High-precision robots available in kit form

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The "Legolas 5" mock-up shows the range of its capacities. Credit: Alain Herzog / EPFL

(PhysOrg.com) -- A doctoral student from EPFL's Laboratory of Robotics Systems has developed a concept for modular industrial robots, based on the technology of parallel robots, whose precision is expressed in nanometers.

Its name is Legolas. It's as precise as the elf of the same name from The Lord of the Rings, and as modular as Lego bricks. This surprising association has been achieved by Murielle Richard in the context of her thesis, conducted in the Laboratory of Robotics Systems (LSRO) at EPFL. Her goal was to create an industrial robot that would be capable of a variable number of "degrees of freedom", according to the needs of its users. "Normally, the development time required for a high-precision robot is long – around two to three years – and expensive. For industry, for example in watchmaking, this is too long", explains Ms. Richard.

To shorten the time required, Murielle Richard has conceived a modular system that has a very limited number of “bricks” – active or passive – whose combinations enable the creation of a large number of robots of different types. “My approach consisted of reducing a three-dimensional complex problem to a combination of problems in two dimensions”, she continues. In practice, “plates” equipped with motors that give them from one to three degrees of freedom are mounted on a cube 10 cm wide. According to their type and disposition, they can allow up to six degrees of freedom (three translational and three for rotation) to a point situated at one of the angles of the cube, on which a tool can be fitted. Ms. Richard’s concept was described in a recent edition of the journal *Mechanical Sciences*.

The legacy of the Delta robot

The technological basis of Murielle Richard’s project is in fact a speciality of EPFL. The assembly of these different “plates” results in a “parallel”-type robot. This principle has already been used by the Director of the laboratory, Reymond Clavel, in the invention of the well-known “Delta robot”, which is used mainly in the packaging industry. The fact that several arms link the “output” (or end-effector, the part that moves and holds a tool) of the robot to its fixed part gives this type of device greater precision, just like when we use both our arms to move an object, instead of just one. Moreover, these structures allow for very high acceleration.

For this new application, Murielle Richard uses the mechanical properties of flexible parallel structures. Each of the “plates” of the robot is composed of parallel elements linked together by very fine metal bands. These plates are made from one piece, carved in a block of metal using a high-precision method of electrical discharge machining. Thus, they are able to generate, in each direction, movements that can be combined and controlled with extremely high precision.

Industry is expected to show a high level of interest in this technology. Precision of the order of five nanometers (millionths of millimeters) in a modular device that is quickly adaptable to specific needs constitutes a record and holds the promise of exciting economic perspectives for those sectors requiring very high precision; for example, fine watchmaking, optics or microtechnology.

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