Collaborative robotics in industry 4.0

Paolo Rocco

Dipartimento di Elettronica, Informazione e Bioingegneria
paolo.rocco@polimi.it

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Industrial robotics today (or yesterday?)

Collaborative robotics

- Humans and robots collaborating at the same task
- Protective fences are not needed
- Reduced cost, reduced foot print

Source: KUKA

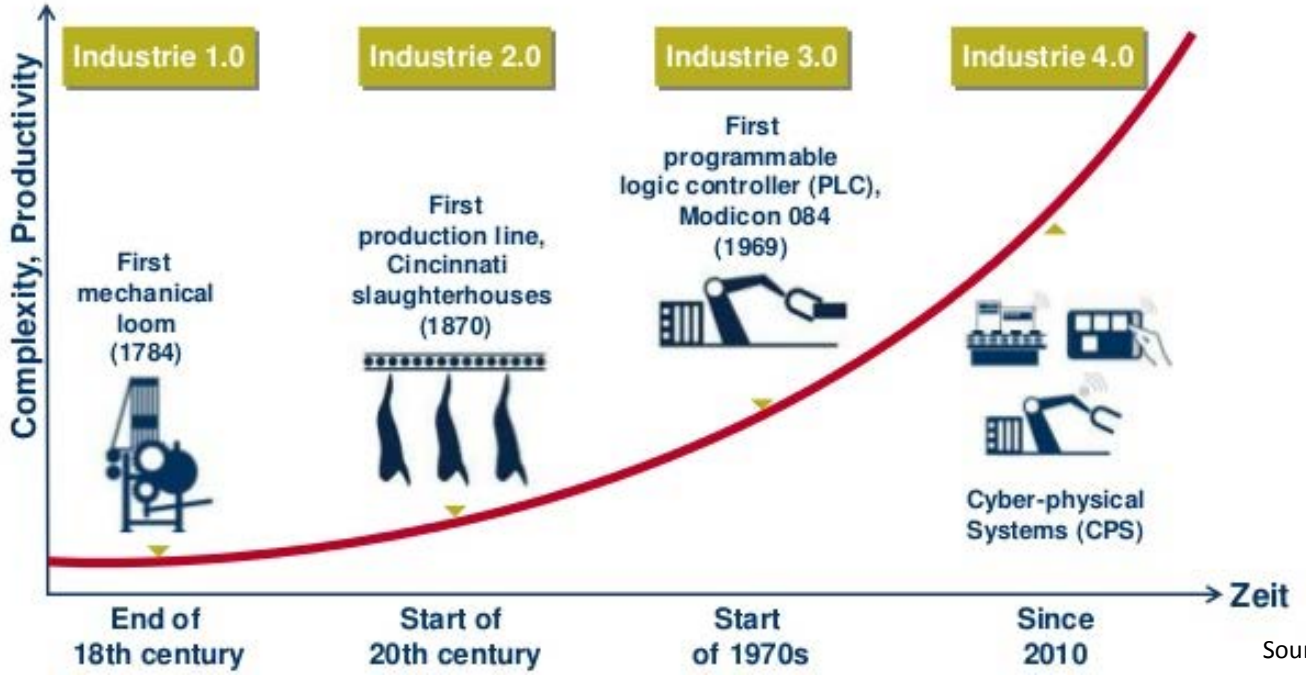
Source: Universal Robots

- New programming interfaces
- Decrease of the deployment time
- High potential for SMEs

From robots to cobots

Robotics and industry 4.0

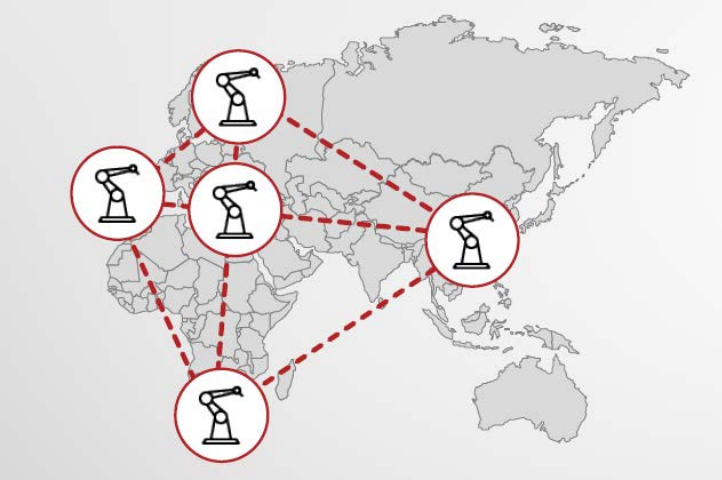
- Robots are key components in the manufacturing of Industry 4.0
- Integration of machinery, warehousing systems and production facilities as Cyber-Physical systems
- Flexibility, cost effectiveness and productivity in smart factories



Source: Bosch

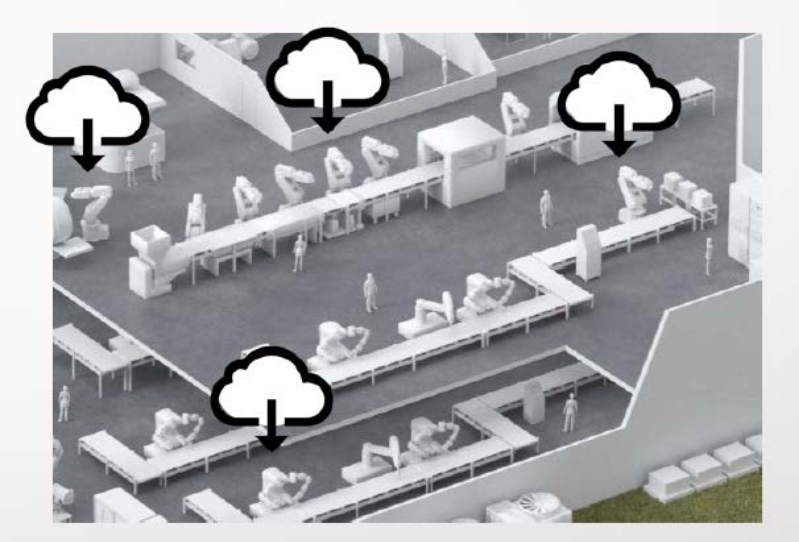
Robots as cyber-physical systems

Self-optimizing production



Robots doing the same task connect across all global locations so performance can be compared and improved at the click of a button

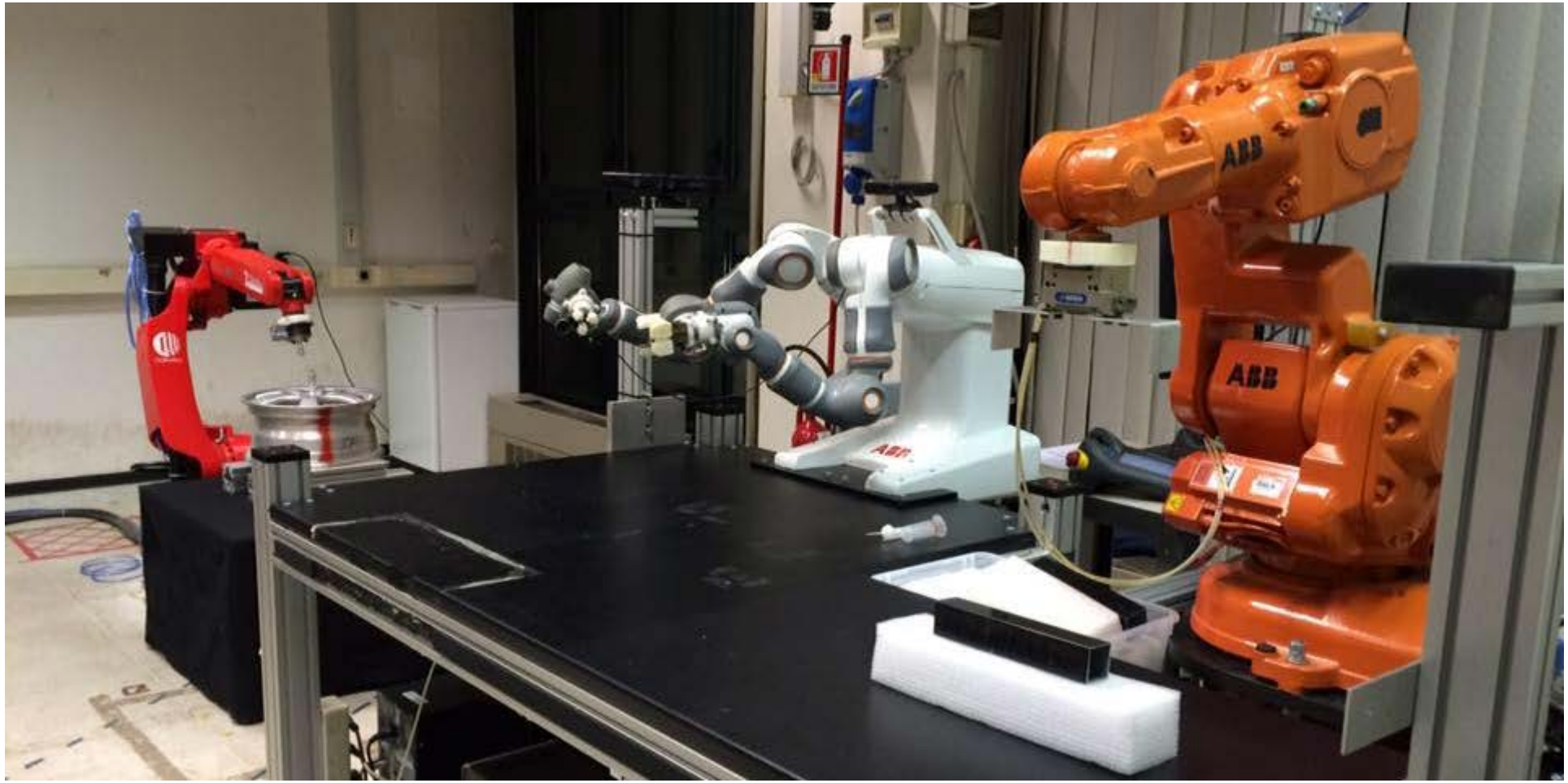
Self-programming robots



Robots automatically download what they need to get started from a cloud library and then start to optimize through “self-learning”

Source: IFR

The MERLIN lab



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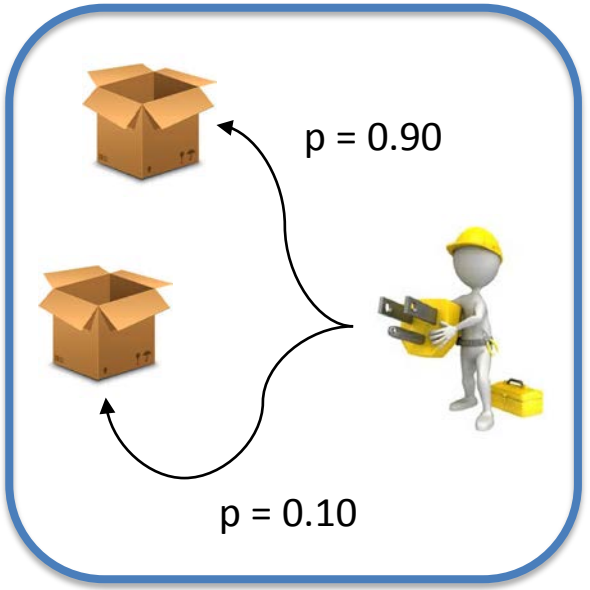
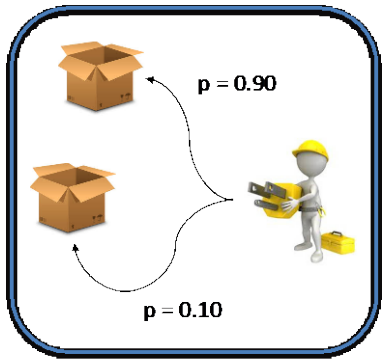
Cobots as fellow co-workers

Cobots as intelligent fellow co-workers

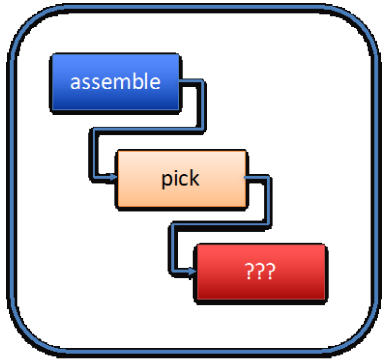


Prediction of the intention of the operator (labelling)

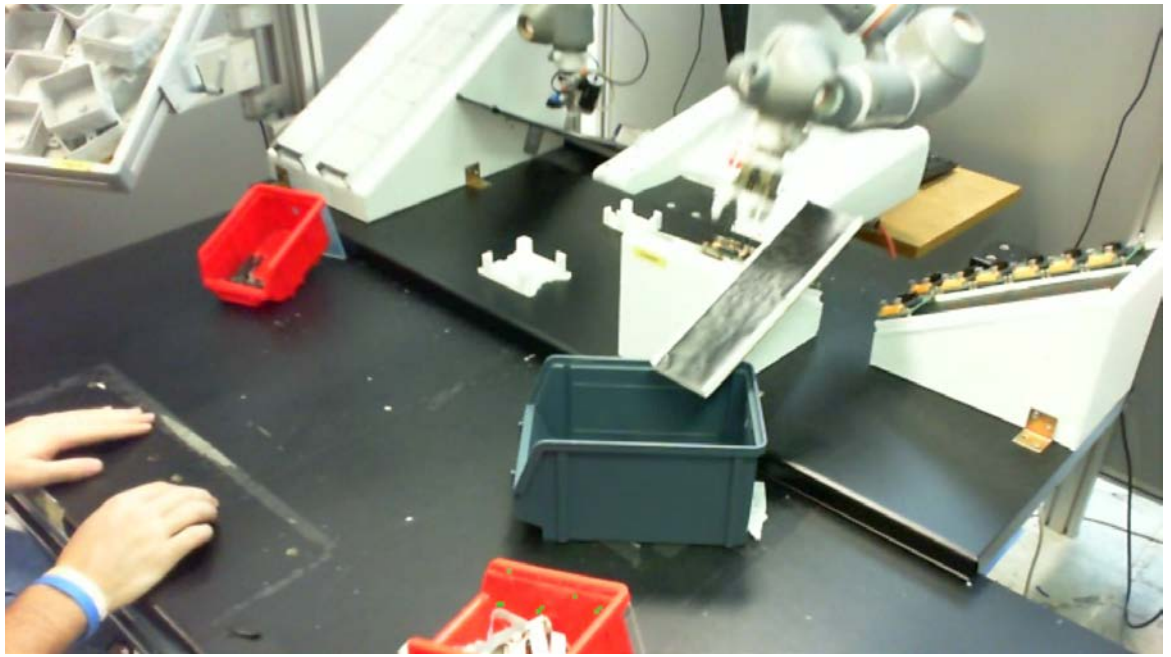
Cobots as intelligent fellow co-workers

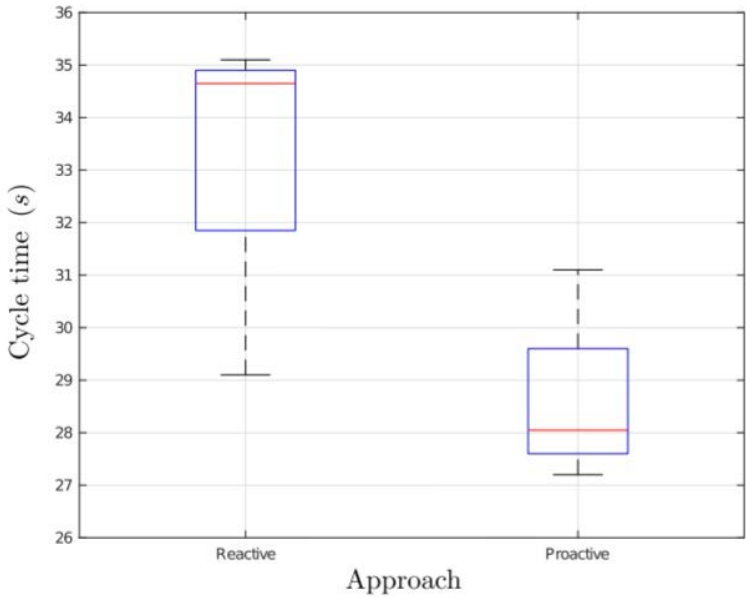


Predizione dell'intenzione dell'operatore (labelling)



Predizione di pattern di attività





Results: cycle time is reduced by 20%

A new spin off company

SMART ROBOTS

Collision avoidance

Schedule best action

Manual scheduling and objects recognition

Gesture interaction

Jan Mar 2017 — Prototypes realization

Mar Jun 2017 — Exhibitions participation

MECSPE · A&T TOGETHER TO SOLVE · APAC Innovation Summit · INNO EVENT ROBO · ICRA2017

May 2017 — Funding Round Completed

Sept 2017 — Smart Robots selected for the MISE 5G Experimental Project

Ministero dello Sviluppo Economico

vodafone

Sept Dec 2017 — Smart Robots Market Tests in production plants

eu ROBOTICS TT award

2018 on market!

Some challenges for the future

What are the topics that the research on collaborative robotics for the smart factory should explore in the future?

Safety

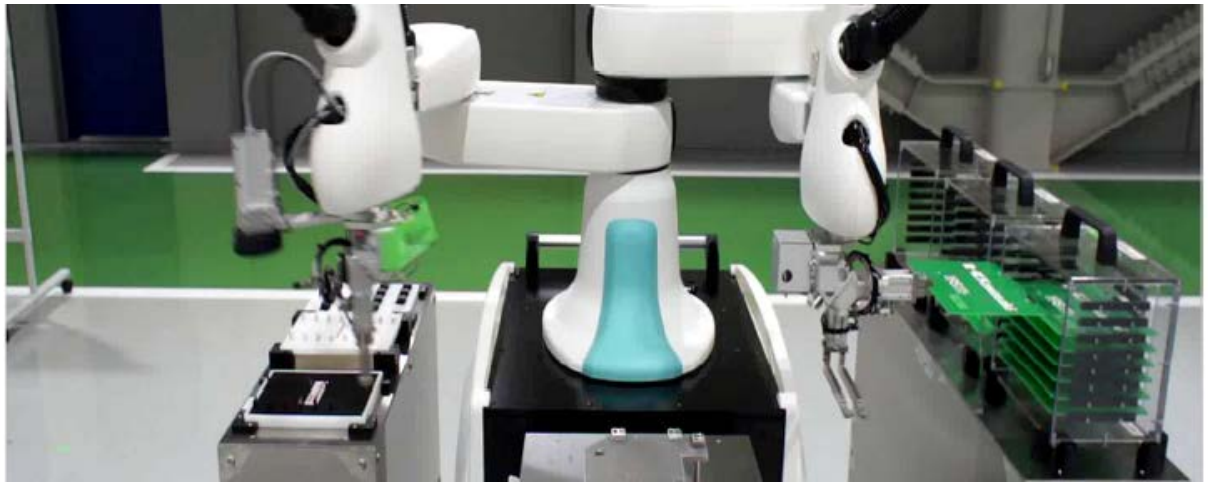
Safety is an essential element in human-robot cooperation.

We need:

- New sensors to make robots, not conceived for collaboration, safe
- Reliable methodologies for risk assessment in the installation of a collaborative operation

Performance

Collaborative robots must guarantee **performance levels** comparable to those of traditional industrial robots.



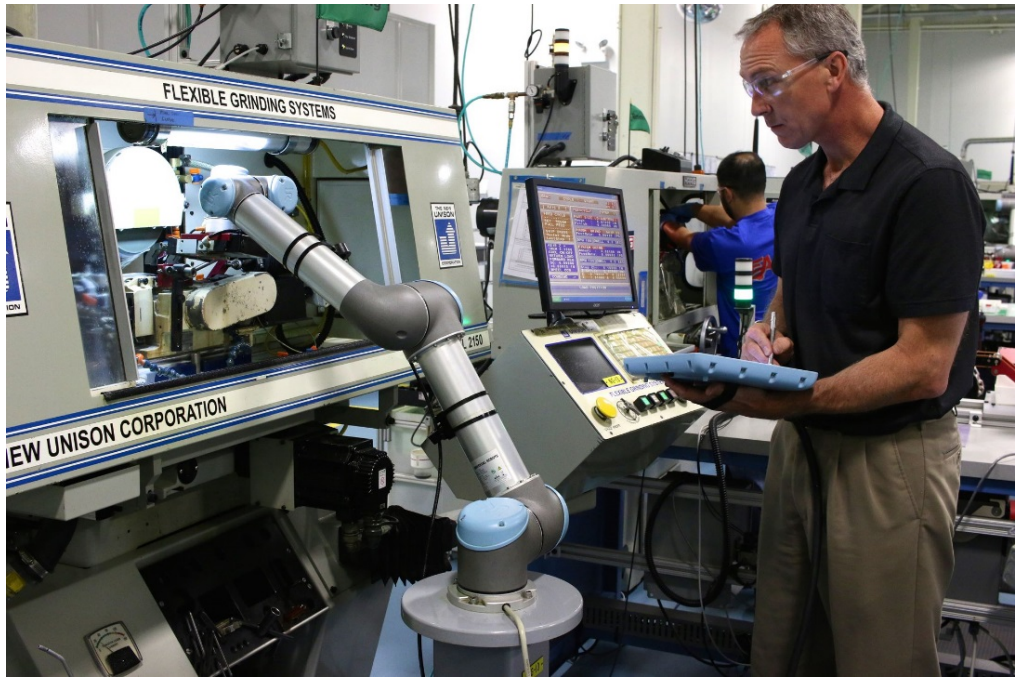
We need :

- Methodologies for mechanical design of the robots that combine lightness with precision
- Control methodologies that account for the reduced mechanical stiffness of the robots

Standardization of the interfaces

We need **interfaces** that are more and more standardized.

- Ease of use
- Possibility of use for unskilled personnel
- Possibility to benchmark several solutions of collaborative robotics



Adaptation to the human

If the robot is going to be in the future a true workmate for the human, it shall **recognize human's intentions** and adapt to the maximum extent to his/her behaviour.

We need:

- Algorithms for the interpretation and the prediction of human's actions
- Machine learning techniques for data elaboration

Really collaborative operations

Today collaborative robots often operate on their own, just sharing the workspace with the human. We need to evolve towards **really collaborative operations**.

We need:

- Algorithms for the scheduling of robot's operations that can adapt online on availability of resources and to the human's behaviour
- Adaptability of the robot to the different skills of the human operators

Social interaction and ergonomics

Besides physical safety of the operator, the **ergonomic aspects** of the working place have to be guaranteed.

In particular:

- The physical wellbeing has to be guaranteed and then the robot has to assist the human, offering objects in ergonomically favorable positions.
- Robot motion does not have to induce psycho-physical stress on the human

Collaborative robotics for the factory of the future

- Collaborative robots are already available on the market
- Applications are diverse and relevant
- The framework for safety standards is today well established
- Good funding opportunities for research and innovation in robotics are available

The revolution of collaborative robotics has already started!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