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.)	FOULING PROTECTION FOR MARINE OPTICAL SYSTEMS
Acronym (20 characters max.)	FOULSTOP
Applying Institution	IFREMER
Legal contact Name Address Function e-mail address	DELAUNEY LAURENT Centre de Bretagne, ZI pointe du Diable CS10070 – 29280 Plouzané – France Detection, Sensors and Measurements Laboratory Manager Laurent.delauney@ifremer.fr
Legal representative Name Address Function e-mail address	VINCENT PATRICK Ifremer 155 Rue Jean-Jacques Rousseau 92130 Issy-les-Moulineaux DGD patrick.vincent@ifremer.fr
Host Institution	UPC
Legal contact Name Address Function e-mail address	Dr. Joaquim Olivé Rambla Exposició 24, 08800 Vilanova I la Geltrú (Barcelona) Professor and UPC Research Group Director joaquim.olive@upc.edu
Legal representative Name Address Function e-mail address	Dr. Joaquin del Rio Rambla Exposició 24, 08800 Vilanova I la Geltrú (Barcelona) Professor and Projects Leader joaquin.del.rio@upc.edu
Host facility(ies)	OBSEA

Have you or other members of your user group previously used the requested facility(ies)?	Yes		No	X
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 below resulting publications, conference contributions,				

patents. List only the ones that acknowledge the support of the European Commission and JERICO	

Is this a resubmission of a previously rejected proposal?	Yes		No	X
If yes, please give the exact reference number and submission date. Kindly describe briefly the changes made in comparison to the rejected version.				

Is this a continuation of an earlier project funded under a previous call for Transnational Access in JERICO-NEXT at the same facility?	Yes		No	X
If yes, please give the exact reference number and submission date. Kindly indicate also what has been achieved in the previous experiment and the reasons why the objectives have not been fully met.				

2. USER GROUP DETAILS

Indicate if the proposal is submitted by

[ ] an individual

[X] a user group

Principal Investigator (user group leader)

First and last name	Laurent Delauney						
Gender	X	Male		Female	Nationality	French	
Institution	Ifremer						
Address	Detection, Sensors and Measurements Laboratory Centre de Bretagne, ZI pointe du Diable CS10070 – 29280 Plouzané – France						
Country	France						
Email address	Laurent.delauney@ifremer.fr						
Telephone	+33 (0) 2 98 22 46 36						
Fax							
Previous user	Yes		No	X			

User group members

Member # 1

First and last name	Kada Boukerma					
Gender	X	Male		Female	Nationality	French
Institution	Ifremer					
Address	Detection, Sensors and Measurements Laboratory Centre de Bretagne, ZI pointe du Diable CS10070 – 29280 Plouzané – France					
Country	France					
Email address	Kada.boukerma@ifremer.fr					
Telephone	+33 (0) 2 98 22 41 70					
Fax						
Previous user	Yes		No	X		

Member # 2

First and last name	Bertrand Forest					
Gender	X	Male		Female	Nationality	French
Institution	Ifremer					
Address	Detection, Sensors and Measurements Laboratory Centre de Bretagne, ZI pointe du Diable CS10070 – 29280 Plouzané – France					
Country	France					
Email address	bertrand.forest@ifremer.fr					
Telephone	+33 (0) 2 98 22 47 39					
Fax						
Previous user	Yes		No	X		

(duplicate below for each member of the user group)

3. HOST INFRASTRUCTURE

Indicate the JERICO-NEXT host facility(ies) offered in you are interested in

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

Chapter 1 (Observing systems)

		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*

Chapter 2 (Supporting facilities and special equipment)

		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)	Marine fouling is very specific to the location where it is considered. The OBSEA Mediterranean location would be very profitable to complete efficiency test of our antifouling system that has been carried out, up to now in Atlantic sea at Ifremer Brest. The OBSEA real time connexion to shore is mandatory to show in real time the performance of the system during the DEMO phase of the EU NEXOS project that is happening at end of 2017. The shallow water of the OBSEA observatory is very adapted to get high fouling development during this period of the year. Finally, the OBSEA observatory is fully compatible with the junction box used on our fouling protection system since the JB is a COSTOF II that is used on the EMSO EGIM module that has been already managed by OBSEA few months earlier.
If possible, list other JERICO-NEXT facility(ies) where you think your experiment could alternatively be carried out	The LoVE observatory is an alternative but has not all the advantages of the OBSEA one. The fouling pressure will be lower, the COSTOFF II compatibility has not been tested yet and the access to the observatory by route is more difficult (we have in mind, may be, to transport our station to OBSEA by route and ourselves in order to lower the cost and to reduce risk during the shipping phase). Since the delay for deployment is very short in order for us to be in time with the final demo phase of the NeXOS project (September 2017), the non-compatibility for connexion of the JB is a high risk for us. Nevertheless, we have in mind to ask for a TNA to the LoVE observatory for the 3rd call. That will give us some time to anticipate the compatibility difficulty. Consequently, up to the NeXOS and the Jerico-Next inter-collaboration, the system would have been tested in Atlantic sea (Brest), in Mediterranean sea OBSEA) and in the North Sea (LoVE).

Is there a facility similar to one/all those you wish to utilize in your country?	Yes		No	X
If yes, please indicate your reasons for requesting access to the JERICO-NEXT facility(ies) you have chosen and also exist in your country	No such real time observatory in Mediterranean sea with such shallow water peculiarity.			

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 comprehensive nominal reference amount of 3000-6000 € is available to each 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. Please be sure to provide detailed justification of your request.

- Travel: 3 persons, 600€ per person => 1800 € (3 x 600€)
  - Delauney Laurent, Project manager, and biofouling sensor protection expert.
  - Kada Boukerma, biofilm Sensor and optical sensor expert.
  - Bertand Forest, Computing network expert.
- Hotel: *3 persons, 3 nights, 90€ per nights => 810 € (9 x 90€)*
- Meals: *3 persons, 7 meals per persons, 21€ per meal => 441 € (3 x 7 x 21 €)*

- Shipment of equipment: *Nexos Biofouling testing underwater station, transportation by road go and return, => 1932€*
  (we may be able to lower shipment cost if we transport the station by route ourselves, only possible to OBSEA observatory)

Optional:

- Travel: 1 persons, 600€ per person => 600 €
  - Marco Faimali (CNR-ISMAR) or Giovani Pavanello (ALVIM Srl), Biofouling sensor expert.
- Hotel: *1 persons, 3 nights, 90€ per nights => 270 € (3 x 90€)*
- Meals: *1 persons, 7 meals per persons, 21€ per meal => 147 € (7 x 21 €)*

TOTAL:

- without the option: 1800 € + 810 € + 441 € + 1932 € => 4983 €
- with the option: 1800 € + 810 € + 441 € + 1932 € +600€ + 270€ + 147€=> 6000 €
-

PART 2

Note: This part contains material for the evaluation

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

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

Work experience:
Laurent Delauney is working at Ifremer for more than 20 years on *in-situ* monitoring systems.
From 1996 to 2006, Laurent Delauney was in charge of sensors development and maintenance plan for autonomous monitoring stations development at Ifremer, in particular for Coastal Marel family products and seabed observatories.
In 2007 Laurent Delauney is then in charge of the Electronics and *In situ* Measurement laboratory.
In 2013 up to now, Laurent Delauney is in charge of the "Detection, Measurement and Sensors" Laboratory in which various oceanographic innovative development is performed to serve autonomous monitoring.

Fields of interest and present research activities
Laurent Delauney's fields of interest are sensors development for coastal autonomous monitoring stations and seabed observatories, biofouling protection for marine *in situ* sensors and transfer from research to PMEs of marine sensors developments.
Laurent Delauney participates to many EU Projects like ESONET, EMSO, HYPOX, JERICO, NEXOS, JERICO-NEXT to diffuse to the EU community Best Practices in metrology and antifouling technics for oceanographic sensors autonomous monitoring systems.
Laurent Delauney participates to US Alliance For Coastal Technologies meetings on metrology aspects and antifouling technics and participates to biofouling protection for sensors deployments to the Venus and Neptune Canada observatories.

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

The user group is part of the Technological Research and Development team of the Ifremer Institute. This 100 persons team is dedicated to development of oceanographic systems from coastal to deep-sea applications. The expertise is, for marine applications, mechanical design, electronic, embedded software, network computing, network management, data management, material behaviour, hydrodynamic, physics and chemistry, acoustic, etc.

So the user group is used to participate to the development of innovative technological systems dedicated to autonomous ocean monitoring.

The user group was or is part of many EU Projects as ESONET, EMSO, HYPOX, JERICO, NeXOS, JERICO-NEXT, ATLANTOS, etc. The user group worked on more than 10 years on biofouling protection for marine sensors by generation of biocide by localized seawater electrolysis. It started by the BROSS project, then the EU BRIMOM 2002-2006 project (Biofouling resistant infrastructure for measuring, observing and monitoring) and then Ifremer constantly improved this technology up to the NeXOS 2014-2017 project (Next Generation Web-Enabled Sensors for the Monitoring of a

Changing Ocean) that allowed to demonstrate in Atlantic sea it's reliability and efficiency for optical sensors and devices.

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

1 - Delauney Laurent, Boukerma Kada, et al. Biofouling protection by electro-chlorination on optical windows for oceanographic sensors and imaging devices. OCEANS 2015 Genova.

2 - L. Delauney, Chantal Compere, M. Lehaitre - Biofouling protection for marine environmental sensors - Ocean Science (1812-0784), Vol. 6, N. 2 , P. 503-511 01/2010

3 - L.Delauney, C.Compère, M.Lehaitre. Biofouling protection for marine environmental sensors. Ocean Science, 6(2), 503-511 - 2010.

4 - L. Delauney and C. Compère (France). Marine and Industrial Biofouling. Chap 12. An example: Biofouling protection for marine environmental sensors by local chlorination. Springer Series on Biofilms. Editors: R. Venkatesan, S.P. Murthy, K. Cooksey, H.C. Flemming. 2009, 333p.

5 - M. Lehaitre, L. Delauney and C. Compère. Biofouling and underwater measurements, Chapter 12. Oceanographic Methodology series, 2008, 860p. Unesco publishing.

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

Description of the project

Main objectives ***(half a page)***

Biofilm and Biofouling growth on marine *in situ* sensors is a well-known bottleneck when autonomous *in situ* monitoring is performed in seawater. Technological solutions have been under investigations for many years now. Still new improvements are studied.

This project consist to test in the Mediterranean sea environment an innovative technique to protect optical windows that are part of optical oceanographic sensors or more generally part of optical devices like underwater cameras and lights. The biofouling protection is achieved by a conductive layer that coats the optical window and is used to generate very low quantity of hypochlorous acid by controlled *in situ* chlorination of seawater.

Moreover, this innovative low power demand and very efficient biofouling protection technique can be controlled by a loop system based on a biofilm sensor (Collaboration with ISMAR-CNR,Marco Faimali (Italy) and ALVIM Srl Giovanni Pavanello (Italy)) that can trigger the active biofouling protection device only when biofilm formation is detected. The final purpose of such arrangement is to save energy by controlling the operation of active biofouling protection systems (wipers, bleach, localized chlorination, etc.) and then to lower as much as possible the energy demand and/or biocide release.

Our biofouling protection technology has been fully integrated to TriOS commercial optical sensors and an HD camera. The deployment at sea is performed on an underwater-cabled structure equipped with an EMSO COSTOF II junction box, and an ALVIM biofilm sensor for the antifouling protection control system loop.

This test station is part of the EU NeXOS project that will end in 2017 by a demonstration phase for which real time data will be displayed at the PLOCAN facility (http://www.plocan.eu/index.php/en/).

Scientific/Technical background and rationale
(one page)

Oceans environmental monitoring and seafloor exploitation need in situ sensors in various locations and on various carriers in order to initiate and to calibrate environmental models or to operate underwater industrial process supervision. From coastal to deep sea, one of the main bottlenecks to perform such task is to prevent the transducing interfaces of the sensors from biofouling development. The major problem is to provide real-time reliable measurements without requiring too frequent maintenance therefore too expensive or even impossible to achieve for systems in deep environment or far away from the coast. It is commonly accepted that a two-month maintenance interval is a minimum for the monitoring of coastal environment and a cost economically viable. Without effective protection against biofouling this goal is unachievable.

Marine biofouling, in the spring, can grow and colonize a system in a week. This colonization causes a drift of physico-chemical sensors thus provide measurements outside tolerances that become

unusable. Imaging systems, cameras and projectors are even disrupted by biofouling. Images become blurred or noisy, projectors lose their light intensity.

Many techniques are actually available off the shelf to protect sensors from biofouling development, for example, passive technics like copper coatings, hydrophobic coatings or bio-mimetic surfaces, and active technics mainly based on wipers, UV irradiations, bleach, and biocide generation by localised seawater electrolysis. These technics have been referenced in publications these last years.

However, for optical sensors, Ifremer has developed a specific biofouling protection. It is based on seawater electrolysis that generates hypochlorous acid on the working electrode of the electrolysis system. For optical system, the working electrode can be a conductive and transparent coating based on doped tin dioxide and sprayed straightforwardly on the optical windows of the device. Ifremer on Helgoland Island, originally, has successfully tested this protection scheme once during summer 2005 (BRIMOM[1] EU project).

In order to optimize the use of energy to protect sensor from biofouling, it is very smart to enslave the active operation of the biofouling protection by the help of biofilm sensor. This is what is tempted in this project by using a marinized ALVIM biofilm sensor.

During the EU NeXOS project, both technologies have been demonstrated with full success in Atlantic sea. A HD camera and fluorescence sensors worked at sea without any maintenance for more than 6 months.

Biofouling protection by conductive layer on optical windows has now a Technological Readiness Level (TRL[2]) equal to 7 (System technology prototype demo in an operational environment). Indeed, the protection has been tested with success for 2 years on 2 prototypes in a relevant environment (Ifremer *in situ* testing bench) and up to now for 4 months on 3 off the shelves sensors and a camera in real *in situ* marine condition (Atlantic sea, St Anne du Portzic Bay).

TRL 8 (System technology qualified through test and demonstration) is in reach and should be achieved soon before the end of the NeXOS project by deploying the testing station on a NeXOS Demo site. The objective of this Jerico Next TNA is to allow performing the final Nexos Demonstration of these technologies in a Mediterranean environment and connected to a real time observatory facility.

[1] EC proposal EVR1-2001-00034 ; Biofouling Resistant Infrastructure for Measuring, Observing and Monitoring

[2] **T**echnology **R**eadiness **L**evel – Technological Maturity scale used for oceanographic instrumentation development

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

Experimental method and work plan ***(one page)***

<Describe the proposed method and work plan for the project>

OBSEA has two operational nodes situated at 20m depth. Each node can provide power and real-time communications. Then we can take advantage of the OBSEA and deploy the NeXOS biofouling protection testing station on one of the two nodes.

In this shallow water conditions and during this period of the year, June to November, biofouling growth is at its maximum.

The station will be deployed and connected to the OBSEA junction box in order to get real time data from TriOS fluorometers and from the HD Camera.

After 6 months of operation the station will be recovered. Photos will be performed to keep track of global fouling covering; sensors and camera optics will be sampled for precise biofilm covering estimation.

During the 6 months of operation, real time data from the fluorescence sensors will be collected and will give instantaneous information on potential drift due to biofouling. To determine drift due to biofouling, 3 fluorescence sensors are placed on the station: a non-protected sensor used as reference, a fully protected sensor and an enslaved (by the Alvim biosensor) sensor. In this way, both arrangements (enslaved and non-enslaved) can be compared and qualified.

In addition, the station is equipped with a fully protected HD camera that is orientated toward the optics of the sensors and allow to check for their fouling covering. And the unblurred images from the camera is as well an indicator of the efficiency of the biofouling protection

Proposed time schedule ***(half a page)***

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

The test will be carried out during 180 days in a row.

Day 0: Deployment, underwater photos by divers of the testing station.

Day 0 – 180: real time data acquisition and web publication. Monthly underwater photos by divers of the testing station.

Day 180: Underwater photos by divers of the testing station, Recovery of the station. Bio sampling on sensors optics and camera optic.

Biofouling protection experiment on optical devices must be performed during long term deployment (at least 6 months) in order to show exceptional efficiency in comparison with conventional methods like wipers, copper, nanomaterial coating, UV, that are known to work but commonly limited to 3 month in harsh coastal environment.

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

- Real time data service (need to arrange connection btw COSTOFF II station junction box and OBSEA Junction box)
- External web server accessibility
- Power for the station
- Regular (monthly) underwater photography (done by Obsea divers)

List all material/equipment you plan to bring to the facility

- Nexos biofouling protection testing station (Frame, 1 HD camera, 3 TriOS fluo sensors, 1 Alvim biofilm sensor, 1 COSTOFF II junction box, inter-connection cables)
- Computer for the on shore station with web server: connected to Obsea network

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	Failure in real time data	The station administration can be operated from shore by remote. A restart can be operated from Ifremer.
2	Failure in sensor operation	This station is working for 6 months at Ifremer Brest in situ testing station. Then, the risk is very low and is part of the TRL assessment.
3	Failure in camera operation.	This station is working for 6 months at Ifremer Brest in situ testing station. Then, the risk is very low and is part of the TRL assessment. At least, monthly underwater photo by divers will take over lack of camera operation.
4	Frame failure	Monthly divers visit will take a look to the frame and the whole station.
5	Cables	Monthly divers visit will take a look to the cables.

4. POTENTIAL FOR SEEDING LINKS WITH INDUSTRY AND/OR POTENTIAL APPLICATION TO STAKEHOLDERS

(maximum score: 5)

Highlight below any innovative aspect of your proposal beneficial to industrial application and/or relevant to other stakeholders.

(half page)

Biofouling protection for optical devices targets a niche market that is oceanographic sensors market, for which actors are well known and will be addressed in the following years after this final demonstration.

The market of marine cameras and light will be addressed as well in peculiar for the renewable marine energy context for which systems are more and more under surveillance by underwater cameras.

These technologies will be presented at OCEAN's 17 conference in Aberdeen and exposed to 2018 Ocean International exhibition in London.

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)

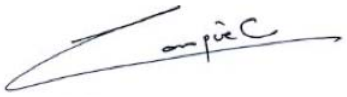
Oceanographic market is so small that such technology must be addressed at least at European level and even addressed to other continent like Asia, USA, Australia, etc.

Biofouling on sensors for marine monitoring is a well-known limitation. It's a bottleneck that every sensors manufacturers and scientific teams try to overcome for ages. The technology concerns by this TNA proposal is a great advance in term of efficiency (energy, protection, integration,, etc) for biofouling protection of optical devices. The *in situ* demonstration with real time data display is a very powerful way to realize the proof of concept of such functionality and to advertise it to the European level and larger. It's much more powerful than publication or conferences. An example of such efficient "communication" strategy is the *in situ* demonstration of the AML antifouling system based on UV irradiation: Aml_oceanographic_biofouling_control.

Date of compilation 06th April 2017

Signature of the PI Laurent Delauney

Signature of an appropriate authorised person
(e.g. Head of Department, Research Office): Chantal Compère
Responsable de l'Unité de Recherche
Recherches et Développements
Technologiques



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Date of proposal receipt by email _____

Assigned reference number _____

Signature of receiving officer _____