Building consensus for using protocols to validate collaborative robotics applications across a wide range of domains

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Overview

- The Challenge
  - Collaborative robotics for various domains
  - Standards not always available
  - How to validate system safety?
- Concepts of safety skills and protocols
  - The standardization conundrum
- COVR Approach
  - Our path forward
- Building a consensus
  - Get involved! You can help!
Collaborative robots are coming to the market

- But what about human health and safety??
- What about the CE Mark?

- “Have I identified all the standards, directives and guidelines that are relevant for my application?”
- “How do I prove that the safety mechanisms I have chosen are correct and offer the required level of safety?”
What if my application doesn’t fit into a domain with available safety standards for collaborative robots?

- Industrial manufacturing
- Healthcare and rehabilitation
- Logistics
- Civil
- Consumer
- Agriculture
How do I test to ensure that my system is “safe”?

- Can I do the measurement myself?

- Performance-based vs. Prescriptive regulation and standardization

- Where/how can we specify a specific measurement procedure, sensor, etc.?

“Give a person a fish,

feed them for a day.

Teach a person to fish,

feed them for a lifetime.”
Can system integrators and end-users validate the safety of their applications featuring collaborative robotics themselves, whereby

- ...the validation procedure is well-understood by the integrator / end-user?

- ...notified bodies / health and safety inspectors across Europe accept the results without requiring further tests?
Safety Skills

- **Safety skill** is the ability of a collaborative robot to mitigate the risk in a potentially hazardous situation.
  - to implement safety requirements

- **Capability of effective risk mitigation** must be proved by validating the skill.

- **Skills** are mostly cross-domain.
Safety Skills

- Industrial manufacturing
  - ISO/TS 15066
    - 4 Safeguarding modes
      - Power and Force Limiting
      - Speed and Separation Monitoring
      - Safety-rated Monitored Stop
      - Hand-Guiding

- Healthcare and rehabilitation

- Logistics

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Safety skills
- Limit force and pressure during collision
- Ability to stop robot movement before a collision occurs
- Ability to reduce the impact effect during contact
- Ability to restrict a single degree of freedom
- Ability to restrict multiple degrees of freedom to define area or volume
- Limit / reduce speed during operation

Approach for Identification of Skills:
- bottom-up
  - identified from existing standards
- top-down
  - analysis of risks and mitigation approaches for various domains
Standards are non-binding

BUT

Burden of proof of conformity increased when not using standards

⇒ Use safety skills - based in standards from other domains - to bridge the current gaps
- **Procedure** to assess the safety capabilities of a certain skill in a quantifiable fashion
  - **Protocols** ensure a consistent and correct validation procedure
- **Contribution** for the validation of collaborative robots
  - Comply with regulations
  - Implement best practices
  - Fill gaps
- **Community feedback** requested for creating new and refining available protocols
- **Developed and proved** through realistic in-house trials

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- Introduction describes the area of applications including:
  - Scope and limitations clarify the specific purpose
  - Normative references summarize the applicable regulations
- Definition and terms
- Concept and Objectives specify the target behavior and target metrics
- Conditions specify the system relevant parameters, sub-systems, and the environment
- Set-up describes the test arrangement, sensing devices and data acquisition
- Procedure describes the test plan, execution, data analysis and how to complete the report
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→ Use Safety Skills concept and associated COVR Protocols for self-validation

- notified bodies across Europe accept the results without requiring further tests?

→ Under what conditions would notified bodies accept results from COVR Protocols?
- Characterize measurement **variance**
  - COVR in-house trials
  - COVR Awards
- **Community feedback** requested for creating new and refining available protocols
  - Identify best practices
    - Identify alternative measurement techniques
  - Fill gaps
    - Add environmental conditions (domain/application specific)
    - Create a family of protocols

COVR Challenges
COVR Validation Awards 1st Call

# Awarded per Domain
- Palletizing/pick and place processes
- Occupational Safety
- Cobots in public space
- Logistics
- Agriculture
- Healthcare and Rehabilitation
- Manufacturing

# Awarded per dominant technology
- Other - hybrid between cobot and vacuum lifter
- Robotic controllers
- Mobile robot + robotics manipulators
- Combination of robotic manipulators and mobile...
- Software
- Rehabilitation robots
- Sensors
- Mobile robots
- Robotic manipulators
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Survey of all EU countries (contact info from EU-OSHA website)

- **Scenario:** I am a robotics system integrator who wants to install an application featuring human-robot collaboration (HRC) in a factory in your country.

- As I am familiar with EU legislation, I have done the following:
  - Adhered to the Machinery Directive 2006/42/EC to be able to affix a CE Mark to the complete system. This included:
    - Carrying out a risk analysis according to EN ISO 12100
    - Determining risk mitigation measures and enacting them according to the C-level standards EN ISO 10218-1 and EN ISO 10218-2, as well as the ISO/TS 15066.
    - In a situation where Power and Force Limiting (according to EN ISO 10218-2, physical contact between human and robot is possible) is the safeguarding method, I have also carried out validation measurements to ensure that the contact forces and pressures in case of a collision are below the limit threshold values specified in ISO/TS 15066 and documented these.

- **COVR questions regarding national law:**
  - Do I need to inform a national certified body or other agency in order to begin operation with my collaborative robot?
    - If yes, who?
  - Do I need any further testing/validation/documentation besides the aforementioned standards?
    - If yes, what specifically?
  - Do I need to consider other local/national legislation, restrictions or requirements beyond the aforementioned standards in order to bring the complete robotic application into the market?

COVR Survey

Only 3 of the 14 responses cited national regulation that went beyond MD 2006/42/EC
Help us build a consensus around the COVR approach!

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See us on YouTube (https://youtu.be/n5DN_ZZPDPQ)
Thanks for your attention!

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