Humanoid robots in tomorrow's aircraft manufacturing

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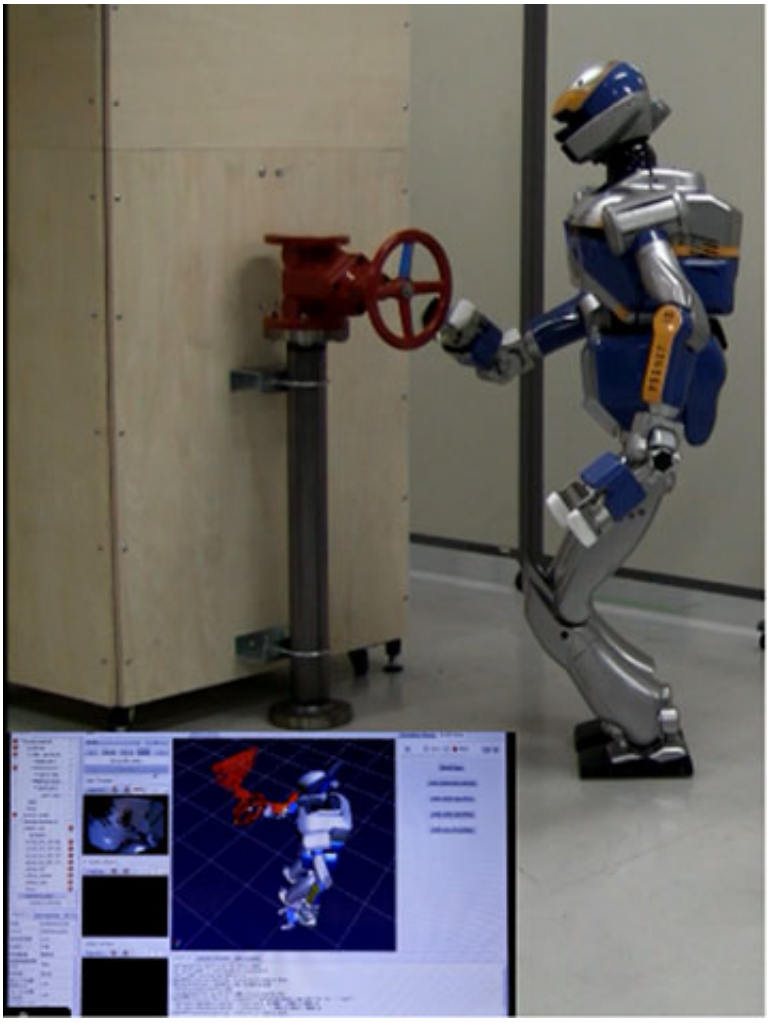

Planning and control of multi-contact movements by humanoid robots. Credit: Joint Robotics Laboratory (CNRS/AIST)

Developing humanoid robotic technology to perform difficult tasks in aircraft manufacturing facilities is the goal of a four-year joint research project, which is being conducted by the Joint Robotics Laboratory (CNRS/AIST) and Airbus Group. It will officially be launched on 12 February 2016 at the French Embassy in Tokyo. The introduction of humanoids on aircraft assembly lines will make it possible to relieve human operators of the most laborious and dangerous tasks, thus allowing them to concentrate on higher value-added ones. The primary difficulty for these robots will be to work in a confined environment and move without colliding with the numerous surrounding objects. This is the first issue researchers will have to solve by developing new algorithms for the planning and control of precise movements.

Due to the size of aircraft (for example airliners), and the very high number of tasks to be executed on a limited number of units, the use of specialized fixed-base robots, like those already in use by the automotive industry, is impossible in the aeronautical industry. There are other difficulties as well, for even if robots with mobile bases and robotic arms can be used by the industry (as with Airbus Group for example), they are limited in their ability to move, since they cannot climb stairs or ladders, or move past obstacles on the floor, etc. For its part, the Joint Robotics Laboratory (JRL, CNRS/AIST) is developing, by way of HRP-2 et HRP-4 robot models, new technologies known as multi-contact locomotion: by making use of its entire body to make contact with its environment, and not just its feet, this type of robot can climb ladders and enter confined spaces. Multiple points of contact also make it possible to increase a robot's stability, as well as the force it can apply when executing a task. Moreover, the anthropomorphic form of these robots offers greater versatility of use to execute a large number of different tasks in varied environments.

The collaboration between JRL researchers and Airbus Group therefore aims to enable humanoid robots to execute manipulation tasks in the

limited and confined environment of assembly lines, where they must make coordinated use of their bodies in order to successfully complete their mission. In fact, these cramped spaces necessitate particular postures. With the calculations for such postures proving to be mathematically complex, the researchers must firstly develop new algorithms that are much more powerful than existing ones, while keeping the calculations sufficiently fast in order for the movement of the robot to remain efficient. Typical tasks to be executed by robots include, for instance, tightening a bolt, cleaning metallic dust from an area, or inserting parts in the structure of an airplane. They could also verify that systems are functioning properly once manufacturing is complete.

These algorithms will be tested on a set of scenarios drawn from the needs of the different branches of Airbus Group (Civil Aviation, Helicopters, and Space), which will become increasingly realistic over the years. With regard to research in robotics, in addition to the contribution of new algorithms, this collaboration will perhaps highlight the deficiencies of current robots (design, precision or power, for example). It could also make it possible to define, in the next 10 to 15 years, the specifications for the first generation of humanoid robots dedicated to the manufacture of large structures.

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