SAFER COLLABORATIVE AND HUMANOID ROBOTS WITH NEW COLLISION DETECTION SOFTWARE UTILIZING PASSIVE (NON-INSTRUMENTED) SKIN

Contact force reduction for robotic manipulators with low inertia.

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Context

In recent years, industrial robots have become increasingly popular on assembly lines. They can perform tasks quickly, with great precision, in a repetitive manner, in addition to being able to lift heavy loads. However, these robots are massive and pose life-threatening risks when in contact with humans. To ensure the safety of workers, they are often placed in metal cages.

Another type of robot that can be used by industries are collaborative robots, or Cobots, whose main application is to be able to interact with humans. This type of robot is currently underused in industry since they do not provide the same performances as standard industrial robots. As a result, until now, no technology makes it possible to combine the safety of collaborative robots with the speed and productivity of industrial robots. Finally, a third type of robot is currently emerging, the humanoid robot. This type is not only designed to imitate human beings, but also to interact with them; therefore, the humanoid robot must also be very safe.

Description

The present invention meets the need for robots that can safely interact with humans while allowing increased productivity. This new technology consists of the combination of a simple-contact detection algorithm (not requiring the addition of a sensor) with a passive robot skin. This allows the active reduction of contact forces between a collaborative (or humanoid) robot and a human operating in the same space. In addition, by coupling the dynamic advantages of actuators with high bandwidth and low inertia, this invention makes it possible to produce very significant contact force reductions compared to the collaborative robots that are currently on the market.

Thus, we have a robot utilizing a passive layer of material (i.e.: non-instrumented skin), that makes it possible to more quickly initiate contact on a less rigid surface, to separate the robot from the human, in order to allow early detection of a contact by the system, without producing great forces. Rapid detection allows the actuators to react before the peak of the contact force, and thus reduce the impact force felt by the human.

Applications

- Collaborative Robots (COBOTs)
- Humanoid Robots
- Markets – data from Markets and Markets
    - The Collaborative Robot market is in full expansion – valued at US$1.2 billion in 2021 and predicted to reach US$10.5 billion in 2027, with a CAGR of 43.4%. The software segment was estimated at US$75 million in 2021 and projected to reach US$1.054 billion in 2027, at the highest CAGR of all segments, at 55.5%.
    - The Humanoid Robot market is also growing rapidly – estimated at US$1.5 billion in 2022 and expected to reach US$17.3 billion in 2027, at a CAGR of 63.5% during this period.

Advantages

- Significant fabrication cost reduction compared to joint instrumentation using force sensors: a passive skin costing less than $100 with significant performance increases.
- Allows rapid contact detection without adding sensors. Does not require calculations or identification of complex parameters. Easily used in real time.
- Contact force reduction between robot and human by >14X (or increase in operating speed of 14X).

- The combination of magnetorheological (MR) actuators with a “passive detection" layer, to allow reaction in time, has not been done before.
- Enable the next generation of Cobots to be as safe as the current generation, while closing the current performance gap between standard robots and collaborative robots.
- Enable the next generation of humanoid robots that are safer and more reactive.

Keywords

- Collaborative (or humanoid) robot safety devices, Cobots, collaborative (or humanoid) robot collision detection, robot collision force reduction, robot foam padding, robot safety skin, magnetorheological actuators (MR).

Technology Readiness Level (TRL)

- TRL 6-7 – An algorithm
    - Solution ready for demonstration and transfer to industry.
    - Proof of concept achieved on robots containing magnetorheological (MR) actuators. Other actuator types with low inertia will work as well.
    - Development activities continue toward a commercial robot.
- Targeted companies
    - Universal Robots, Kuka, Fanuc, Kinova, ABB, Franka Emika, Rethink Robotics.

Intellectual Property

- Patent application filed.

Seeking

- Commercial partners.
- Development partners.
- Investments.
- Licenses.

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