioning issues.

Different acoustic methods have been developed during last decades, such as Long Baseline (LBL), Ultra Short Baseline (USBL) and GPS Intelligent Buoys (GIB). Each of these systems have his own application as a function of project necessities and constrains. For example LBL system offer the best precision accuracy, but with a high deployment and maintenances costs, these can be solved by GIB systems, which use surface buoys instead of seafloor nodes. In addition, if the main goal is to reduce the setup time, the best option is an USBL system, but with less accuracy than the others methods.

On the other hand, acoustic waves have also been used for underwater communication. Last years the performance of acoustic modems have been increased, nowadays they have more capabilities such as synchronization and time stamping, that capabilities can be used to solve positioning problems. These acoustic modems can be integrated in an Underwater Wireless Sensor Network (UWSN) [2] for communication and also for node localization [3]. Therefore the main advantage of these modems is that with one device both communication and localization can be solved, which decreases the number of devices used, and consequently power consumption, complexity, space and price.

Finally in order to reduce the costs of these acoustic systems, some studies have focused on single beacon localization methods. In these architectures the main goal is use one mobile beacon to localize different underwater targets. This methodology, known as single-beacon range-only localization [4][5][6], have his particular challenges, which nowadays still open, such as path characterization (path shape, number of points and maximum range) or performance studies (accuracy and reliability). All of these parameters must be evaluated under different circumstances, where shallow waters are one of the most challenging environments for their high number of echoes and acoustic noise.

[1] W. S. Burdic, Underwater Acoustic System Analysis, Canada: Peninsula Publishing, 2 edition (2003).

[2] J. Heidemann, W. Y. J. Wills, A. Syed and Y. Li, "Research Challenges and Applications for Underwater Sensor Networking," IEEE Wireless Communications and Networking Conference, 2006. WCNC 2006, pp. 228-235, 2006.

[3] A. Munafo, J. Sliwka, G. Ferri, A. Vermeij, R. Goldhahn, K. Lepage, J. Alves and J. Potter, "Enhancing AUV localization using underwater acoustic sensor networks: Results in long baseline navigation from the COLLAB13 sea trial," Oceans - St. John's, pp. 1-7, 2014.

[4] C. LaPointe, Virtual long baseline (VLBL) autonomous underwater, M.S. thesis, Dept. Mech. Eng., Massachusetts Inst. Technol., Cambridge, MA, USA, 2006.

[5] M. F. Fallon, G. Papadopoulos, J. J. Leonard and N. M. Patrikalakis, "“Cooperative AUV navigation using a single maneuvering surface craft," Int. J. Robot. Res., vol. 29, p. 1461–1474, 2010.

[6] G. Antonelli, F. Arrichiello, S. Chiaverini and G. Sukhatme, "Observability analysis of relative localization for AUVs based on ranging and depth measurements," IEEE International Conference on Robotics and Automation (ICRA), pp. 4276-4281, 2010.

3. QUALITY OF THE WORK PLAN
(maximum score: 5)

Experimental method and work plan

Describe below the proposed method and work plan for the project

(one page)

UPC’s OBSEA platform, has two operational nodes about 100m away each other. Each node can provide power and realtime communications. Besides the underwater observatory platform, UPC will also provide an AUV (GuanayII) for the target localization.

1- **Long term deployment:**
We can take advantage of the OBSEA and deploy one modem in each node, which are deployed at 100 m of distance and at 20 m of depth. In this shallow water conditions we can measure the range variability and its distribution (variance and mean) under a monitored environment. Therefore we can compare this distribution by different parameters such as temperature or underwater currents. Moreover we can repeat this test, moving one of the modems in order to observe also the variation in the mean distribution error.

2- **Static target localization:**
The second test proposed is use the modems for localization using one-beacon range-only algorithms. For this test we can use the OBSEA and an AUV, where one modem can be attached to the vehicle and use it to localize an underwater target, which can be one of the instruments deployed on the seabed near the OBSEA. In order to avoid aberrant uncertaintes, this test is proposed to be repeated 5 days with an average of 10 localization tests per day, in order to achieve a total of 50 different data sets, which are necessary to observe the variance of the localization algorithm.
Given the authonomy of the AUV, of 4 hours at continuous movement, it's not possible to perform more tha 10 tests per day.

3- **Moving target localization:**
Finally we will perform a experiment, where an acoustic modems will be used to localize a moving target. For example, this target can be a drifting buoy or another vehicle. The main goal for this experiment is to run different algorithms to know their performance in a real environment and under real conditions.
This test will be carried out along 20 hours, as it has been detailed at static target localization, in order to avoid aberrant errors and to extract the variance of proposed algortihms.

Proposed time schedule

Provide below a clear schedule for your project including interruption, restarts and expected duration of access time

(half a page)

The test will be carried out during 180days, since this is the period of Mediterranean Sea condition's variation. With 180 days we can ensure, that sea tests will cover the whole temperature, current and salinity (noise) spread given in the sea, avoiding this way an extrapolation of field tests in a specific season to different season conditions.

1- **Long term deployment: 170 days**
170 days of continuous range variability study in order to conclude with the mean and variance of the process at any sea condition.

2- **Static target localization: 5 days**
10 localization tests per day, resulting in 50 tests as described in previous section

3- **Moving target localization:5 days**
1 tracking and following test per day of a total of 4 hours, resulting in 20 hours of tests as described in previous section

Please specify your requests regarding the use of your chosen facility's equipment/instruments/sensors, including any additional services, data or other requirements

It will be necessary data from the Obsea sensors: CTD and current meter data. All this information will be used to find a correlation between sea conditions and localization uncertainty variation

List all material/equipment you plan to bring to the facility (if any)

Proposed modems to be used: a couple of S2CR 18/34.

Risks, contingencies and mitigation measures

Describe below the potential risks and contingencies that might occur during the project and how do you plan to avoid, mitigate or resolve them

#	Risk / Contingency	Prevention / Mitigation / Corrective action
1	S2CR modem failure	All systems will be tested in an hyperbaric chamber at UPC installations, before any sea deployment
2	AUV failure	All mobile tests will be supervised by 4 divers who are in charge of OBSEA platform maintenance.
3	Bad weather conditions	Trip will be scheduled when UPC experts validate weather forecats
4	Modem transport delays	Evologics' experts will depart to Vilanova I la geltrú once the equipment has been received by UPC.

4. POTENTIAL FOR SEEDING LINKS WITH INDUSTRY
(maximum score: 5)

Do you think that this proposal has potential for seeding links with Industry? If so, how?
(half page)

Yes. EvoLogics is a company leader on underwater acoustics. The tests carried out at Obsea are important for the use of EvoLogics devices in shallow water applications.

5. EUROPEAN RELEVANCE AND INTERESTS FOR THE SCIENTIFIC COMMUNITY
(maximum score: 5)

Describe the relevance of your proposal at the European level and the potential interests for the research community
(half page)

Given the growing interest of both research and industry on underwater research, the amount of sensors deployed at the seafloor has grown significantly. Since, sea currents or seafloor movements cannot be controlled, usually some of these instruments are lost because they are not at the same deployment place, or simply they were deployed from a ship, and on their way to the seafloor suffered from sea currents drifting.

For these, and many other reasons a precise localization system would be necessary. Then, this study pretends to evaluate some of the actual state of the art algorithms for target localization in field tests, which can open new lines of research in terms of enhancing range estimation accuracy, as it is one of the actual main research fields at ISEN group, headed by Dr. Yves Auffret and Dr, Pierre-Jean Bouvet.

Long term underwater field tests are a valuable information for researchers, since most of publications have to be based on simulations given the leakage of facilities to acquire this kind of data. So we expect that these field tests can help the European research community.

Date of compilation 27.03.2017

Signature of the PI [signature] = K. Kebkal =

Signature of an appropriate authorised person (e.g. Head of Department, Research Office) [signature] = K. Kebkal =

EvoLogics® GmbH
Ackerstraße 76 • 13355 Berlin
Tel. (030) 46068226 • Fax (030) 46068215
info@evologics.de • www.evologics.de

This section is reserved to the JERICO-NEXT TNA Office

Date of proposal receipt by email __________

Assigned reference number __________

Signature of receiving officer __________