Jamming Concept in Robotic ARM as EOAT

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***Abstract* - A gripper is a component of an automated system. It is a device which allows the holding of an object to be manipulated. The human hand is an amazing machine that can pick up, pick and place objects easily, but for a robot, this "gripping" mechanism is a vexing challenge. Just like a human hand, a gripper enables displacing, tightening, holding and releasing of an object. A gripper is attached to a robot or it can be part of a fixed automation system. Based on the applications the size and type of grippers may be used. As we can see the increasing advancements in Robotic technology causes the evolution in Robotic arms.**

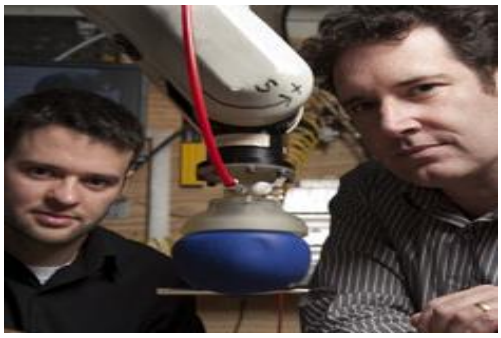
Researchers from Cornell, the University of Chicago and iRobot Corporation have created a universal gripper using everyday ground coffee and a latex party balloon, bypassing traditional designs based on the human hand and fingers. It conforms to the object it's grabbing, rather than being designed for particular objects. Universality of the grippers will make future applications seemingly limitless, from the military using it to displacing explosive devises or to move potentially dangerous objects like TNT and Concentrated Acids, robotic arms in factories, on the feet of a robot that could walk, or on prosthetic limbs.

The concept is called as "jamming transition", which turns EOAT behavior from fluid-like to solid-like when the particles can no longer slides on each other. Jamming transition provides a unique framework for understanding and predicting behavior in a wide range of randomly disordered, amorphous materials.

Keyword: EOAT, Jamming, Gripper.

I. INTRODUCTION

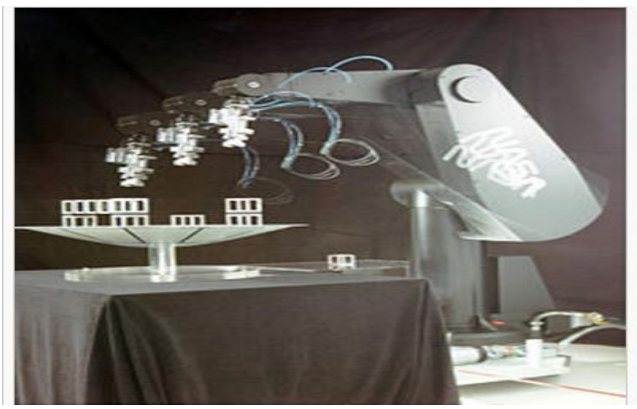
The scope of robots can be found in every industry not only in India but also in various countries. In the current era of technology, every creature is looking for a scope of modification in traditional technology. The utility is not only restricted to technocrats but is utilize in health, finance, corporate institution etc. the major advantage of robots are they increases Productivity, Safety, Efficiency, Quality, and Consistency of products and also they can work in Hazardous environment and have capabilities beyond that of humans. Industries are moving towards automation, increase in production and increase in accuracy of the product. All the developed and developing countries are started using Robot for the Automation and higher amount of production of similar products. Indian accounts for slightly less than the 1.5% of global purchases of Industrial robots. The EOAT (sometimes called end-effector) is another most important part after controller of the robot. The end-effector is the "hand" connected to the robot's arm. It is often different from the human hand , it could be a tool like a gripper, a vacuum pump, tweezers, scalpel, blowtorch, just about anything that helps it do their job. Some robots can change end effectors or EOAT, and be reprogrammed for a different set of tasks. But for a robot, this "gripping" mechanism is a tough challenge. To overcome this challenge there is a new evolutionary concept of making a gripper which can even pick 2D objects such as 1 rupee coin, and this concept is named as "Jamming Transition".



Picture 1: Graduate student John Amend, left, and associate professor Hod Lipson with the universal robotic gripper.

II. HISTORY

Robotics is a branch of electro-mechanical engineering, electrical and electronics engineering that deals with the design, manufacturing, construction, working, operation, and application of robots, as well as computer systems of its control and sensory feedback, and information conditioning.



Picture 2: Puma, one of the first industrial robots

These technologies deal with automated machines that can take in place of humans in hazardous environments or manufacturing processes, or replace humans in appearance, behaviour. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics.

In 1942 the science fiction writer Isac Asimov created his Three Laws of Robotics.

In 1948 Norbert Wiener explained the principles of cybernetics, the basic practical robotics.

Autonomous robots only appeared in the 20th century. The first machine language operated and programming robot, the Unimate, was installed in 1961 to lift a hot pieces of metal from a die casting m/c and stack them. Commercial and industrial robots are widespread today and perform jobs more efficiently, more accurately and more reliably and trusted, than humans.

III. GRIPPERS:

A gripper is a device which enables the gripping of an object to be manipulated. The easiest way to describe a gripper is to think a human hand. Just like our hand, a gripper enables gripping, tightening, gripping, handling and releasing of an object.

Compressed air is transferred to the cylinder of the gripper body forcing piston up and down, which is through a mechanical linkage, force the gripper jaws open & closed. There are 3 primary motions of the gripper jaws, parallel motion, angular and toggle motion. These operating principles refer to as the motion of the gripper jaws in relation to the gripper.

Picture 3: The Shadow robot gripper hand system

Parallel Gripper
The gripper jaws moves in the parallel motion in relation to the gripper body. Parallel gripper is more accurate & precise than other style grippers.

Angular Gripper
The gripper jaws are opened and closed about a central pivoted point, moving in a sweeping or arcing motion. Angular grippers are often used when less space is available or when the jaws needed to move up and out of the way

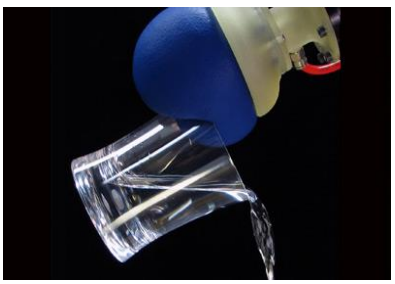
Applied Robotics Inc., headquartered in Glenville, N.Y. is an ISO-9001 certified, employees are owned company serving in the world's automation market. Founded in 1983, Applied Robotics used to design and manufactures end-or-arm tooling and connectivity solutions intended and solve complex automation problems with improve efficiency and accuracy. Serving a wide spectrum of customers and industries ranging from a large of about 500 companies to small privately-held businesses, the company's wrist-down solutions are found in manufacturing, welding, assembly and material handling applications throughout the United States, Canada, Pacific Rim, Mexico, Europe, South America and Australia.

IV. CONSTRUCTION AND WORKING OF GRIPPER

An everyday party balloon filled with ground coffee (of any variety) is attached to a robotic arm. The coffee-filled balloon compresses down and deforms around the desired object, and then the vacuum sucks the air out of the balloon, solidifying its grip. When the vacuum is removed, the balloon returns to its soft state again, and the gripper lets go.

Coffee is an example of a particulate material that is characterized by the large aggregates of individually solid particles. Particulate materials have a jamming, which turns its behavior from fluid like to solid like when the particles can no longer slide past each other.

The phenomenon is similar to vacuum packed coffee which seems be hard as a brick until the package are unsealed as a brick until the package is unpacked. The ground coffee grains acts like lots of small gears, when they are not compressed together they can roll over each other and flow. When they are

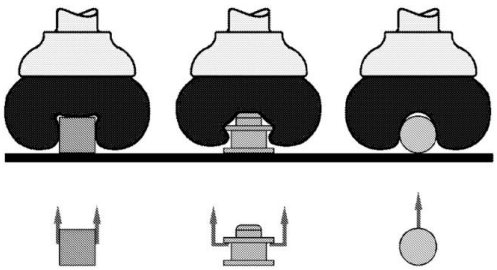


Picture 4: The robotic gripper conforms to the shape of the item it is lifting

compressed together just a little bit, the teeth interlocks, and they become solid.

The concept of a jamming transition provides a framework for understanding the behaviour in a wide range of disordered, amorphous materials. These materials can be driven into a glassy state where they acts like a solid yet structurally resemble a liquid, colloids, emulsions or foams, as well as particular matter consisting of macroscopic grains.

Here we have a case where a new concept in basic science provided a fresh perspective in robotics and then opened the door to tremendous applications.



Picture 5: Working concept of gripper

V. AREAS OF APPLICATION

1. This gripping technology can be used in Medical science as Prosthetic hand tools for disabled and physically handicapped people.
2. Military can also utilise this technology in picking and holding dangerous things and weapons that need intense care.
3. Chemical laboratory would become more worker friendly by using these types of less expensive low cost grippers.
4. In robotics it would be an effective End of Arm Tool (EOAT).

VI. ADVANTAGES AND FUTURE SCOPE

1. A deformable membrane having an opening fluid attached to a source of fluid ingress and egress in an evaluable sealing relationship
2. The granular material are characterized by having the volume change equal to or less than about 5% between a fluid phase and a solid phase of the material.
3. Universal robot grippers are robotic end effectors that can grip a wide variety of arbitrarily-shaped objects.
4. Active universal grippers typically have an anthropomorphic, multi-fingered design, inspired by the human hand.
5. One approach to achieving a lower threshold of universal gripping is to add deformable materials to the gripping faces of a traditional jawed gripper to increase the compliance of the surfaces.

VII. DISADVANTAGES

1. Passive universal grippers are generally easier to use and require minimal visual preprocessing of their environment, but they too have limited success gaining the adoption.
2. Often their many passive components are easy to damage and difficult to replace.
3. Passive universal grippers can be very expensive as well, and their ability to grip many different objects often renders them at gripping any one object in particular.

VIII. CONCLUSION

A passive universal gripper includes a mass of granular material enclosed in an elastic membrane. Using a combination of positive and negative pressure, the gripper can rapidly grip and release a wide range of products that are typically challenging for conventional universal grippers, such as flat objects, soft objects and objects with complex geometries. The gripper passively conforms to the shape of a target object, then the vacuum hardens to grip it effectively; later using positive pressure to reverse this transition-releasing the subjected objected and returning to a deformable state. The apparatus and method enable the fast ejection of objects from the gripper, and essentially instantaneous reset time between releasing and gripping.

IX. REFRENCES

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