



## → Kick-Start webinar

## Robotics for society

<https://business.esa.int/funding/invitation-to-tender/robotics-for-society>

Webinar dates: 11 May 2020 & 26 May 2020

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BUSINESS  
APPLICATIONS

BUSINESS  
INCUBATION

TECHNOLOGY  
TRANSFER



→ Welcome to the webinar

## Robotics for society

Before we start...

- Due to the number of attendees, please keep your microphones muted at all times and switch off the webcam function
- You can use the conversation function anytime to submit your questions. They will be addressed during the Q&A at the end of the webinar



## → Webinar Agenda

### 1. Introduction

- Space Applications (tech & market)
- What ESA offers

### 2. Introduction to Kick-Start Activity

- Study Tasks

### 3. Space for 'Robotics for society'

- Background
- Key topics
- Enablers from space

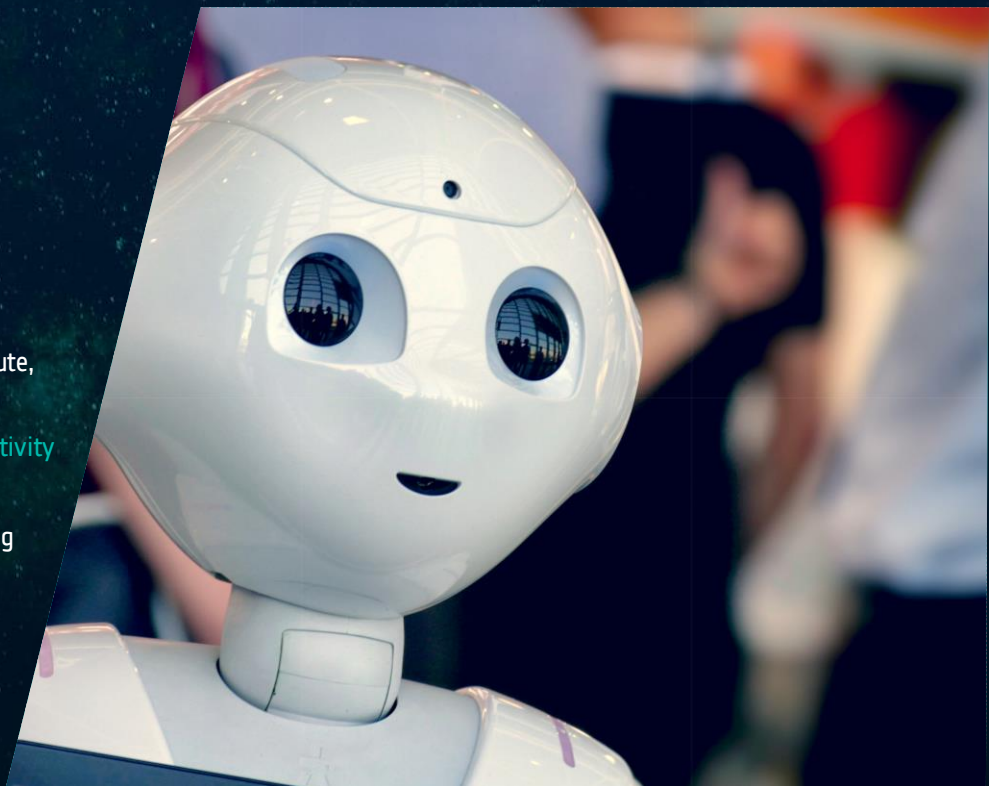
### 4. Guest speaker

- Dr Ioannis Havoutis  
Oxford Robotics Institute,  
University of Oxford

### 5. How to apply to Kick-Start Activity

- How to apply
- Authorization of funding
- The proposal template

### 6. Q&A





## → Space Applications

### Space technology

Earth Observation



Satellite Navigation



Satellite Communication



Human Spaceflight Technologies



Space Weather



### Users & Market

Maritime



Environment



Financial



Education



Energy



Agriculture



Healthcare



Transport



Media



Aviation



## → What ESA offers

We'll work together to make your idea commercially viable, with:



Zero-Equity  
Funding  
(€50K-€2M+)



Tailored Project  
Management  
Support



Access to our  
Network and  
Partners



Use of ESA  
Brand for  
Credibility

## → Kick-Start study tasks

6 months duration - Overall cost €80K

For SMEs:

€64K ESA funding

(80% ESA co-funding)

For non-SMEs:

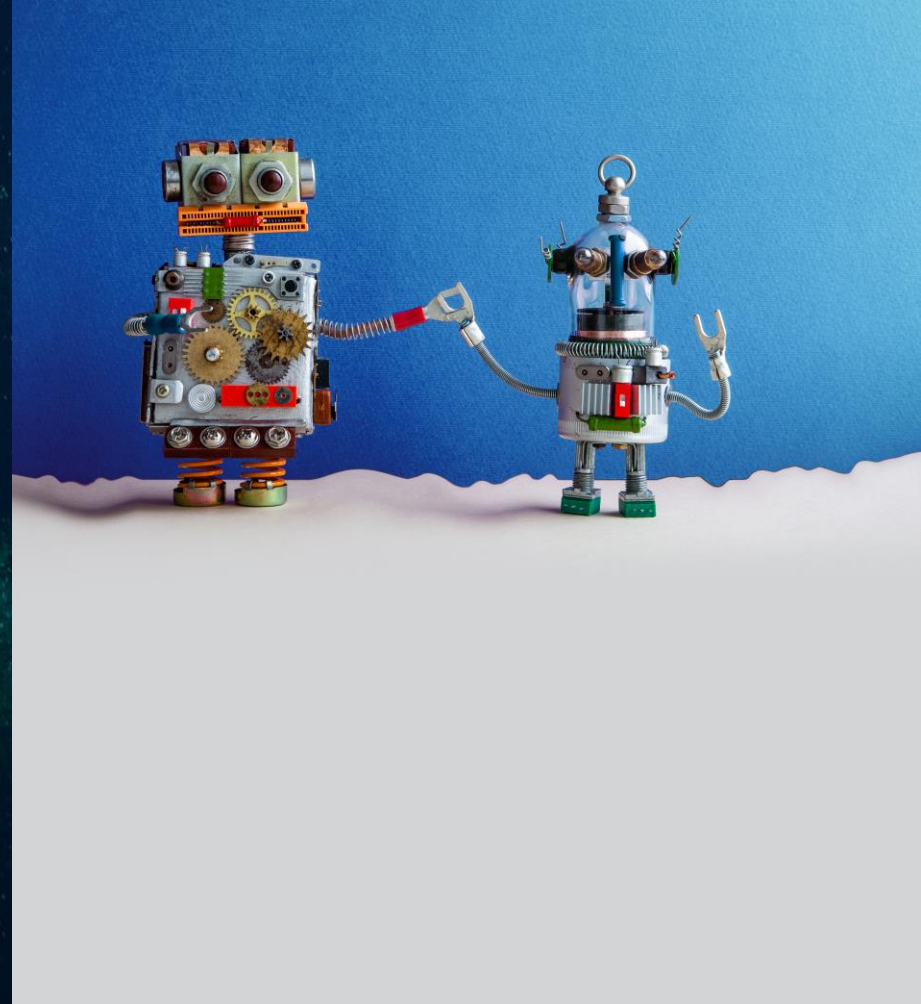
€60K ESA funding

(75% ESA co-funding)

Develop and assess new business case for commercially viable services

- Customer Engagement  
incl. needs and value proposition validation
- Technical Feasibility Assessment  
incl. service and system architecture, space data/technology integration
- Commercial Viability Assessment  
incl. business model and plan

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## → Kick-Start Robotics for society

### Background

To explore new business models and space-based solutions for commercially viable services to stimulate the development of robotic applications underpinned by space technologies in a wide variety of sectors, such as:

- Extreme environments
- Agriculture
- Infrastructure monitoring
- Transport
- Social care
- Soft robotics

The call is open between: 3/06 – 15/07/2020



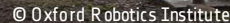
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## Robotics for extreme environments

Robotics and autonomous systems, equipped with advanced instrumentation and analytics, can represent the future of resilience management.







## → Key topics (2/6)

### Robotics for agriculture

Agricultural robots, underpinned by GNSS, SatEO and Satcom technologies, are poised to be at the centre of the third agricultural revolution; not by displacing farmers, but by increasing the farmer's added value while maximising yield and optimising the use of natural resources.





## → Key topics (3/6)

### Robotics for infrastructure monitoring

Structural health monitoring (SHM) is an essential component in civil engineering for safety and integrity of civil structures such as buildings, bridges, power plants, off-shore structures and tunnels. State-of-the-art sensing, automation and robotic technologies can greatly facilitate construction automation of infrastructure systems.





## → Key topics (4/6)

### Robotics in the transport sector

Robotics is expanding the transport and logistics industry. Amongst all the modes of transport robots, self-driving cars are those receiving most of the attention. Safety can be improved and journeys made faster thanks to robot-enabled services for road maintenance. Getting autonomous buses on the road is a significant step forward for the future of public transport.







Robots and autonomous systems, together with AI, connected data and digital infrastructure have the potential to revolutionise the way in which social and medical care is delivered, for the elderly and disabled people.





## → Key topics (6/6)

### Soft robotics

There is a whole field of cognitive robotics that is concerned with giving robots intelligent behaviour. Any artificial intelligence is of much greater use when embodied, and only with proper body an agent can do complex tasks. Types of soft robots include robotics muscles as well as climbing, edible, wearable and prosthetic robots.



## → The power of space



Global Navigation Satellite Systems (GNSS) provide precise positioning and guidance. GNSS data can support trace and tracking applications and geo-tagging data collection.



EO satellite imagery can be used to provide maps to evaluate the conditions on the ground. EO technology can provide meteorological information, key data for monitoring and forecasting air pollution, CO2 emissions, information about crop health, the build environment, burnt structures, etc. to be integrated with other data sources for the above described applications.



Satcom offer reliable connectivity in places with insufficient terrestrial cellular broadband coverage, especially in the case of extreme/ remote environments. They can therefore provide robust communication links to control and command the robots as well as to rely data from them.



## → Guest speaker

### Dr Ioannis Havoutis

Dynamic Robot Systems group

Oxford Robotics Institute

The University of Oxford

<https://ori.ox.ac.uk/labs/drs/>



# Legged Robotics for Industrial Facilities

– Monitoring & Inspection –

Ioannis Havoutis



- **Dr. Ioannis Havoutis** -  
Motion Planning, Control,  
Machine Learning



- **Dr. Maurice Fallon** -  
State Estimation, Localization,  
Mapping



Optimal Control

Motion & Path  
Planning

Machine Learning



# Multiple Domains



RAIN



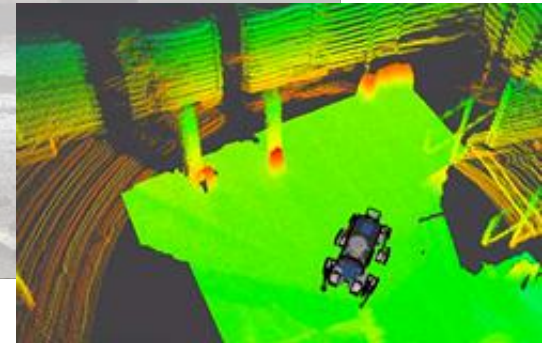
# Legged Robots





- **12** Rotational Joints
- Electric, **Torque** Controlled
  - High-res Encoders
- 3 Intel i7s **Onboard**

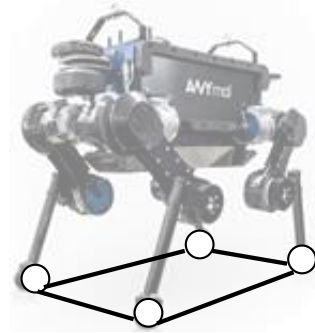
- LiDAR, 2 x RGBD, Tactical Grade **IMU**
- **2** Hours Autonomy
- Waterproof, rugged
  - IP67 sealed



# Advantages



CoM



Area of Support



Simple Leg Kinematics





# Examples

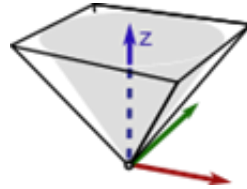




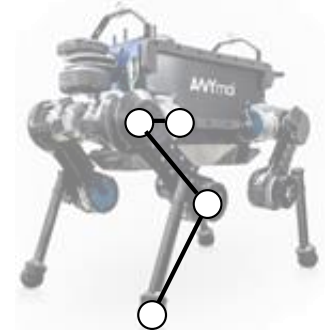
# Challenges



Complexity

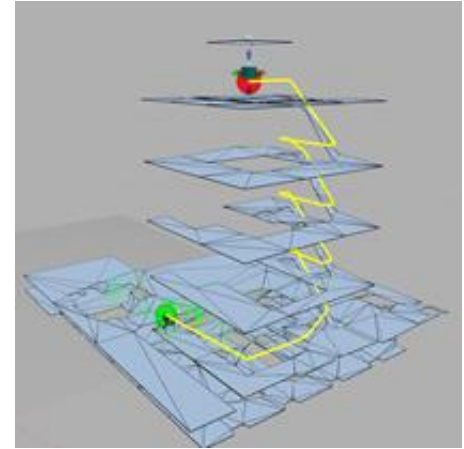
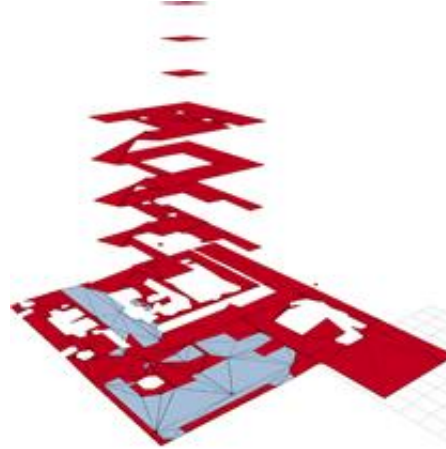
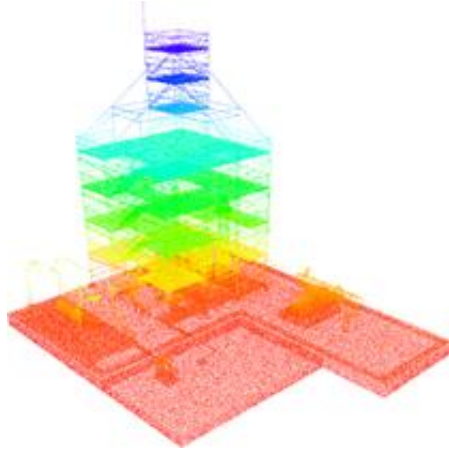
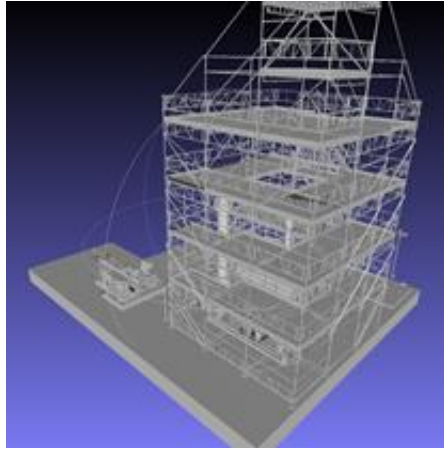


Contacts



Constraints

# Representation



Model



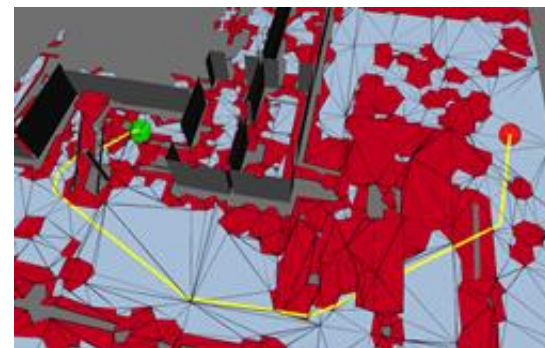
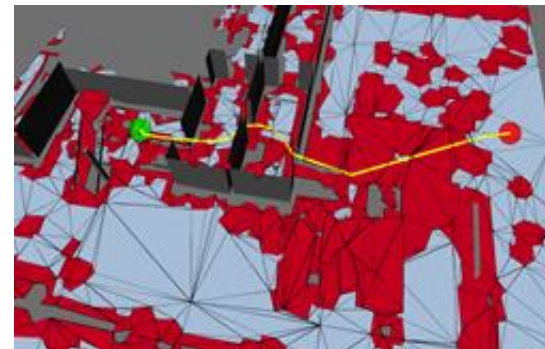
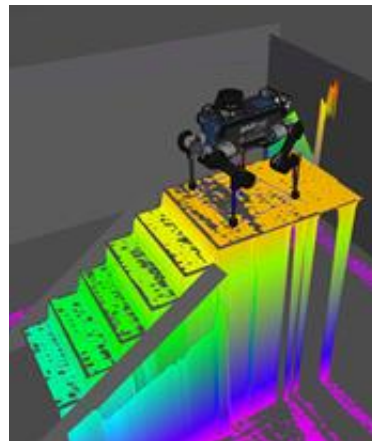
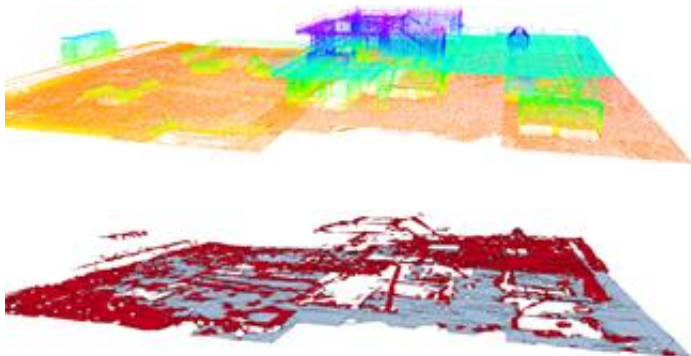
Point Cloud



Mesh



Navigation



# Autonomy



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OXFORD





# Obstacles

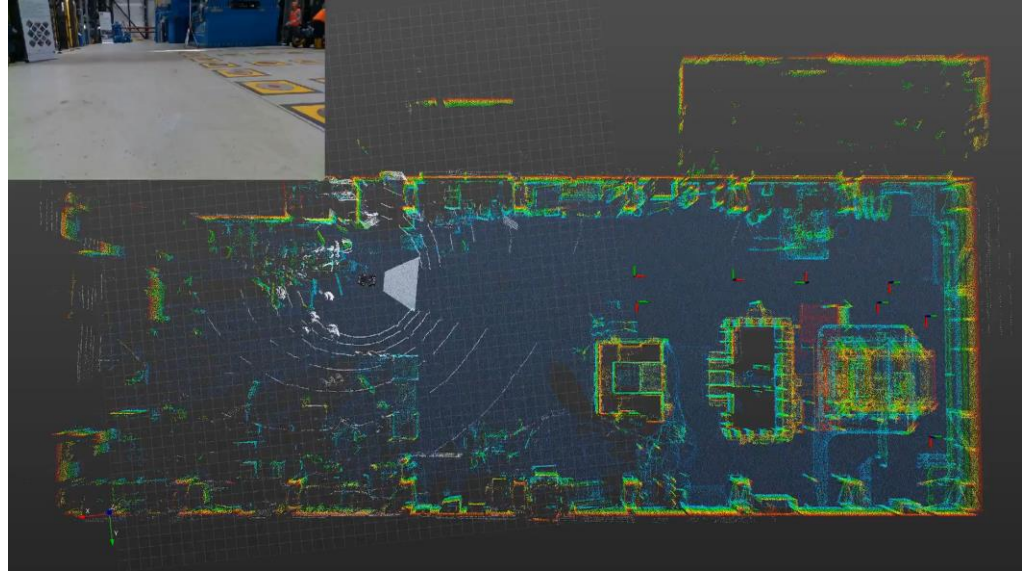


*"ANYmal in the Field: Solving Industrial Inspection of an Offshore HVDC Platform with a Quadrupedal Robot," C. Gehring, P. Fankhauser, L. Isler, R. Diethelm, S. Bachmann, M. Potz, L. Gerstenberg and M. Hutter.*



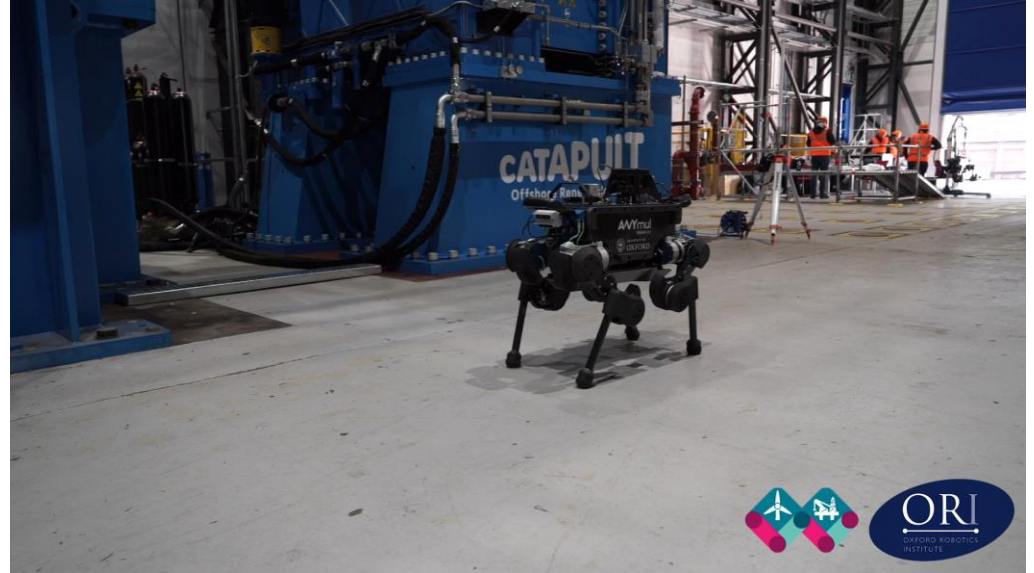


# Monitoring



- Offshore Renewable Energy Catapult, Blyth, October 2019.





- Offshore Renewable Energy Catapult, Blyth, October 2019.





**INDUSTRIAL  
STRATEGY**



**UK Research  
and Innovation**



**Engineering and  
Physical Sciences  
Research Council**

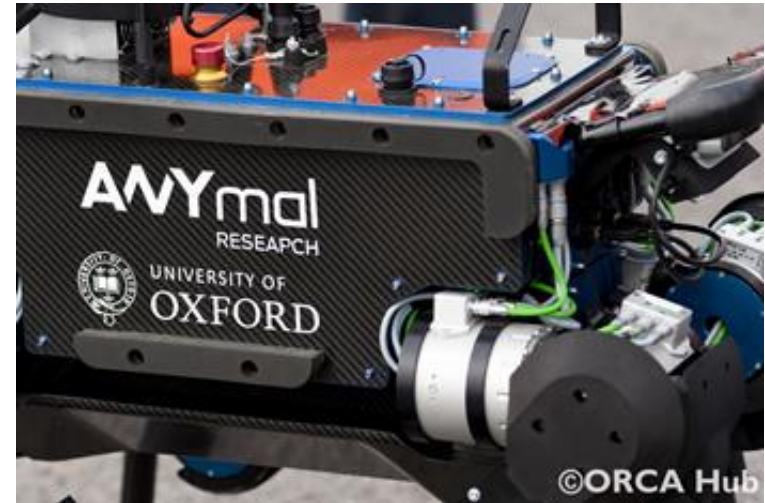


**Innovate  
UK**



**European  
Commission**

Horizon 2020  
European Union funding  
for Research & Innovation



..thank you for you attention!

**Questions?**



## → How to apply (1/2)

1. Register by completing online questionnaire on [ESA-STAR Registration](https://esastar-emr.sso.esa.int) (minimum 'light registration')  
(<https://esastar-emr.sso.esa.int>)
2. Download the official tender documentation (Invitation to Tender) via EMITS 'AO 1-10390' from [3rd June 2020](#)
3. Create 'Bidder Restricted Area' in ESA-STAR
4. Write your proposal and obtain Letter of Authorization from National Delegation, if needed.
5. Submit your proposal via 'Bidder Restricted Area' in ESA-STAR Tendering by [15th July 2020 13:00 CET](#) (Don't wait until the last minute!)

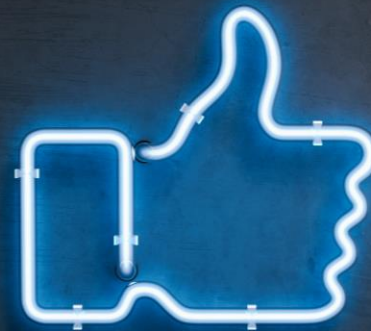




## → How to apply (2/2)

The Letter of Invitation to Call for Proposals is issued on EMITS (<http://emits.sso.esa.int/emits/owa/emits.main>) under 'AO 1-10390' and includes:

- Cover letter
- Appendix 1:  
List of Thematic Calls for Ideas (including the calendar of the Thematic Call for Ideas and specific information on the themes)
- Appendix 2:  
Draft Contract
- Appendix 3:  
Tendering Conditions for Express Procurement Procedure - EXPRO/TC
- Appendix 4:  
Proposal Template







## → Authorisation from National Delegations

- The **authorization from National Delegation** for the specific Thematic Call against which you submit your Proposal is an admissibility criterion. Proposals not authorized at the closing date of the Thematic Call will not be admitted for evaluation
- For each individual Thematic Call, **dedicated clarifications will be posted in EMITS** to provide information on the list of Member States that have already provided their pre-authorization to the Thematic Call
- In case your company/organisation resides in a country which has not provided a pre-authorization to the Thematic Call you are interested in, you need to contact your National Delegation. The contact information of the National Delegations can be found at <https://business.esa.int/national-delegations>

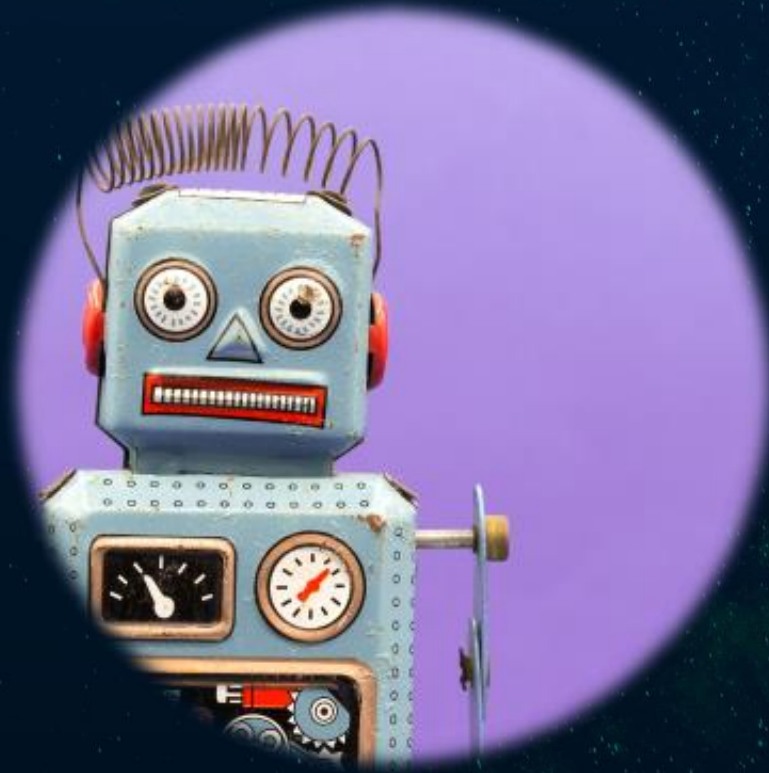
## → Proposal template

Your Proposal shall include the following information:

1. Executive Summary (max 1 page)
2. Business Potential (max 5 pages)
3. Technical Concept (max 5 pages)
4. Team and Resources (max 3 pages)
5. Management (max 4 pages)
6. Financials (max 2 pages)



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# Thank you!

→ Questions?

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**Invited speaker** Dr Ioannis Havoutis, Oxford Robotics Institute

## BUSINESS APPLICATIONS

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