Collaborative robotics: overview and safety background

A robot system manufacturer perspective

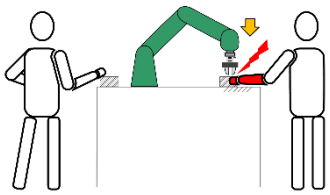
Collaborative robotics

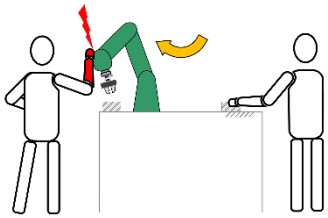
Operations in automatic mode with presence of operators inside the machine workspace

Motivations

- frequently interact with devices (robot systems) for performing common actions in the same workspace
- better use of space and/or reduction of footprint on layout
- ergonomics: robot assistant provide support for handling, kitting, etc along repetitive and dull tasks
- operators retain dexterous tasks; shift from execution to supervision

Breakthrough with respect conventional robotics





"fence-less" applications: access to moving devices (and potential hazards) is not prevented by perimeter safeguarding, BUT risks are mitigated by collaborative features:

- Detect potential collisions with real-time safety-rated sensors in order to prevent contacts with robots
  - Technology under development and testing
- Limitation of the energy of machines, as a reaction to potential contacts (limited magnitude of the physical interaction)
  - Principle of "pain onset threshold": potential contacts are comparable with regular daily life experiences (e.g. accidental bumps)
  - Layout design completely changed (new mindset for designers) to accomodate human presence, no sharp objects, free space
  - Tools and exquipment dedicated to physical interaction

Increased level of training and awareness.

Effects on risk assessment

Intended use: set the foreseeable variants to layout and robot operations due to production changes.

- How to efficiently update the intended use (and propagate to following steps in risk assessment and evaluation)

Hazard identification: top-down approach starting form actions of operators (i.e. fault-analysis for the system are possibly inefficient), so that hazards are application-dependent. Human-robot interaction hazards are originated by situations and behaviors

- Humans not completely repeatable in task execution: potential errors. HazOp or similar techniques to be adapted for collaborative tasks
- Humans partly unpredictable. What to consider reasonably foreseeable misuse

All other hazards remain.

Risk estimation: reduction of the severity factor AND/OR reduction of the probability of occurrence of failures, with improvement in avoidability

- severity of hazardous events to be adapted to very low magnitude values
- intensity of interaction under investigation and subject to research (ISO/TS 15066, ISO/CD 21260)
- probability distribution of human errors mostly unknown

Risk evaluation: residual risks are always present (due to the possibility of access to machines even when all safety functions and safeguarding is activated)

- what to consider for complementary protective measures
- how to ensure that complementary measures are not replacement for safeguarding
- how to assess the expected level of enforcement of complementary measures

References

- ISO/TS 15066 Collaborative robots (to be merged with ISO 10218)
- ISO 10218-2 Robots and robotic devices — Safety requirements for industrial robots — Part 2: Robot systems and integration (under revision)

Contacts

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