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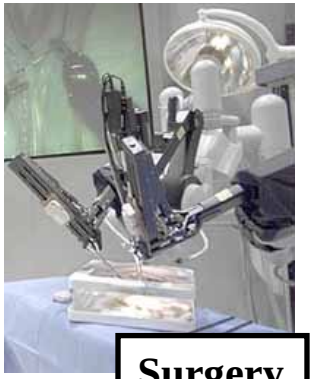
KTH VETENSKAP OCH KONST

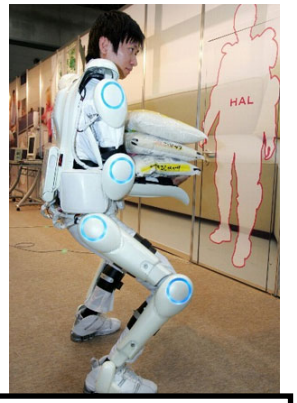
Manufacturing

Collaborative



Surgery

Person carrier



Physical assistant

Robot standardisation: Modularity

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1) Convener: ISO TC 184/SC2/WG7: Personal care robot safety
2) Convener: IEC SC62A & ISO TC 184/SC2 JWG9: MEE & MES using robotic technology
3) Convener: ISO TC 184/SC2/WG10: Modularity for service robots
4) Director: euRobotics Topic Group Standardisation for H2020

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Why international standards?

- Countries need to regulate their own markets to ensure products are safe and organisational procedures reduce environmental impact to allow trade between countries to simplify procedures and make things work
- Standards are voluntary and do not limit/restrict any organisation in any way
- Allow consumers to benefit by the knowledge that state-of-the-art practices are developed/adopted for global relevancy
- Types of standards: Quality, safety and efficiency specifications for products, services and systems
  - Minimum acceptable requirements for: Health, Safety, Environment
  - Metrics for assessing: Safety related performance, quality performance
  - Guidance documents: Test procedures
  - Other standards: Inter-operability, terminology
- Overall aim: one standard, one test, one time
- Too many bodies producing too many standards and this does not help
  - ISO and IEC are the two main organisations globally accepted for producing standards
  - Regional, national and private organisations also develop standards
    - OMG (robotics.omg.org): Foster the integration of robotics systems from development of modular components (mainly S/W); ASTM (www.astm.org): Homeland security, UAVs; IEEE (www.ieee.org): Robot ontology.

ISO-IEC Basics + robotics related

ISO: International Org for Standardization (www.iso.org)

- World's largest developer of voluntary International Standards
- Founded in 1947
- 163 countries as members
- Published more than 19,500 ISs covering almost all aspects of technology and business
- Robot activities
  - TC199: Safety of machinery
    - SG1: Safety data for human-machine interactions: Brian Tranter, Email btranter@btinternet.com
  - TC184: Automation systems and integration
    - SC2: Robots and robotic devices
      - WG1: Vocabulary and characteristics; Soon-Geul Lee, Email: sglee@khu.ac.kr. ISO 8373, WD 19649 (MR)
      - WG3: Industrial robot safety; Pat Davison, Email: pdavison@robotics.org, EN ISO 10218-1, -2, PD TR 10566
      - WG7: Personal care robot safety; Gurvinder S Virk, Email: gsvirk@clawar.org, EN ISO 13482
      - WG8: Service robots, S Moon, sbmoon@sejong.ac.kr, ISO DIS 18446-1 (Locomotion for wheeled robots),
      - WG10: Modularity for service robots; Gurvinder S Virk, Email: gsvirk@clawar.org
      - New JWG Medical robots; Michel Brossoit, Email: michel.brossoit@csagroup.org

IEC: International Electrotechnical Commission (www.iec.ch)

- World's leading organization for all electrical, electronic and related technology standards
- Founded in 1906
- 82 members and 81 affiliates, and 12,500 experts in 1,196 groups
- 6,959 publications in electro-tech
- Robot activities
  - SMG SG7: Electrotechnical applications of robotic technologies; Kevin Behnisch, kevin.behnisch@vde.com; Ma Dejun, Email: madj@cheari.com
  - SC59F: Surface cleaning appliances. WG5-Surface cleaning robots; S Rhim (ssrhim@khu.ac.kr)
  - TC61: Safety of household and similar elect appliances. Safety of vacuum cleaning robots
  - TC166: Safety of hand held motor-operated electric tools. IEC 60335-2-107 (Lawn mowing robots)
  - TC62: Elect equipment in medical practice (IEC 60601 docs)
    - SC62A: Common aspects of electrical equipment in medical practice
      - JWG9: Medical electrical equipment and systems using robotic technology
        - » IEC/TR 60601-4-1: MEE and MES employing a degree of autonomy. (TR ⇨ Collateral)
    - SC62D: Electromedical equipment
      New JWG Medical robots (Being balloted)
      - » Surgery robots; Kiyoyuki Chinzei, Email: k.chinzei@aist.go.jp
      - » Rehabilitation robots; Burkhard Zimmermann, Email: burkhard.zimmermann@hocoma.com

Robots as Machines and as Medical devices

Definition of medical device; IEC 60601-1 Definition 3.63, 3.64:

- **medical device shall assume the same meaning as me equipment or me system**
- **medical electrical equipment-me equipment: electrical equipment having an applied part or transferring energy to or from the patient or detecting such energy transfer to or from the patient and which is:**
  - **a. provided with not more than one connection to a particular supply mains; and**
  - **b. intended by its manufacturer to be used:**
    1. **in the diagnosis, treatment, or monitoring of a patient; or**
    2. **for compensation or alleviation of disease, injury or disability**
- **medical electrical system- me system: combination, as specified by its manufacturer, of items of equipment, at least one of which is me equipment to be inter-connected by functional connection or by use of a multiple socket-outlet**

- **Broadest definition of machinery is given in the EC Machinery Directive as:**
  - **an assembly, fitted with or intended to be fitted with a drive system other than directly applied human or animal effort, consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application**

Missing robot markets

State of the current robotics industry: "Dawn of robots" (Scientific American, Jan 2007) widely accepted but have many problems:

- **Lack of key applications**
- **Fragmented hardware/software**
- **Difficult to provide for reliability**
- **Limited tools and technologies**
- **Lack of reusability**
- **Difficult to transfer skills**
- **Difficult to transfer experience**

Similarity to early personal computer industry!

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ISO robot modularity: What and how?

- **Explore different aspects of robot modularity and develop international standards within ISO TC184/SC2/WG10**
  - **To speed up application development of robotics in industrial, domestic and medical environments**
  - **To guide manufacturers to a unified worldwide market**
  - **Integrated approach requires detailed consideration to developing interoperability standards for**
    - **Software modularity (Interfaces between S/W components)**
    - **Hardware modularity (Electrical connectors, Mechanical connectors and interfaces)**
    - **Specific robot components (e.g. navigation, exoskeleton arm, etc)**
  - **Define granularity and grade of modules**
    - **Basic modules, super modules: interfacing protocols and communications**
    - **Industrial grade, Medical grade, Domestic grade**

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Key issues for robot modularity standardisation

- **Different robot sectors**
  - **Industrial robots (WG1)**
    - **Software & Electrical : No interest for major manufacturers vs. strong interest for SMEs**
    - **Mechanical: Need for reusable mechanical components may not be limited to end-effectors**
  - **Personal care robots (WG7)**
    - **Similar needs to consumer electronics industry, such as PC markets**
    - **Interchangeability of (S/W and H/W) components needed**
    - **Anticipation for major cost reduction**
  - **Medical robots (JWG9)**
    - **Easier certification of medical devices using certified components**
    - **Needed to have affordability**
    - **Mechanical : Surgery tool interface standard could be helpful**
- **Robot modularity could create single new market sector for robotics**
  - **Open market for component makers, component sellers, component assemblers, system integrators as well as application developers (via different grade robot components)**
- **Role for researchers**
  - **Participate actively in WG10 to ensure results are based on state of the art**
  - **Develop new methods for obtaining robot modularity or assess existing methods?**