COROMA

Cognitively enhanced robot for flexible manufacturing of metal and composite parts

PRESS RELEASE

Intelligent, flexible and safe robots for a more competitive manufacturing industry

- **The COROMA European project, seeks to develop a new robot concept with capacity to carry out multiple industrial tasks autonomously**
- **The initiative, that got underway at the end of 2016, has the participation of a consortium of 16 international partners, a budget of €7 million and will last for three years.**
- **The project will develop three robotic applications geared towards the manufacture of metal and composite material parts capable of interacting both with humans and other machines**
- **One of the COROMA objectives is to contribute to the technological development of robotics in Europe, a key discipline for the progress of Industry 4.0.**

Introduction

Advances in the scientific and technological development of robotics is one of the mainstays of industry 4.0 and constitutes one of the priority lines of action established by the European Commission for driving the competitiveness of industry in Europe.

The COROMA (Cognitively Enhanced Robot For Flexible Manufacturing of Metal and Composite Parts) European project, an initiative coordinated by the IK4-IDEKO technology center, is being developed within this context and seeks to develop a new intelligent, modular and flexible industrial robot concept with the capability to carry out multiple processes and manufacture of metal and composite material parts for sectors as demanding as aeronautics, shipbuilding and energy generation.

COROMA has a budget of more than €7 million, of which 6 have been funded by the European Commission through the program to boost research and innovation, Factories of the Future, within the Horizon 2020 multiannual framework.

The consortium has the mission to develop a modular robotic system that will carry out numerous manufacturing tasks that are adapted to production requirements. Specifically, the new system will carry out tasks such as drilling, trimming, deburring, polishing, sanding, non-destructive inspections and could even be used as a moving support for the manufactured parts themselves.

To achieve this, the system will be equipped with a simple interface for the robots to receive basic commands that require minimum programming effort by the human operator. The technical

team will work to ensure that the design will allow quick programming through the human-robot interface.

The control system will also be optimised so that the robotic system is aware and reactive to the process condition.

The modularity of the COROMA robotic system allows it to be adapted to the specific requirements of different manufacturing companies.

The initiative, which began at the end of last year and will conclude in October 2019, has the participation of a total of 16 companies, research centers and universities, as well as a standardization body from seven different countries.

Guaranteed safety

One of COROMA's top priorities is safety. The project team will work to equip the new robotic systems with cognitive abilities that will enable them to interact safely both with humans and other machines.

The robots will navigate autonomously through the workshop, automatically perceiving the coordinates of the manufacturing environment, they will locate the part that must be worked on and will even be capable of handling some of the necessary tools. Furthermore, the system will be configured in such a way that it can increase its own performance by learning from previous experiences such as movements, tool clamping, the location of parts and the manufacturing processes.

The new robot concept will be of a collaborative nature and will be able to interact with other machines, so it will be possible to work on one workpiece while other machines located in the same manufacturing environment carry out other actions.

The safety of the manufacturing environment is achieved through the robot's ability to react automatically in the presence of human beings or other machines.

A single project with diversified aims

The COROMA project has several objectives, among which are the strengthening of the global position of European manufacturing industry and contributing to technological development in the manufacturing and robotics field.

1.- Towards the creation of collaborative robot-machine environments

One of the main goals of this project is to facilitate collaboration between robots and machine tools or non-cognitive robots. This will bring new market opportunities to the robotics industry, to the machine-tool industry and to the industrial manufacturers that use a new generation of robotic production units.

2.- Positive impact for robot manufacturers

The project will have a positive impact on the global market share of European robot manufacturers (currently 32%), by providing additional support that may make their product ranges more competitive.

Moreover, the initiative could result in a 20% reduction of setup costs of new production processes or re-setting between two sequential processes, thus increasing their efficiency.

3.- Boosting the implementation of robotics in component manufacturers

The project also has the purpose of boosting the implementation of robotics in companies that specialise in the manufacture of metal and composite material components for sectors such as aeronautics, light boatbuilding and energy generation.

To achieve these objectives, the initiative is supported by the proven experience of the participating entities in manufacturing technologies and in the field of robotics, as this project merges the two disciplines.

The COROMA project scientific coordinator, Asier Barrios, makes it clear that this initiative is focused on the application of already mature technologies.

“It is a research and innovation project. We start from a technology base that is already mature and consists of equipping the intelligent robots with sensors and algorithms so that they can understand the manufacturing processes in which they are going to work” added Barrios.

Specifically, the developed prototypes must be able to carry out drilling, trimming, deburring, polishing, sanding and non-destructive inspection tasks.

Furthermore, they will be able to operate as a moving support tool to eliminate vibrations that occur during the machining processes of parts used in the aeronautic sector, these tend to be very thin and are more sensitive to vibrations produced during their manufacture.

Exceeding the current paradigm

Currently, industrial robots are widely used in repetitive manufacturing operations. The car industry, the first and biggest user of industrial robots in the world, is a prime example of this situation. The robots are used in various positions throughout the vehicle production chain, but there is a limited flexibility with respect to the possible uses of each robot, as these units have been designed to carry out a particular task in the optimal way.

European manufacturing companies that offer new and numerous products attempt to react quickly to market changes and they face a series of limitations with current industrial robots:

- Time consumed in the installation of the robotic cell for the new operation or product.
- Inability to learn. Robots specialise in repeating programmed operations, but, in contrast to human workers, they do not learn from previous experiences.
- Limited mobility. The great majority of industrial robots are located in static workstations.
- Safety requirements. The majority of industrial robots operate in segregated environments, away from human workers.

- Specific process tools. When different manufacturing operations are required for a robot, special tools and tool changers are needed which add additional costs and greater complexity to the use of robots for manufacture.

In this context, the mission of the COROMA project is to design a new robotic concept that allows current limitations to be overcome and so progress towards a new paradigm.

A modular system

The companies participating in COROMA have the mission to construct flexible prototypes that can carry out up to six different tasks, and to achieve this highly modular robots must be designed.

The project will develop seven modules that can also be used to improve the performance of already existing robotic systems. For this reason, the COROMA modular platform is an innovative development in itself.

One of the modules planned in the initiative will equip the robot with process awareness (CORO-OPTIM). That is, the robots will be capable of detecting vibrations during drilling in order to take a particular measure or check tool wear if a sanding operation is being carried out.

The second module (CORO-MOB) provides the robot with mobility so it can move autonomously through the workshop where it is working.

The experts are also working on a safety module (CORO-SAFE) with an artificial vision system so that the robots can detect the presence of humans and make way.

In addition, a cooperation module will be designed (CORO-COOP) focused on providing developments for a communication platform so that the robot can interact with other machines and robots.

“This is so that the robot can “talk” to machine tools and other robots”, added Barrios.

The robots will also have a sense of vision for which a vision module (CORO-SENSE) will be implemented by means of camera systems and laser technology, so that they can understand their environment and find the part on which they must work.

So that the robot responds to operator instructions, a programming module will be created (CORO-PROG) that will make it possible for the robot to respond to visual instructions in a simple way. To achieve this, the system will be equipped with a simple interface that will require a minimum programming effort by the human operator.

It also has an extremity or robotic hand (CORO-HAND), so it can pick up various tools and provide the system with dexterity.

Within the project framework, new examples for use will be demonstrated and made possible by the intelligent combination of modules. For example, an autonomous robot (CORO-MOB) with 3-D vision capability (CORO-SENSE) could be used for monitoring and maintenance tasks in a nuclear power station. This is an important demonstration because in the industrial scenarios defined for the project, experiences of this type have not been put into operation until now.

The project will demonstrate how the function block programming (CORO-PROG) can reduce the time necessary for programming new tasks and how adaptive computation can reduce the time robots take to learn new pitfalls (CORO-MOB).

Three prototypes for three scenarios

The COROMA project foresees the development of three different robotic systems for each one of the sectors at which the developments are aimed: shipbuilding, energy and aeronautics.

The three prototypes will be trialled and undergo complex tests, and will be validated by the specialist partners in each one of the industrial sectors.

The company devoted to the manufacture of metal and composite material parts for aircraft, Aciturri, will be responsible for carrying out the aeronautics prototype demonstrations. The Nuclear Equipment company (ENSA) will carry out the robot tests for the energy sector, and the glass fibre boat builder, Beneteau, will be the demonstrator for the marine sector.

IK4-IDEKO will carry out coordination functions and will be the entity responsible for working, together with the other participants, on the machining, polishing and non-destructive inspection processes, as well as monitoring the progress of the demonstrators.

Advantages for the industry

One of the main advantages that the COROMA project offers industry is the opportunity to work with highly flexible robots that can perform highly specialised tasks at the same time.

COROMA is focused on industrial end users and on suppliers of innovative products and services within the new digital manufacturing ecosystem of Industry 4.0.

The project may have a positive impact on employment in the robotics industry, as the manufacture of this new robot concept will require new, different, professional profiles.

Another of the advantages lies in the fact that the COROMA project robotic systems make effective collaboration possible between humans and robots, so that robots can alleviate the most arduous worker tasks and keep them safe.

Specifically, the new concept will allow the automation of tasks important to the final result and visual finish of the parts, such as polishing and sanding. This work has until now been carried out manually and can lead to injury, as they entail very repetitive joint and muscular movements.

Furthermore, European market share in robot production is currently at around 32% and, according to the robotic private public alliance SPARC, it could go down if great innovation efforts are not made in this field. The innovations developed in the COROMA project are designed to support the European commission’s objective to raise the current market share to 35%.

And beyond the benefits that the results could have on increasing industrial competitiveness, the project will contribute to the consolidation and development of a technological and scientific robotics base in Europe, a very important discipline for progress in industrial digitalisation.

Industry 4.0, the new scenario enabled by the application of communication and information technologies in manufacturing environments, is giving rise to the construction of intelligent factories where machines can communicate with each other and with people.

"Intelligent robotics is one of the pillars of this new paradigm, therefore it is strategically important for European industry to progress in this field and develop its own technological base so we will not have to depend on external agents. Robotics is being developed now in several places in the world and it is important that Europe has a technological base that looks to the future" reasons Barrios.

Specialised and international consortium

The COROMA project is being developed by a consortium consisting of 16 companies, research centres and universities from seven different European countries.

Under the leadership of IK4-IDEKO, Aciturri, ENSA and Beneteau will implement the demonstrators. Also taking part in the project are the University of Nantes, the University of Sheffield, The Royal Stockholm Technology Institute, The German Artificial Intelligence Research Centre, the robot manufacturer Stäubli, the companies Convergent Information Technologies, IT+Robotics, BA Systemes, Shadow Robot Company, SORALUCE manufacturer or Milling Machines, Milling-Boring Machines and Machining Centres. and Europe Technologies and the German Institute for Standardization DIN.

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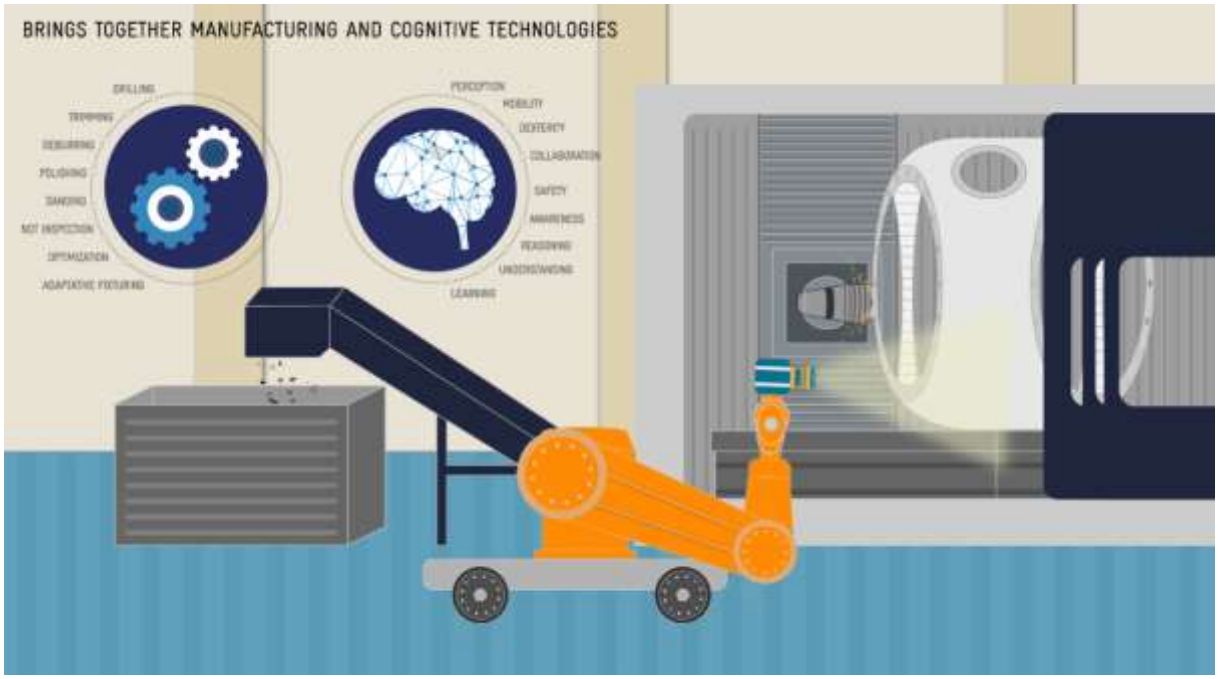
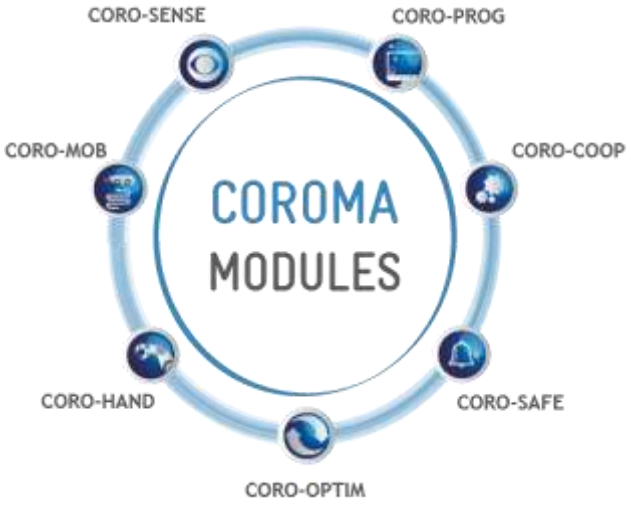
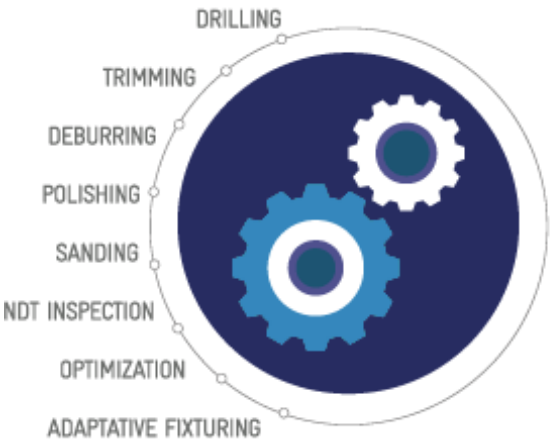
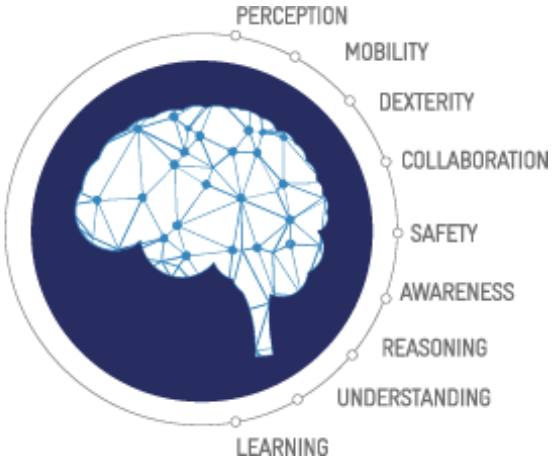
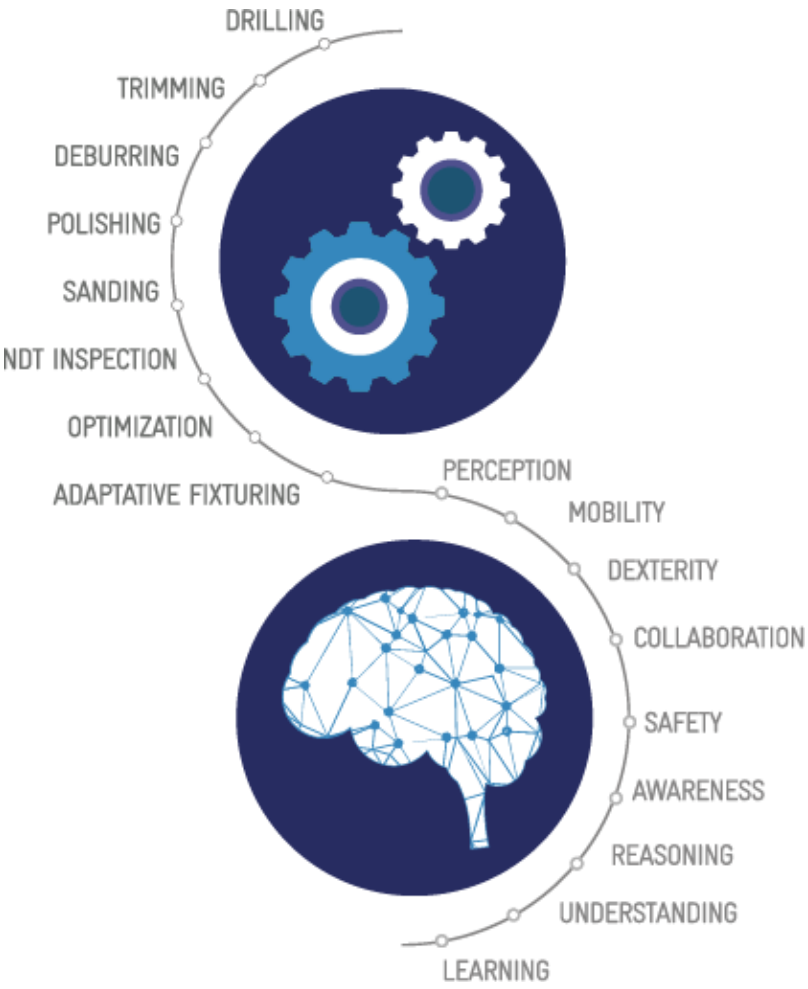


Some Figures:





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