PYTHON Robot Arm

PYTHON PRESENTATION

Python is a motorized arm, remotely operated with a full electronic steering, designed to perform many operations on radiating or contaminated elements. Most usual market tools can be adapted onto *Python* gripper to perform specific operations are of such as the cleaning and/or cutting materials, drilling a wall, etc… *Python* is also suitable for the handing of light objects.

The use of rigid mechanical connections for all transmissions of motion gives the *Python* high reliability. Its control is performed by means of a casing provided with two small proportional joysticks which allow to place the teleoperator with *Python* high pre vision in all positions.

Python can be installed in vertical or horizontal position. In the latter case, *Python* can perform over penetration with a maximum deflection.

FEATURES

Python is a manipulator which can control the teleoperator seven movements, which confer an arm a large workspace and high dexterity. Its main advantage is the ability to adapt onto its gripper many usual market tools.

The seven movements are controlled by a control terminal shielded. It consists of a *stop* emergency button and a *mode selection*, two joysticks to control six movements (movements along the two axes of rotation and joystick itself) control buttons for opening and closing the clamp, two command buttons programming. A display screen allows the teleoperator to choose from various functions available and display different messages.

The electronic control allows the use of a *mode level*: the user selects to move the arm end only in a horizontal plane and vertical. This feature allows for example to move remaining always the same distance from a wall, which is very useful for cleaning.

Depending on the needs of the operator, *Python* can be controlled in *slow mode*. The various movements are then two times slower than *normal*. This allows for example the operator to use the *normal mode* to move the arm in the local and the *slow mode* to perform delicate operations requiring high precision, such as cutting a sheet or piercing a wall using a suitable tool.

The user can choose, according to its needs, the gripping force.

Finally, a *maintenance mode* allows access to different information about motion control, allowing the operator to identify the cause of eventual malfunctions.

HANDLING EASE

Handling habituation is relatively simple and quick. The use of proportional joysticks makes the approach very intuitive. The main difficulty is to operate the different controls based on visual feedback transmitted in live from the arm.

You firstly become familiar with *Python* in an environment in which we can directly see the arm move. We learn to handle different objects mass different t the position at a specific location, etc… Then you can learn to fly from the *Python* images from onboard cameras by the arm. The three-dimensional digital interface (presented in section *interfacing with a computer*) allows complete control of the visual approach.

Few hours only to initiate pilot *Python*. In two or three days of handling, the operator is able to use most perfect features of the device and can manipulate various objects with great dexterity.

SPECIFICATIONS

ELECTRONIC CONTROL

The electronic control is achieved with an electronic central unit through seven variators, the seven direct-current motors insure the seven motions. The electronic central unit is connected by a single cable to arm *Python*, and another cable to the remote control box. It can be interfaced with a computer to track the motion of the arm in a virtual environment (*cf.* Paragraph *interface with a computer*).

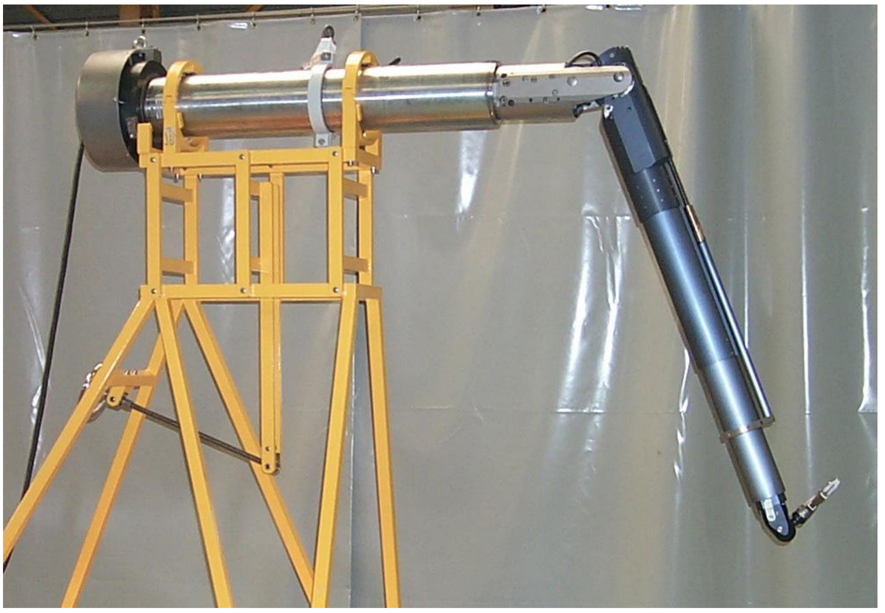
The electronic variators of the electronic central unit were specially developed for *Python*. They are designed and dimensioned to supply motors up to 150W. All motions, except the one for gripper opening & closing, are performed by a control typical proportional.

TECHNICAL SPECIFICATIONS

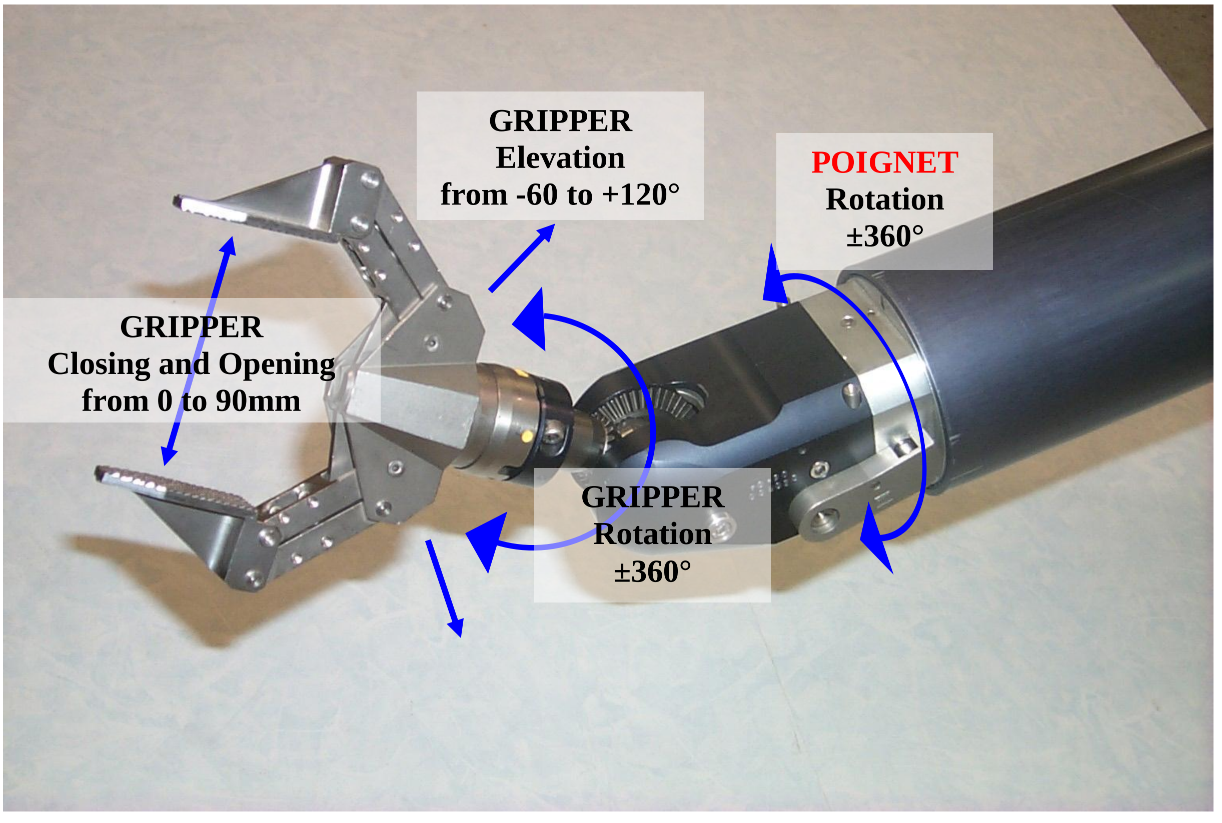
Python is a available in different versions, example of 3 versions :

	Version 2m.30	**Version 3m.30**	**Version 4m.20**
Max. arm	2150 mm	3000 mm	4000 mm
Max. end arm	30 kg	30 kg	20 kg
Wrist rotation	± 360°		
Elevation gripper	+ 115° - 65° (relative to the axis of the arm)		
Rotation gripper	± 360°		
Opening max. gripper	90 mm		
Max. tightening gripper	400 N (adjustable from 30% to 100% in steps of 10%)		
Rotation in the axis of the cross piece	± 270°		
Motion along the axis of the shoulder	+ 20° - 102° (with respect to the horizontal)		

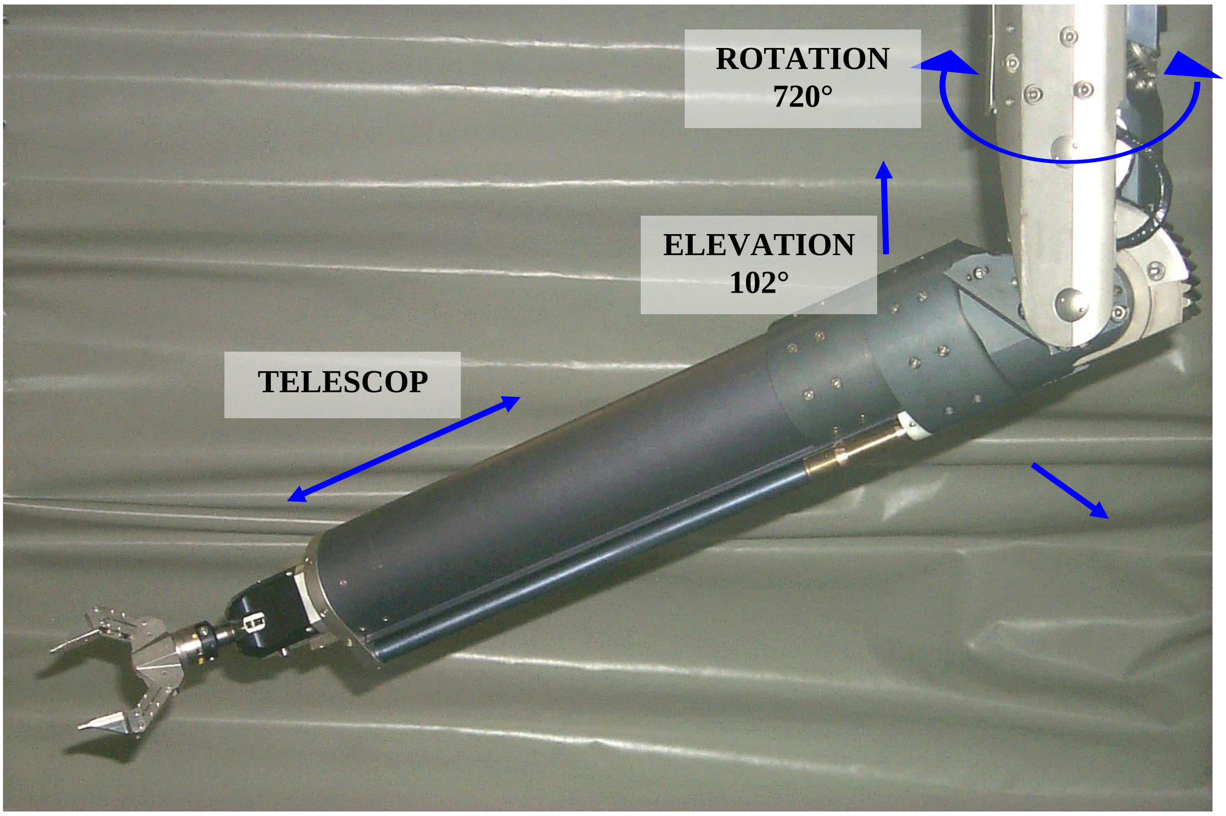
Python on its trolley



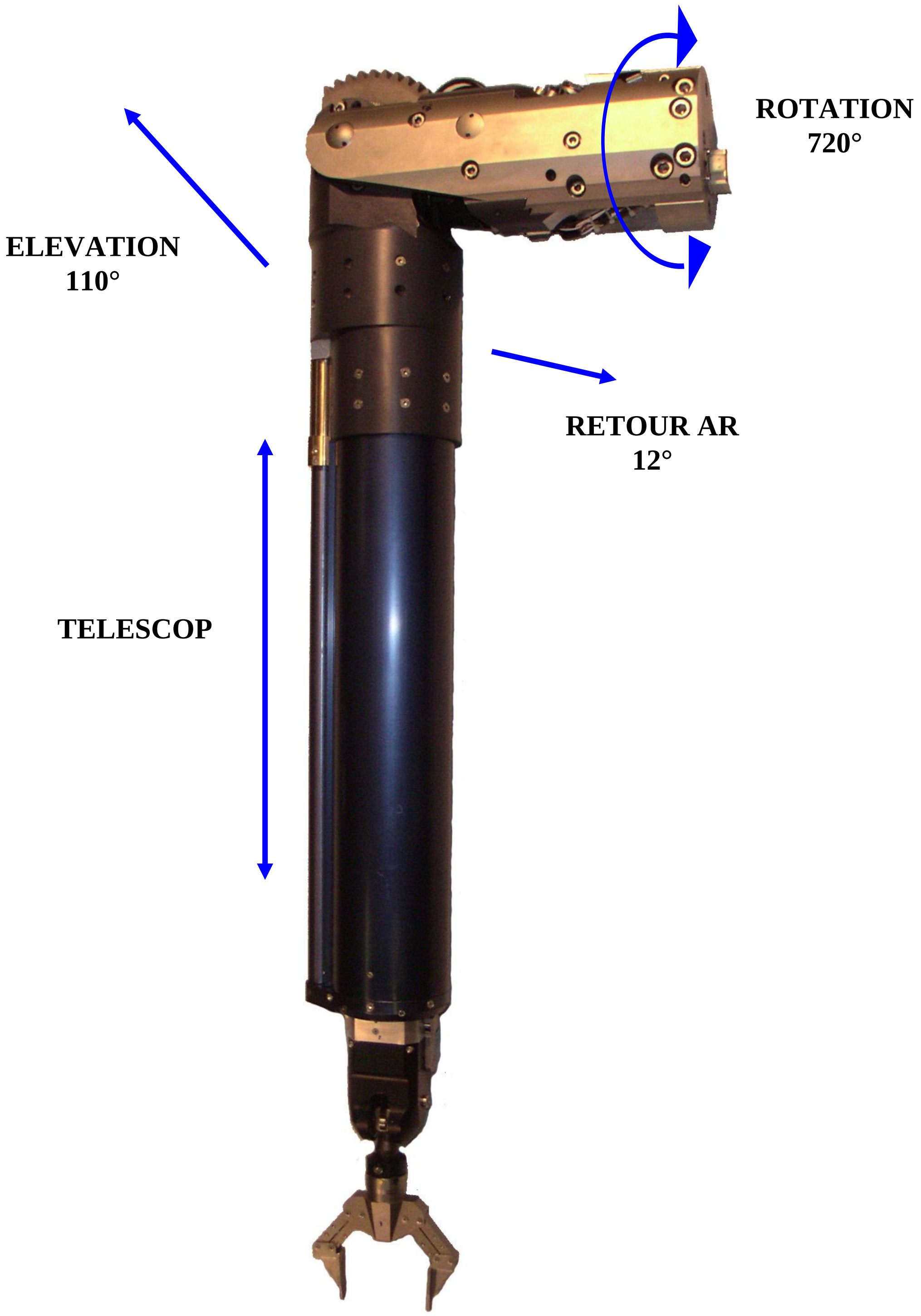
Gripper & Wrist motion



Motions of the shoulder, arm in vertical position



Motions of the shoulder, arm in horizontal position



RADIOLOGICAL PROTECTION

A sealed polyurethane handle helps protect the equipment radiological area. A tight connection of the toggle lev ensures sealing and therefore non-contamination of the arm during the manipulation of objects contaminated.

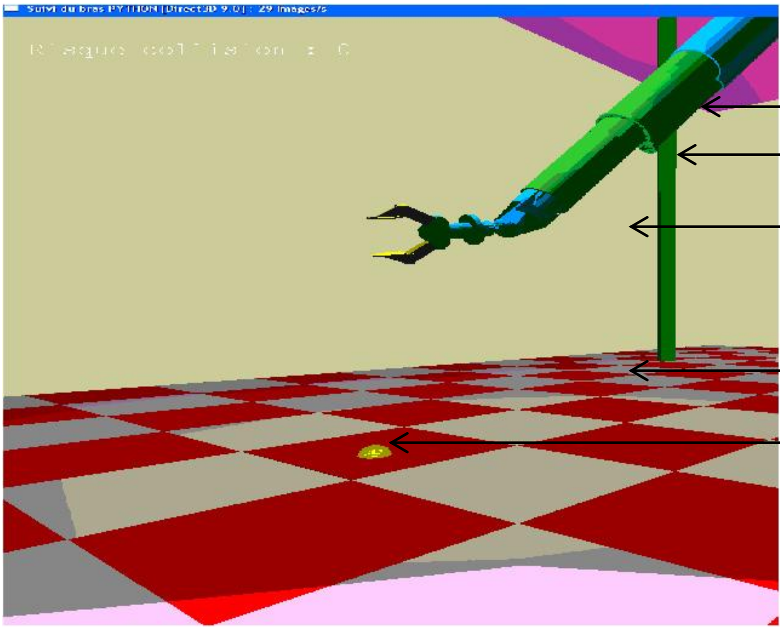
The entire control arm is done through the electronic case, connected by a single cable with a length of up to 60m. The lack of electronics inside of the arm allows high reliability of the control radiological environment ; *Python* supports a high integrated dose

Integrated dose max.	**10^4 Gy**

INTERFACING WITH A COMPUTER

Thanks to the electronic control unit, the arm *Python* can be interfaced with a computer. This allows to reconstruct the motions of the robot arm in a virtual environment. This evolutionary tool aims to facilitate the work of operators, reduce risk and provide position information useful for the characterization measurements, characterization of samples, identification of wastes, etc …

Software running on a computer can display a three-dimensional environment (the *scene*) which allows the operator to better spot.



The first module is responsible for communication with the arm to receive the positions of all axes and interact with the terminal control information risk of collisions and control application. A second module using the positional information and the definition information of the arm to calculate the angular positions of the articulations that uses the display module. The last module manages the three-dimensional display elements and arm scene lighting and views (cameras), and calculates the risk of collision between the arm and the scene.

The operator can manipulate the arm with more ease, it has indeed:

- From the display in real time the scene and different angles configurable
- From age displayed the position of the gripper
- From the display and management of tooling carried by the arm
- In a collision risk monitoring, broadcast the terminal command that display information, possibly emits sound signals in case of imminent danger and reduces the speed of the arm as the approach of an obstacle (gradual decrease in speed from 30cm from the obstacle)
- From the display arm positioning and projection point of the tool with nozzle cleaning, radiological mapping probe and collimator, identification of hot spot …

This software tool is particularly useful when *Python* is used in complex situations and the various images provided by the cameras are not enough to control the arm with sufficient accuracy.

OPTIONS

1 - Option « *measured* force feedback *on the gripper* »

2 - Option « force feedback *joysticks to control* »

1. Option « *measured* force feedback *on the gripper* »

This option is to measure directly the force exerted on the ripper, using two force sensors (strain gauge) at the drive of the wrist.This option allows to continuously measure the force exerted on the gripper, the arm is in force or not.

This effort can be measured as communicated to the operator in different ways:

- By a display on the screen of the control terminal
- By a display on the screen of the virtual 3D
- By sound information proportional to the force measured

This effort can be recorded, dated and stored in the computer virtual 3D. Consultation at this information can be used to visualize the extreme use of arms (frequency and duration and explain a possible degradation of the latter.

2. Option « force feedback *joysticks to control* »

This option consists in a first step, to continuously measure the force exerted by the arm 6 axes;

In a second step, we use this work effort to harden the joystick on the corresponding axis and opposing flight requested by the operator.

Way the operator will return direct work effort exerted by the arm.

Last change: Increased engine wrist and fixing the wrist on the engine, ensuring better resistance on the end of the arm.