TECNALIA · **ADVANCED MANUFACTURING**

PARALLEL CABLE ROBOTICS

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BEST SOLUTION FOR **OPTIMIZING OPERATIONS IN LARGE SPACES**

PARALLEL CABLE-DRIVEN ROBOTICS PROVIDES THE **BEST COST EFFECTIVE SOLUTION, AUTOMATED AND MANUALLY CONTROLLED**, OVER LARGE OR VERY LARGE WORKSPACES.

CRANEBOT developed by TECNALIA & CEMVISA VICINAY

BIG SPACES **CHALLENGE:**

Automation of operations is one of the biggest challenges to optimize operability. Due to limitations such as the reduced workspace of commercial robots, or high cost of large Gantry robots, manipulation over large workspaces is still done with traditional manual cranes.

Parallel cable-driven robotics provides the best cost effective solution, automated and manually controlled, over large or very large workspaces. They are able to position any kind of tooling or another anthropomorphic robot, accurately in a along a wide workspace withstanding external loads just by using cables.

They are:

- **Highly flexible.** They can manage 6 degrees of freedom, or even more if another robotic system is used on the platform.
- **Easily installed,** with no major construction modifications.
- **Highly productive.** Their response time is low and can move around at a high speed.
- **Versatile and multi-tasking,** as can be used in complex manipulation tasks in multiple sectors (for horizontal and vertical works).
- **Low maintenance consumers.**
- **Low space users.** Columns are placed in corners, and the rest of the system does not need floor space.
- **No swinging of the load:** Parts firmly held by 8 cables coming from different directions.
- **Highly modular.** They can be mounted on a fixed structure or on a double bridge crane.

COGIRO developed by TECNALIA & CNRS-LIRMM

Parallel cable-driven robotics **opens enlarged business perspectives in multiple sectors with a wide range of applications.**

PARALLEL CABLE ROBOTICS **TECHNOLOGY:**

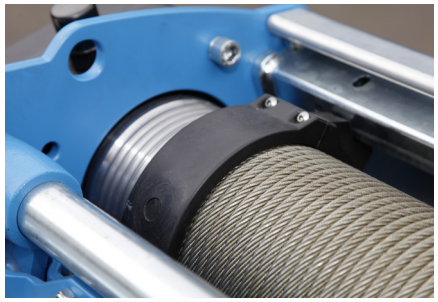
A cable-driven parallel robot is mainly composed of:

- Winches (motor + encoder + drum)
- Cables
- Pulleys
- Platform (anchoring of cables and tool)
- Controller and drives

The **pulleys** permit the routing of the cable from the winch to the desired output point. They can be directly fixed on the building or on a dedicated frame.

The lengths of the **cables** are synchronously controlled in order to provide the desired motion of the **platform** in the Cartesian space.

The implemented model on the **controller** takes into account the exact cable routing, sagging and elongation for a better positioning accuracy.



Final users

- **Naval construction and renewable energy:** Production of large and heavy metallic parts and structures, notably involving welding, sand-blasting, painting, inspection and deconstruction
- **Aeronautics industry:** Measurement, inspection, stripping and/or painting tasks
- **Nuclear industry:** Handling of material and equipment, maintenance, inspection, monitoring in radioactive areas, disassembling of nuclear plants
- **Civil engineering:** Monitoring, maintenance, 3D printing, automated assembly, repair and maintenance of facades panels
- **Logistics industry:** Quick pallet manipulation and storage in automated mode
- **Material handling equipment industry:** Manipulation positioning and assembling of large parts, in a precise way and with a complete control of part orientation (6 dof)

PARALLEL CABLE ROBOTICS PROVIDE **HIGHLY FLEXIBLE AND VERSATILE AUTOMATED SOLUTIONS** FOR OPTIMIZING OPERATIONS IN LARGE SPACES

CABLE ROBOTICS **APPLICATIONS:**

Automated assembly of large parts controlling the rotations

Manually controlled cable driven robot by one person, performing assembly operations

→ Manipulation, assembling and maintenance of large parts and systems

Manipulation, positioning and assembling of large parts, in a precise way (+/-2 mm) and with complete control of part orientation (6 dof)

Operation mode: Manual

→ Automated logistic operations

Quick pallet manipulation and storage in automated mode.

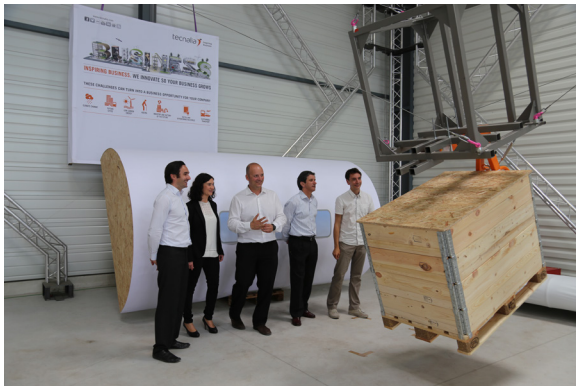
Transport loads up to 500 Kg. with present prototype.

Very high speed.

Can perform unmanned operations.

Collision control and error detection.

Operation mode: Automated and manual



Cable-driven robots in automated logistic operations

→ Inspection and maintenance

Fast movement along large spaces with platforms and/or camera, incorporating specific tooling and repairing materials.

It can perform operations in highly risky confined spaces.

Operation mode: Automated and manual

→ Operations on big surfaces: painting and welding

Automated painting of large surfaces (planar of curved ones), with maximum accuracy.

In the same way, other operations as welding large parts are also available.

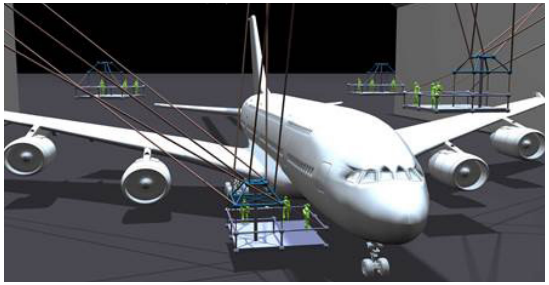
Operation mode: Automated

→ Automated operations in facades:

Cleaning, inspection, maintenance, construction works.

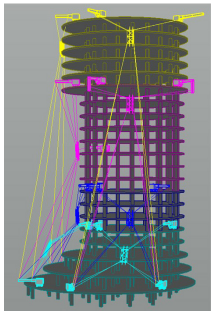
All facade positions reachable with 8 winches.

Variable surface geometry.



Cable-driven robot for inspection and maintenance of big components

Painting on a curved surface with a robot arm mounted on the cable-driven robot's mobile platform



HEPHAESTUS Project
732513- H2020- ICT 2016-2017

Thanks to the Cable-Driven Robots it is possible to fully **control the 3 displacement and 3 rotations** of the part to be handled, **avoid the swinging** of the load and **place it with accuracy**.

- **Automation of processes in large parts:**

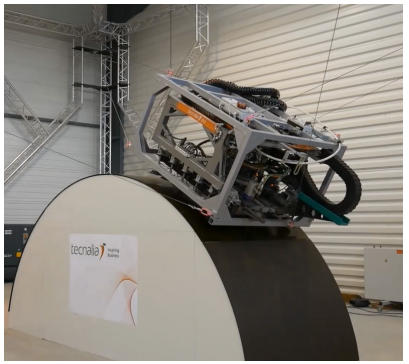
  Handling and positioning of end-effectors in large structures for multiple tasks (drilling, riveting, sealing, inspection...).

  All rotations are controlled and can be combined.

  Fits any position in the designated area.

  Fine trajectory tracking.

  The end-effector is clamped to the fuselage with vacuum cups and then, the drilling and riveting process can begin.



CABLE-DRIVEN ROBOT TECHNOLOGY **BENEFITS:**

- Improve the **working conditions**
- Guarantee the **safety in the handling**
- **Accuracy in the movements**
- **Avoid the swinging** of the parts during handling
- **Reduce** the **setting time** after movements
- **Increase** the **productivity** by 50%
- **Reduce** the **cycle times** by 50%
- **Reduce work accidents** by 50%

3D PRINTING OF LARGE SCALE CONSTRUCTION PARTS & SMALL SCALE BUILDINGS USING COGIRO

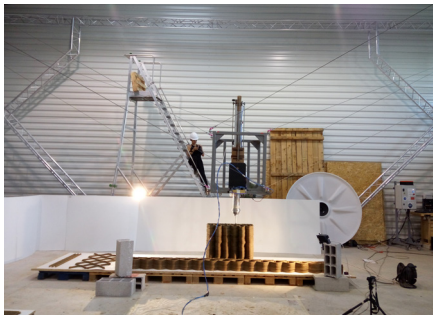
Developed under The On-Site Robotics Project in collaboration with IAAC

The 3D printing system includes:

Cable robot COGIRO with an integrated CNC control, which is able to automate the movement of the 3D extruder withprecision. Thanks to the use of cables operated by servo-controlled winches with easy assembly, maintenance and reconfiguration, the printing can happen in a very wide range of workspaces, and even directly on the construction site.

An extruder and a natural, biodegradable, recyclable and local clay-based extrusion material, based on the Pylos project.

A custom script integrated in the CAD software allows to easily translate the complex forms of 3D design in the robotic trajectories.



Institute for advanced architecture of Catalonia

COGIRO: A CABLE DRIVEN ROBOT MOUNTED ON A FIXED STRUCTURE

Developed by TECNALIA & CNRS-LIRMM

Characteristics:

Footprint: 15*11*6 m^3. **Workspace** up to 80% of the footprint.

Payload: 500kg. 4 mm diameter steel cables.

Industrial controller: B&R Automation.

Mean positioning **accuracy**: 20 mm.
Mean positioning **repeatability**: 3mm.

Crane-like configuration: all its cable drawing points are located above its workspace, gravity being used to keep the cables taut. No cable clutters the lower part of the workspace to avoid cable collisions.

Robot calibration improved (required to achieve as high accuracy as possible).

Advanced robot control algorithms implemented.

Programming of trajectories in a **CNC module**.

Robotic arm mounted on the cable robot to perform **dexterous tasks over wide workspaces**.

COGIRO & CABLECRANE: Smart Solutions Based on **Cable Driven Robot Technology**

LIRMM

cnrs

CRANEBOT: FLEXIBLE ROBOTIC CRANE

Developed by TECNALIA & CEMVISA VICINAY

Cable Robotics Technology:

Fully control in position and orientation of the load while it is being manipulated (6 degree of freedom controlled).

Precision load handling and movement without oscillations in any direction and in any orientation.

Automation of operations throughout the production plant.

Enhance plant **safety**.

Increase the **productivity**.

An Innovative Patented Machinery:

Power provided by the traditional gantry crane.

Control provided by the cable driven robot technology.

Flexible and **versatile** product suitable for multiple tasks in multiple sectors.

Hoist of the **crane** works in **synchronization** with the **cable robot** and withstand most of the payload.

Novel solution patented for optimizing operations in large spaces that sum the **advantages of smart cranes and parallel cable robotics**

Industrial Controller: B&R Automation

Programming of trajectories in a CNC module.

Programming of movements point to point.

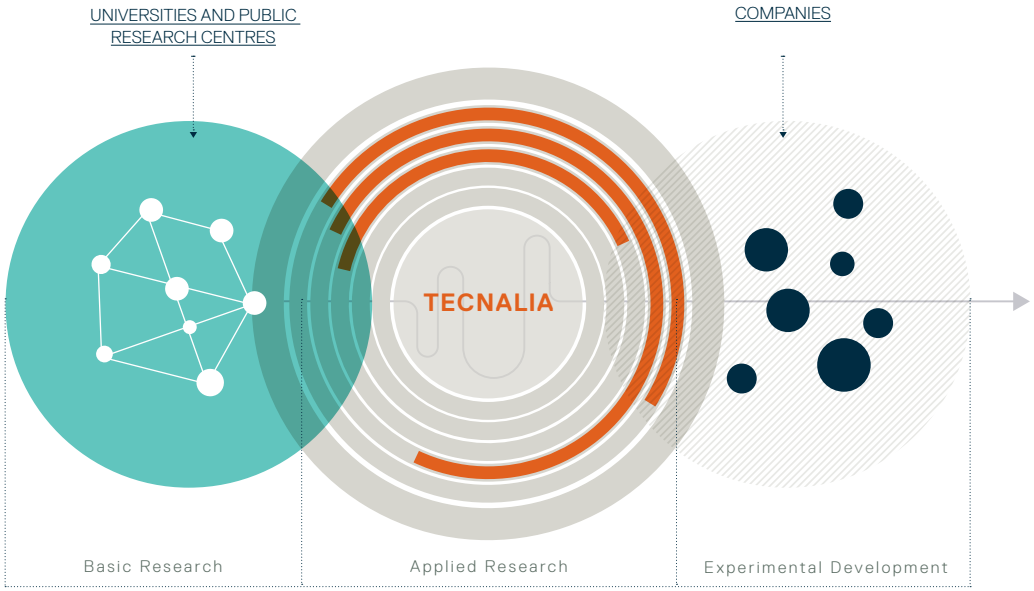
Operation Modes:

Automated operation mode.

Manual operation mode via remote controller.

VICINAY Cemvisa

TECNALIA
IS A RESEARCH AND TECHNOLOGICAL DEVELOPMENT CENTRE



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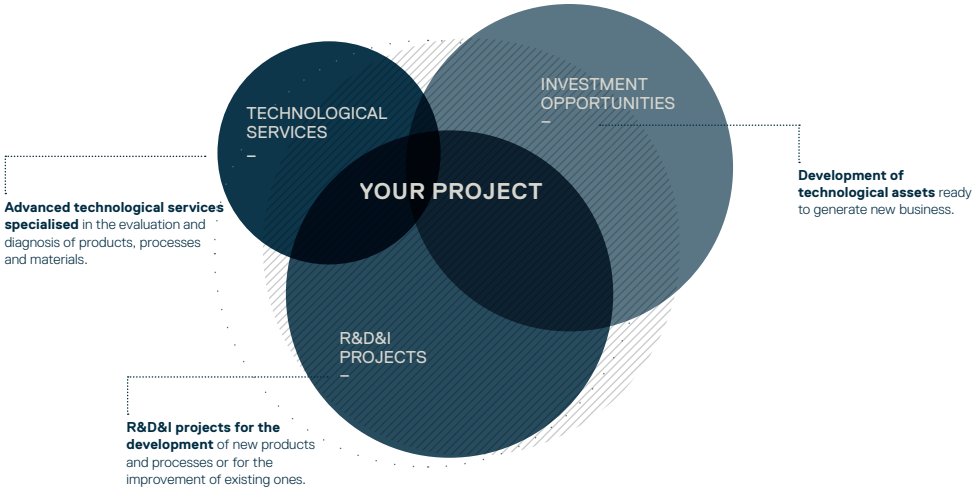
TO MARKET

MISSION

We transform technology into **GDP**

We transform technology into wealth to obtain beneficial visible results for companies, society, our environment and in short, for people.

SERVICE **OFFER**



Advanced technological services specialised in the evaluation and diagnosis of products, processes and materials.

Development of technological assets ready to generate new business.

R&D&I projects for the development of new products and processes or for the improvement of existing ones.

WE CAN DO SO MUCH **TOGETHER**

Our work cannot be understood without yours; we would like to work together so your company can compete better. Because together, we can develop technologies which will transform the present.

The future is technological, let's share it!

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