Safety of collaborative robotics
Overview and Critical Issues

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About 150 European structured collaborations with:

- Enterprises
- Universities
- R&D Institutes & Centers
- Industrial Associations,
- Organizations
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collaborative robotics in use
Outillage développé par Einea

6 actionneurs, 4 commandes, 1 capteur et de la logique embarquée
collaborative robotics launched 2009ish

infancy problems:

- **awareness**: clarity of needs, reasonable expectations
- **understanding**: standards, technical means for safeguarding, risk estimation
- **experience**: feedback from the factory floor, extend the knowledge base on impacts
- **acceptance**: consensus on validation tools, metrics and risk evaluation
background
energy reduction

contact

pain

i

jury

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contact

energy reduction

pain

injury

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<150 200 250 >250

N/cm²
protective devices / safety functions
- force limitation (e.g. 100-300 N)
- speed limitation (e.g. 300-600 mm/s)
- padding and soft/round covers
- constrain tool orientation (e.g. downward)

protective measures (administrative)
- free escape space
- alerts and signalling
critical issues
the big mistakes

“my application is safe because I use a collaborative robot”

No, this is a dangerous shortcut. Please, do risk assessment.

Collaborative solutions require different mindsets:
- design your layout,
- prepare your environment,
- anticipate errors and misuses.

Combine safeguarding and protective measures

Do not force collaboration when unnecessary

“any moving part is hazardous, so guards must be installed. Please stop this unsafe machine.”

No, this is preemptive technology rejection. Please review risk assessment.

Collaborative solutions require different mindsets:
- Understand new machines,
- Be aware of advantages and downsides
- Anticipate errors and misuses.

Train about safeguarding and protective measures

Do not deny collaboration when necessary
open issues

- **Residual risk – manufacturer**
  - Liability for risk reduction, committed to include safety functions
  - ALARP: contacts due to accidental, misused access to work area, is the low probability acceptable for risk estimation?

- **Residual risks – user**
  - How to establish an agreement for acceptable level of residual risk?
  - How to establish an agreement for misuses and training level?

- **Data-driven risk estimation**
  - Probability of errors, trends in attitude: how to measure?
  - How to report feedbacks by operators?

- **Validation**
  - Expensive and little repeatable: how to test affordably before commissioning?
  - How to provide evidence to facilitate inspection?
  - What to require (what to look for) when assessing a robot system?

- Changing layout and mobile robotic manipulation
- Legacy machinery and assemblies of machinery