



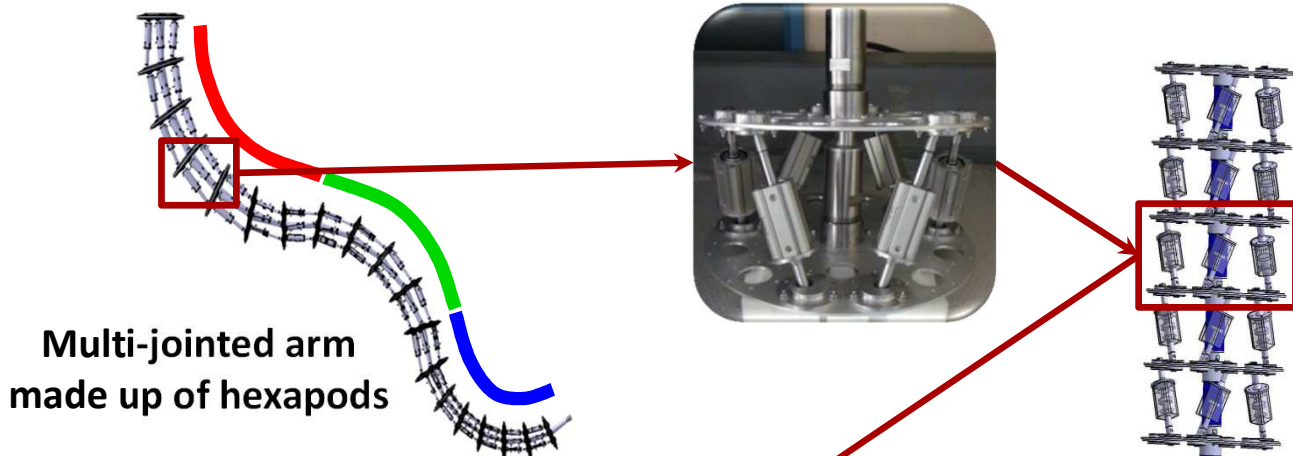
## MULT-JOINTED ROBOTIC ARM MADE UP OF HEXAPODS FOR INTERVENTION IN HOSTILE ENVIRONMENTS OR POINTS OF DIFFICULT ACCESS

### Presentation of the technology

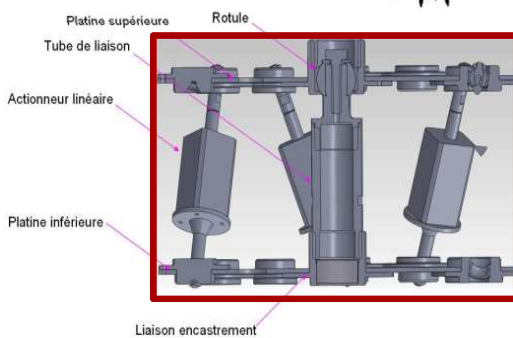
As a device with a structure designed for absorbing thrust, one part of it is anchored onto its first support base and the other, extending into space, is coupled to its second support by a series of rotating ball joint connections.

The system can effectively take shear forces and devote the effort of its actuators to rotary motion.

Each joint thus has its weight and size reduced. Thanks to this particular design feature, the entire structure is of reduced weight.



Multi-jointed arm made up of hexapods



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The arm can be equipped, according to the need, with cameras, a prehensile tool, a machining tool, a laser, a detector...

**Adjustable load capacity** by selecting appropriate actuators and taking into account the number of levels of hexapods.

**Possibility of miniaturization.** The diameter of the current prototype ranges between 600 to 700 mm. but it can be reduced to pass through smaller holes .

**Flexible insulation systems :** the center of rotation of the system is always located in the volume of the system. This enables us to avoid rupturing the sheath.

**Operating environment:** Underwater, high temperature ( 200 ° C), at high pressure ( 2105 Pa).

## Maturity Level

Level of the maturity of the technology (TRL): 3 (Validation per component and/or mockup in a laboratory environment).

The invention has undergone several analytical and numerical calculations as well as complementary performance tests

## Patents

The invention is protected by two French patent applications filed in 2012 ( FR2997887 and FR2997888 ) and several international patent applications filed in 2014.

## Advantages of the technology

- **Robustness and accuracy**
- **Large load capacity**
- **Adjustable Length**
- **Perfect sealing (leaktightness) thanks to its sheath**
- **Easy assembly**
- **Exclusive Feature: the only hexapods that can be aligned one after another in a chain and controlled with perfect precision**

## Value added offer

A license to use this technology on the **French and European Markets**

Associated **know-how**.

**CEA support** in developing this product.

The DEN has expertise and recognized know-how in the design of mechanisms immersed in **specific and / or hostile environments** which enable us to meet your needs

✓ **Design and assessment of multi-jointed mechanisms immersed in hostile environments:**

- Hot and pressurized gases
- Liquid metals

✓ **Sodium Technology**

- Work carried out in a hostile environment (heat, noise, lack of space,..)
- Construction, Installation and Operation of sodium facilities
- Mastery of specific Sodium risks

✓ **Consultancy**

Expertise

✓ **Manpower**

Instrumentation /  
Sodium Equipment :

10 research  
engineers or  
technicians

2 families of patents  
protect the multi-  
jointed robot arm  
made up of reinforced  
hexapods

Key  
figures

DE LA RECHERCHE À L'INDUSTRIE

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They've  
entrusted  
with  
their work



Equipment

**CEA/DEN has considerable testing and development means at their disposal that enable them to validate their clients' technologies:**

- ✓ in **liquid sodium medium**: chemical compatibility,...
- ✓ in **air**: operation and maintenance mechanics, technology verification, functionalities and the development and perfecting of remote controls,...
- ✓ in **water** : underwater mechanical operation , buoyancy-induced effects, overall reaction, leaktightness (sealing) , fluid structure interaction, ..
- ✓ in **temperature (up to 600°C)**: thermomechanical strength, functioning of actuators and of the instrumentation.

## Challenges & Markets

The monitoring , maintenance or dismantling of complex structures in hostile environments usually requires remotely operated means. They must be resistant to strong environmental constraints (temperature and pressure , chemically aggressive environments , radiation ... ) .

In this context, improving the safety of large systems and control risks when working in this type of environment is a real economic and ecological issue for many sectors such as:  
the chemical industry,  
the nuclear industry ,  
underwater research, the off-shore ...

## A major actor in research, development and innovation



The French Commission for Atomic and Alternative Energies relies on the excellence of its fundamental research and provides a supporting role to industry.

The CEA operates over 10 centers throughout France. It develops many partnerships with other research organizations, local authorities and universities.

Recognized as an authority in its field of expertise, the CEA is fully involved in the European area of research and is rapidly asserting a growing international presence .

Concerning the technology presented in this document, and more generally , the technologies for measuring heat transfer and thermal fatigue of materials, the CEA provides industrial **expertise** to analyze their challenges as well as **R & D support to adapt their technologies to suit specific needs.**