H2020-ICT-25-2016-2017

HYbrid FLying rollIng with-snakE-aRm robot for contact inSpection

HYFLIERS

D8.1

HYFLIERS Project Presentation

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Abstract:

This deliverables presents the project outlining its objective, motivation, implementation and expected results.

Keywords:

Cost efficiency. Hybrid robot. Ground support platform. Horizon 2020. ICT. Inspection. Oil and gas industry. Pipe corrosion. Prototyping. Robotic arm. Robotic system. Safety. Flying vehicle stability. Ultrasonic sensors. Ultrasonic thickness measurements.

Executive summary

HYFLIERS is a research and innovation action (RIA) of EU Horizon 2020 programme for advanced robot capabilities research and take-up, worth 3,9 million euro funding.

HYFLIERS will develop the world's first industrial integrated robot with hybrid air and ground mobility with a long-reach hyper-redundant manipulator capable of reaching sites where no other robot can access, reducing the exposition of human inspectors to potentially dangerous working conditions. Targeting ultrasonic thickness measurements for oil and gas refineries and chemical plants, the results could be applied to many other robotic inspection technologies.

The consortium is composed of eight partners from Finland, Spain, Italy, France and Switzerland, including high reputation universities, research institutes, industrial partners with research and innovation development capabilities, and two world leader oil and gas industrial companies.

Abbreviations

ctrl	control
HYFLIERS	Hybrid flying rolling with-snake-arm robot for contact inspection
nav	navigation
NDT	non-destructive testing
OpEx	operating expenditures
teleop	teleoperation
UT	ultrasonic sensing

Table of Contents

1. Overview

HYFLIERS is a research and innovation action (RIA) of EU Horizon 2020 programme for advanced robot capabilities research and take-up, worth 3,9 million euro funding.

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1.1. Objective

Focusing on non-destructive contact measurements but with potential application to a wider set of industrial scenarios, the scope of HYFLIERS project is to study and develop solutions to perform inspection measurements with reduced exposure to risks and costs. To this end, the first accurate controlled hybrid aerial-ground robot with a hyper-redundant lightweight robotic articulated arm equipped with an inspection sensor will be developed together with supporting services for efficient and safe navigation in complex and safety-critical environments.

1.2. Motivation

In oil and gas production plants, all or part of the components are often subject to degradation caused by exposure to the environment or products within the production process. Excessive pipe corrosion may lead to accidents, including catastrophic failures with explosions and release of toxic products, thus having impact on safety, environment and availability of the plant.

Inspection processes for thickness measurements ensure that plants are in safe operating condition or provide alerts to execute necessary corrective actions. These measurements are traditionally executed by personnel that requires access to specific locations. Typically, more than 50% (and up to 90%) of these activities are carried out by working at elevated locations with the use of ladders, scaffold, rope access or cranes, and sometimes in presence of high temperatures or toxic materials. Obviously, this causes considerable costs for ensuring safety of inspection personnel but in some cases, casualties may occur. Moreover, anxiety and exposure to dangerous locations affects concentration and promote human errors.

There are safety, quality and cost drivers for novel inspection methods.

1.3. Implementation

HYFLIERS will address the above objectives by studying, designing, developing and testing a robotic system including prototypes for the first worldwide hybrid aerial/ground robot with a hyper-redundant lightweight robotic articulated arm equipped with an inspection sensing sub-system and a ground support unit for efficient and safe inspection in industrial sites.

The robot will be equipped with interfaces for teleoperation, but it will also possess automatic collision detection and avoidance. This will ensure accurate positioning, guidance, landing and rolling on constrained surfaces, such as pipes. The control system also integrating environment perception

and aerodynamic control will moreover include a mission planning system to optimise the use of the robot in the inspection and therefore bringing energy savings.

1.4. Expected impact

HYFLIERS will decrease the cost and risks of current human inspection in production plants. The technology results will be validated in the inspection of pipes, which is a very relevant short-term application, but the results of the project could be also applied to other industrial scenarios, such as power generation plants.

2. Consortium

The HYFLIERS consortium is made of the partners described in Table 1.

Table 1. The HYFLIERS consortium.

Partner	**Country**	**web-site**
University of Oulu (coordinator)	Finland	www.oulu.fi www.oulu.fi/bisg
University of Seville	Spain	www.us.es grvc.us.es
Chevron Oronite	France	www.oronite.com
Total	France	www.total.com
Consorzio di Ricerca per l'Energia e le Tecnologie dell'Elettromagnetismo C.R.E.A.T.E.	Italy	www.create.unina.it www.prisma.unina.it/
Advanced Center for Aerospace Technologies FADA-CATEC	Spain	www.catec.aero
General Electric Inspection Robotics	Switzerland	inspection-robotics.com
Dasel sistemas	Spain	www.daselsistemas.com

3. Appendix: HYFLIERS presentation poster

Additional details are provided by the poster for the presentation of the HYFLIERS project, see below.

hyfliers-project.eu

HYFLIERS

HYBRID FLYING-ROLLING WITH-SNAKE-ARM ROBOT FOR CONTACT INSPECTION

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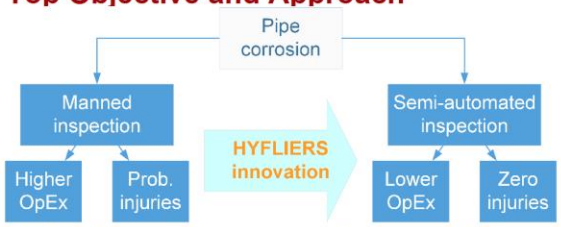
Use Case: Inspection Measurements

Oil plants: large number of pipes, subject to **atmospheric and processing elements**, causing **corrosion**.

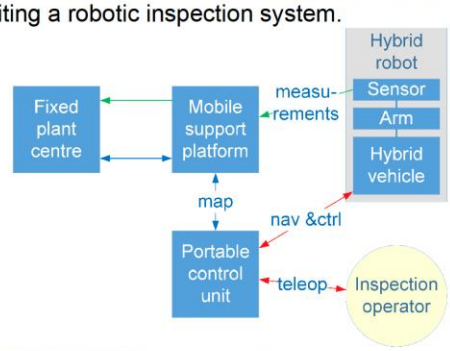
An example petrochemical processing plant. Grangemouth, Scotland. CC Public Domain. Source: pxhere.com.

Ultrasound thickness measurements: **dangerous and costly** when carried by humans (only).

Top Objective and Approach



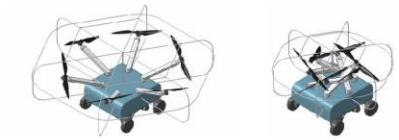
Reduce inspection costs and **improve safety** by exploiting a robotic inspection system.



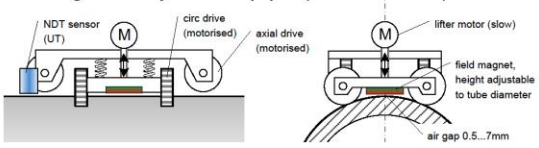
Complete system, including hybrid (flying and rolling) robot with robotic snake-arm, miniaturised ultrasonic sensor and a mobile operation support platform.

Prototype A: Hybrid Mobile Robot

Hybrid robot moves to bring sensor to inspection site.



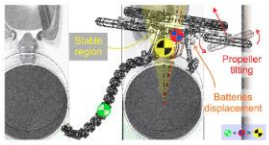
Tilted propellers for improved manoeuvrability plus assisting stability on the pipe (lateral thrust).



Magnetic attraction for stability on pipe, magnetic force modulation (varying air gap) for landing/take-off.

Prototype B: Hybrid Robot with Arm

Arm brings sensor on end effector to inspection site.



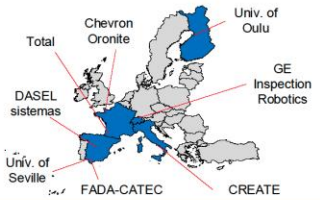
Stability on pipe by propeller tilting and moving system's centre of gravity (incl. batteries displacement).

Operation Support System

Navigation support, battery recharge and couplant refill, data communication and processing.

Consortium

8 partners
5 countries
4 years (2018-2021)
3,9 MEUR



University of Oulu	University of Seville	Chevron Oronite	Total	Consorzio CREATE	FADA-CATEC	General Electric Inspection Robotics	Dasel Sistemas
Finland	Spain	France	France	Italy	Spain	Switzerland	Spain
www.oulu.fi www.oulu.fi/bisg	www.us.es grvc.us.es	www.oronite.com	www.total.com	www.create.unina.it www.prisma.unina.it	www.catec.aero	inspection-robotics.com	www.daselsistemas.com