

TECHNOLOGY VENTURES

Transforming robotics with Soft Robotics

ABB Technology Ventures (ATV) is ABB's strategic venture capital investment arm. ATV finds the startup partners from which ABB can best benefit, both strategically and financially. ABB's partnership with Soft Robotics provides a perfect example of how proactive engagement with a startup can make all the difference when it comes to improving innovation processes.



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Who says a robot has to be made of metal? For the past decade, Harvard's George Whitesides and his army of post-doctorate fellows have been rewriting the rules on what constitutes a robot. Through a collaboration between Harvard and DARPA, the innovation arm of the Department of Defense, the Whitesides Group at Harvard University has been focused on a new breed of biologically inspired "soft robots." The challenge was initially to create a robot that could make its way underneath a pane of glass just 20 mm above a surface [1]. While most robotic engineers attempted to solve this problem with traditional, rigid robots, Dr. Whitesides drew inspiration from nature to create a new class of soft robots made entirely of elastomeric polymers. It was that challenger mindset that made way for a breakthrough in the field of robotics.





Soft Robotics is born

The earliest applications of the technology to come out of the DARPA collaboration were in surgery and other biomedical applications. But a major unmet need and opportunity in industrial automation were recognized: The majority of robotic solutions today are based on hard linkages, making it difficult for them to pick up soft and variable objects, like fresh produce, or interact safely with humans. If the new robot technology could safely manipulate and transport organs and soft tissue without damage, it could easily grasp

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delicate and variable products that had previously been off-limits to automation, like fresh produce or consumer goods. This premise resulted in the foundation, in 2013, of Soft Robotics as a spin-off from the Whitesides Group →1.

Getting the upper hand

The underlying design for Soft Robotics' technology was inspired by the octopus's tentacle – a dramatic shift away from the traditional robotics approaches involving hard linkages, sensors and servo motors. This inspiration led to the invention of soft robotic actuators made entirely of polymers that do not require sensors or other electromechanical devices for operation. Soft Robotics' novel approach solves the problem through material science, not through higher levels of cost and complexity. The computational power of the system is built into the gripper itself – a proprietary blend of materials with microfluidic channels that, when actuated, mimic the soft tissue of the human hand.

Prof. Whitesides' work at MIT spawned an entirely new area of research, with soft robotics becoming a focus at Harvard University and the associated Wyss Institute, Cornell, Stanford, MIT and numerous other institutions. While there is now significant academic work in this area, Soft Robotics Inc. has been the pioneering force in developing the first and only commercial applications. The commercial need is driven by the fact that only 12 percent of non-automotive industries are automated by robots today because solutions for tasks that are either unstructured or that call for dexterous manipulation of variable product have not been available →2.

By leveraging the properties of soft and compliant materials, Soft Robotics has been able to build a fundamentally new set of adaptive and dexterous robotic hands and automation systems that open up completely new applications. Labor-starved industries such as food and beverage, advanced manufacturing and e-commerce can now realize

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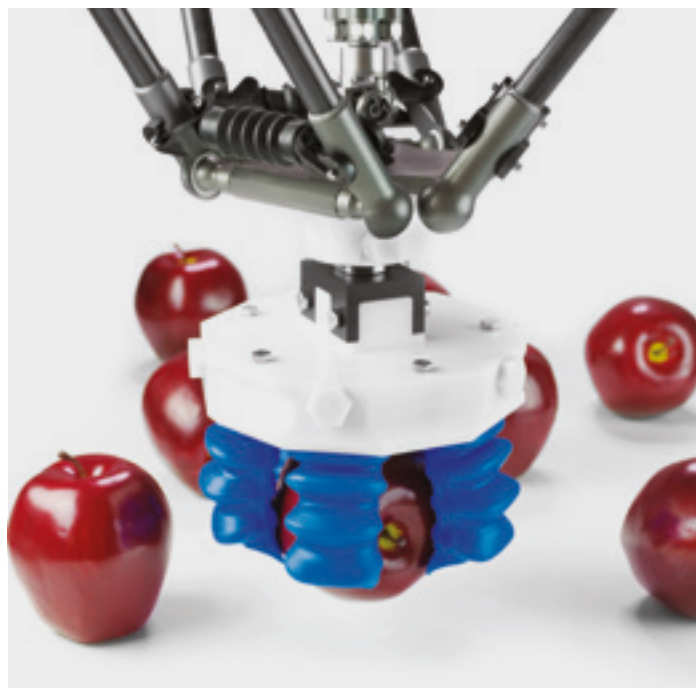
the power of robotic automation. Soft Robotics' technology can now manipulate objects that vary in shape, size and weight, and that are easily damaged →3. The most immediate need for this type of technology was seen to be in food and agriculture, advanced manufacturing and e-commerce, where automation is needed not only to meet increasing market demand and labor scarcity but to manipulate the variable and fragile nature of the product.

Productization challenges

While Harvard and DARPA had grown a robust foundational IP platform over nine years of development, Soft Robotics was faced with the challenge of moving an academic technology from the bench into the market – and designing it to meet the highest automation standards of Fortune 100 customers. DARPA and Harvard had built the grippers, but Soft Robotics needed to solve the challenge of how to control them and evolve the technology into a solution that could operate reliably, repeatedly and at high speeds for customers in food and beverage, advanced manufacturing and e-commerce. The company advanced the grippers and incorporated FDA-compliant materials to meet the food handling sanitation guidelines as outlined in the Food Modernization and Safety Act. An electro-pneumatic control system enabled by proprietary firmware was designed and developed to give customers full command over grip parameters including speed, force, gripper spacing and opening width.

The power of pairing the system with AI and machine learning was recognized: Once one solves for the human hand in robotics, machine learning can be used to train robots on how to grasp and manipulate a wide range of other things. Human-supervised automation of highly unstructured tasks like bin picking, sorting and even harvesting are now a reality. This vision for a “robotic-human alliance” has manifested itself into version 2.0 of the technology: SuperPick – designed specifically for the unstructured environments in e-commerce and logistics.

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01 Soft Robotics was spun out of the Whitesides Group in 2013.

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02 Soft Robotics has the first commercial solution to robotic gripping of delicate items.

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03 Soft Robotics' technology mimics the human hand, thus allowing easy gripping of objects that are delicate and that vary in size, shape and weight.

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Reference
[1] <https://www.youtube.com/watch?v=QpnLj-rzjlo&>

Robotic synergies

ABB is a pioneering force in industrial automation and the company's decades of experience have proved invaluable to the Soft Robotics team as they scale their technology to meet the demands of automation customers. ABB is both a partner and investor in Soft Robotics and ABB's robotic systems bring the highest level of speed and accuracy to the Soft Robotic solutions. When the Soft Robotics gripping systems are combined with ABB technologies like the IRB360 FlexPicker, entirely new pick and place applications are opened up. In partnership, the two companies have built solutions for the food and beverage industry, helping to solve top industry challenges such as food safety, productivity and regulatory compliance.

For example, one of the largest global pizza retailers and e-commerce companies ships its dough fresh to its retail locations around the world. Due to the variable and delicate nature of the dough balls, the company had been trying for two years to automate the manipulation and packaging of the end-product. Soft Robotics was able to develop a customized solution to automate this customer's challenge in under a week. The automation solution combines Soft Robotics' gripping system with ABB IRB360 FlexPicker robots to dexterously grasp and maneuver the dough at high speeds. Today, this system is being deployed at this customer's manufacturing facilities around the world.

A partnership for the future

A core premise of Soft Robotics is that the company is not looking to re-invent anything ABB is already doing; the startup is simply adding on functionality to ABB's existing robots and enhancing the value ABB can deliver to its

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customers. At the vanguard in the fast-moving field of agile, automated manipulation, Soft Robotics presented a compelling opportunity for ATV to take an equity position in the startup and accelerate the business partnership with ABB. As Grant Allen, Managing Director and Head of Ventures at ABB Technology Ventures has said: "ABB is one of the leading corporate investors in the robotics space and we saw a critical need in markets such as food processing, agile manufacturing and logistics for an adaptable soft gripping mechanism. Soft Robotics has delivered a compelling solution – and, frankly, gone well past that."

Buoyed by this endorsement from ABB, Soft Robotics' engineers continue to break new ground in the area of intelligent grasping. They are now looking to broader automation challenges and are currently rolling out a solution for e-commerce fulfillment centers where robots can identify objects in a bin and not only identify the correct object for packing, but reach in, grab the correct object and complete the packing task. This "bin picking" task has been a classic problem in robotics. Soft Robotics' solution will help write the future of increased autonomy and customer efficiency in warehouse operations, all thanks to a dynamic young startup out of Cambridge, Massachusetts. ●