Current Activities in International Robotics Standardisation

Dr Chris Harper presentation to European Robotics Forum 2012

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- Head of UK Delegation, ISO TC184 SC2 WG7 (Safety of Personal Care Robots)*

*(recently, supported by euRobotics CA)
WG1 - Terminology and Definitions

An update to ISO 8373 has just been completed

– General class hierarchy of robot types

**Robot**
actuated mechanism programmable in two or more axes with a degree of autonomy, moving within its environment, to perform intended tasks

NOTE 1 It includes the control system and interface of the control system.

NOTE 2 The classification of robot into either industrial robot or service robot is done according to its intended application.

– Extension of vocabulary to include terms for service robots
– New section on Sensing & Navigation
– New diagrams for mobile robots

An update to ISO 9787 (Co-ordinate Systems) is under development

– New co-ordinate systems for mobile service robots
Collaborative operation is the major new development in industrial robotics

Collaborative operation requirements have motivated the following work items:
- Recent updates to ISO 10218 (safety requirements for industrial robots)
- A new Technical Specification (TS 15066) defining collaborative modes is under development

Source: Haddadin et al, Towards the Robotic Co-Worker, Proc. ISRR 2009
Collaborative modes and requirements under consideration in TS 15066:

- **Minimum Separation Distances**
  - Avoid contact with persons as they enter the shared workspace area
  - Maintain minimum separation distance in accordance with ISO 13855

- **Safety-rated Monitored Stop**
  - When no person is in the collaborative workspace area, operate autonomously
  - When person is in workspace area, perform a ‘monitored stop’
  - If person is within minimum separation distance (see above) while robot is moving, perform protective stop

- **Speed and Separation Monitoring**
  - Person and robot may move simultaneously within collaborative workspace
  - Speed and separation of robot shall be adjusted dynamically
  - Robot shall maintain minimum separation distance (see above) at all times
  - Violation of separation distance shall result in a protective stop

- **Power and Force Limiting**
  - Where contact between robot and operator may occur, power and forces shall be limited to inherently safe levels
  - **What is safe level of power or force?** - current work in WG3 - see following presentations by Suzanne and Sami in this session

- **Hand Guiding**
  - Hand-guiding mode is a mix of Speed/Separation Monitoring and Power/Force Limiting
ISO 13482 (draft) - Safety Requirements for Robots in Personal Care Applications

- An interpretation of ISO 12100, the general standard for safety of machinery
- Applies the ISO 12100 risk reduction methodology to robots with personal care applications
- Unusual history - the standard has been developed prior to first commercial applications, not afterwards
- Seen as essential for enabling commercial applications

- ISO 13482 is intended to be a harmonised European standard - compliance with the standard will be interpreted by EC as compliance with European Machinery Directive.
WG7 - Personal Care Robots

Definitions:

**Personal care robot:** service robot that performs aiding actions and actions contributing directly towards improvement in the quality of life of humans, excluding medical applications. This may include physical contact with the human to perform the task

1. **Mobile Servant robot:** personal care robot that is capable of travelling to perform serving tasks in interaction with humans, such as handling objects or exchanging information

2. **Physical Assistant robot:** personal care robot that assists a person to perform required tasks by providing supplementation or augmentation of personal capabilities

3. **Person Carrier robot:** personal care robot with the purpose of transporting humans to an intended destination
WG7 - Personal Care Robots

Mobile servant robots
Fraunhofer IPA Care-o-bot 3
Honda Asimo

Physical assistant robots (incl. exoskeletons)
Boston Dynamics “Big Dog”
Honda prototype exoskeleton

Person carrier robots
Toyota i-Foot / i-Wheel
 WG7 - Personal Care Robots

ISO 13482 contents:

Safety requirements and/or protective measures
- General
- Hazards related to charging battery
- Energy storage and supply
- Hazards due to robot shape
- Emissions
- Electromagnetic interference
- Stress, posture and usage hazards
- Hazards due to robot motion
- Insufficient durability
- Incorrect autonomous actions
- Contact with moving components
- Lack of awareness

Safety-related control system requirements
- General
  (safety integrity levels of standard safety functions)
- Robot stopping
- Software-controlled limits to the robot workspace
- Singularity protection
- Speed restriction and safety-related speed control
- Safety-related environmental sensing
- Force restriction and safety-related force control
- Actuating controls
- Command devices

Verification and Validation

Information for Use
Current Schedule for Completion:

1: Currently resolving comments raised on 1st Draft
   - Due to be completed in July 2012

2: Internal 2nd DIS ballot
   - Lasting 10 weeks, due to finish in mid-October 2012

3: Resolution of comments on 2nd Draft
   - Due to be complete by December 2012/January 2013

4: Register Final Draft version (February 2013)

5: Resolution of comments on Final Draft
   - Due to be complete by July 2013

6: Official Publication of ISO 13482
   - Project to end Aug 2013
**WG8 - Service Robots**

Currently developing a new ISO standard - Performance Criteria for Service Robots

- Specifying performance criteria related to safety requirements in ISO 13482
- Defining benchmark test procedures and test environments intended to validate relevant performance in robots

![Diagram showing test apparatus and procedure](image)

- e.g. obstacle detection test apparatus and procedure
- e.g. speed test

Bristol Robotics Laboratory
WG7 & SC2 - Future Work

Possible Future Developments of ISO 13482:

1: New Personal Service Robot types
2: Incorporation of feedback from industrial experience
3: More detailed requirements for personal care robot tasks
   - c.f. collaborative mode requirements in TS 15066
4: Improved requirements regarding autonomy technology

Future Work in ISO TC184 SC2 (personal opinion):

• Collaboration with other ISO TCs to develop standards for robots in differing industry sectors
  - SC2 provides the expertise on autonomy
  - Other TCs provide the expertise on industry-specific machinery

• Possible future robotic equipment safety standards include:
  – agricultural robotics
  – underwater robotics (oil & gas)
  – intelligent transportation / automotive