

Human-robot interaction finally reaches the work floor



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Competitiveness and globalization



Competitiveness means :

- Productivity : automate tasks that are not automated
- Quality : more precise
- Durability : take into account people



Be competitive against low cost countries means automating more. Of course, robotics is not the only solution, but this is one solution.

We know how to automate the beginning of a line of a production for a car but the final assembly is largely manual. The goal of this new kind of robotics is to automate tasks that have not been automated before.

Combine human & robot skills



One solution to automate such tasks is to combine human and robots skills. What is interesting is that strength of humans are weakness of robots and the contrary.

What kind of tasks?

- Loosely structured tasks
- Short tasks
- Repetitive tasks or tasks that require high dexterity

What kind of industry / tasks ?

- Pick and Place / Packaging
- Manufacturing
- Fine assembling
- Small and medium companies



The type of tasks that can be automated using collaborative robotics are essentially unstructured tasks where it is hard or too expensive to use traditional industrial robotics. Small and medium companies (SME) are good candidates for the usage of collaborative robots to do short and small tasks such as pick and place or other kind of tasks with low added-value.

What kind of tasks?

The Adaptive Gripper:
Third Hand Application on
Kuka LWR-4+ Robot



In this video a Kuka robot is collaborating with a human to build a device. The robot is adjusted by the human and position the product at the right position at the right time. The job is more comfortable for the human. He can be more precise and faster and can do the job for a longer time.

What is collaborative robotics ?

Cobots are robots that work alongside humans. These machines are :

- Safe
- Easy to use
- Affordable



Flexible
(used in a much wider range of tasks)

But they are :

- Slower
- Less powerful

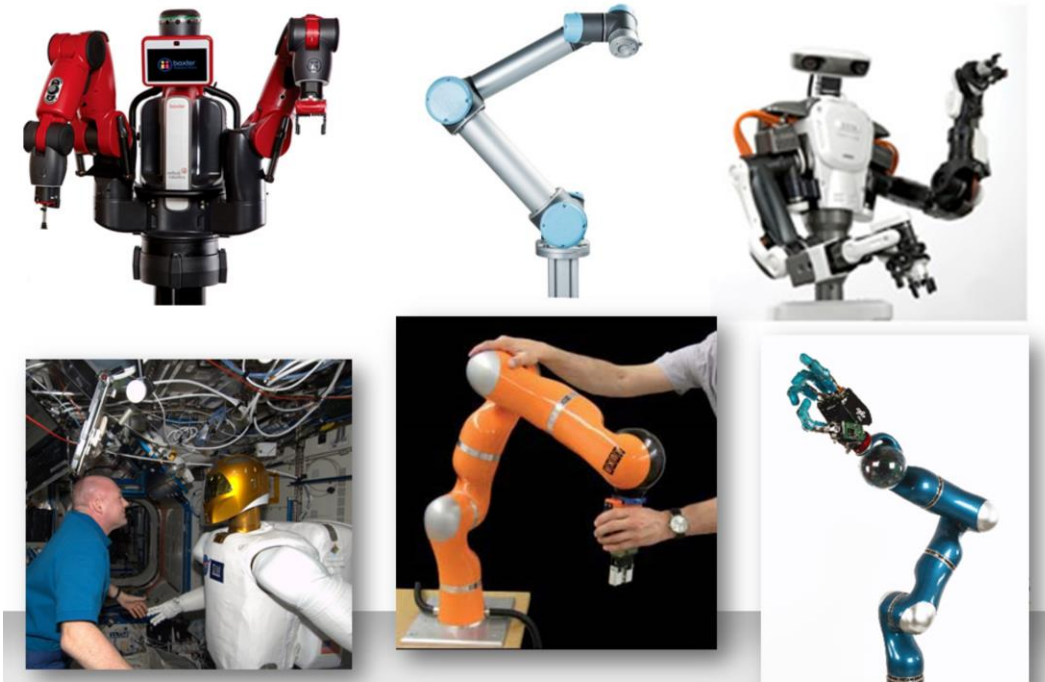


Cobots are Collaborative robots. There 3 main characteristics are: safe, easy to use and affordable.

Cobots are slower and less powerful than traditional industrial robots but they don't need to. In fact, they don't have to be too powerful or too fast. They have to work at the force and velocity of their human partner.

The keyword for Collaborative robots or Cobot is flexibility.

Some products available on the market



From top to down and left to right :

- Baxter robot by Rethink Robotics : 2 arms with 7DOF. Created by Rodney Brooks.
- UR5 arm: by Universal Robots
- NextAge from Kawada Industries
- Robonaut2 (by GE). This is interesting to note that a pioneer in industrial robotics, when it does robots now, are collaborative robots.
- Kuka LWR : By Kuka
- Justin : by DLR (Germany Aerospace center)

Safety first

Cobots require no safety cages !

To ensure safety :

- Torque and force sensors
- Strength limitation
- Specific sensors:
 - Vision (Safety Eye from Pilz, 2007)
 - Voice : use microphone to stop the robot (ABB)
 - Touch : artificial skin
 - ...



Collaborative Robots are safe, easy to use and affordable. But, the safety first. Some mechanism that are used to ensure safety.

Easy to use

No programming ! Demonstration !



Collaborative Robots are easy to use. Baxter is programmed by demonstration, just by moving its arm and demonstrate the movement that is supposed to do.

Use the advances of Human-Robot Interaction researches.

Visual Feed back (the eyes of Baxter are not here just to make Baxter friendly).

This is a revolution, there is no need for an expert programmers that is costly. Any worker without knowledge of robotics or computer science can program the robot. The collaborative robot is a tool given to any worker to improve its efficiency and make its jog easier.

Easy to move

- Collaborative robots are Flexible.
- They perform (many) short tasks.
- They need to be moved from places to places in the factory.



Since the collaborative robot is easy to use, it must be easy to move to be placed anywhere a job has to be done in the factory.

Easy to use + easy to move => Flexibility

Affordable

	Price	ROI
Baxter (Rethink Robotics)	≈25 k€	8 months
UR5/UR10 (Universal Robots)	≈25 k€	6 months
NextAge (Kawada Industry)	≈35 k€	<12 months

ROI is very high because :

- Increase of the productivity of humans (not only a process)
- Capacity to automate many tasks for a brief period of time
- When robots team up with people, they automate tasks that have never been automated before
- Product is accepted by workers



Collaborative robots are affordable. They are less expensive than traditional industrial robots but more than that, they have a very low ROI because they are simpler to install and there is no need to reorganize the factory (no cage, no special safety equipment's), there is no need of an expert programmer and collaborative robots are well accepted by workers.

A new revolution ?

MainFrame / Industrial robots



Personal computer / Collaborative Robotics



Will collaborative robots be the personal computer of production ?

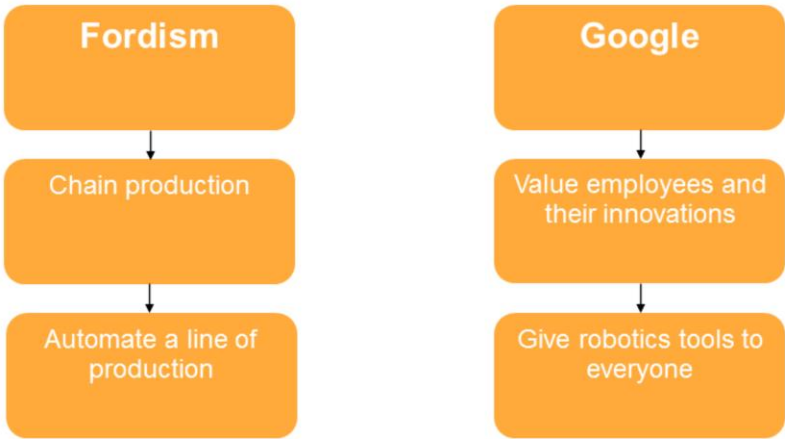
The factory of the future won't be centralized



Industrial robots can be compared to mainframe in the computer industry : there are robust and efficient but they need expert programmers and are difficult to change/update. On the contrary, the personal computer such as Collaborative robots are tools for end users, easy to use and to move.

Personal computer are at the base of the internet revolution and other new markets. PC are also at the origin of a fabulous gain of productivity. Will Collaborative robots be the personal computer of robotics?

Collaborative robotics is a management project



Adding a collaborative robot in a factory is not just an industrial project but also a management project.

Collaborative vs Industrial Robotics



Blind and unaware of surroundings	Sees & understands people & environment
Dangerous	Safe
Compete on precision and repeatability	Focused on flexibility and ease of use
Task must be restructured for that solution	Task done just as a human does it
Requires components and integration	Fully integrated & self contained
Requires expert programmers	Can be trained by ordinary people
Expensive	Unbelievably inexpensive



The purpose of this slide is not to compete collaborative robots vs. industrial robots but to highlight their differences. Collaborative robots and classical industrial robots are not competitors. Collaborative robotics is a new kind of robotics that is complementary of industrial robots.

What about workers?

- Workers accept more easily Cobots because
 - Cobots are seen as assistants
 - Workers become more qualified
 - Job become easier
- Young workers come back to the factory



Workers feel more valued when they use a collaborative robots instead of doing the tasks with low value-added.

What's next ?

- Need an ISO certification (ongoing process) for Cobots
- More products will arrive on the market soon
- Major industrial robot manufacturer will add more and more collaborative technologies in their offers.
- Sensors and software (with IA) will improve the offers.



Lots of new improvements and new products will arrive soon on the market. Human Robots Interactions studies are very promising (here with Icube) and they will unleash a lot of advances in collaborative robots.

One research topic that seems interesting is mutual comprehension of intent through attitudes.

Thank You !



Q&A

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