IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

issa

Occupational Safety in Collaborative Robot Applications

(Extract)

Digital manufacturing

Research results from occupational safety and health

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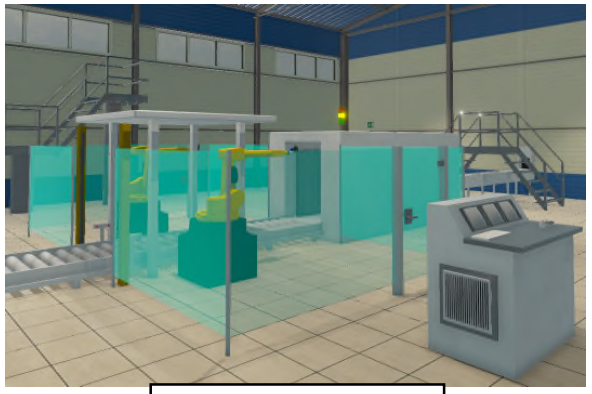
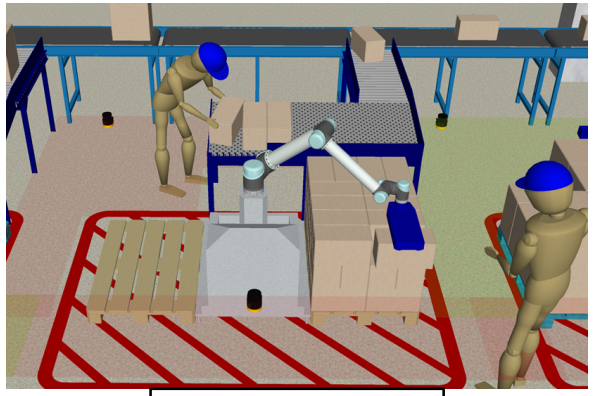
Webinar ISSA, 24.06.2024

Forms of a HRC and compliant safety principles



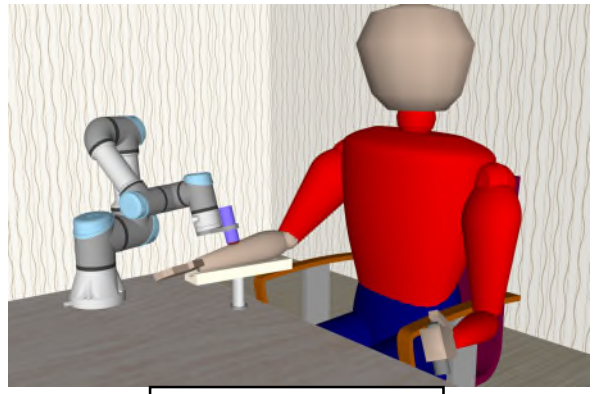
Coexistence

Separate workspace



Cooperation

temporary simultaneous working



Collaboration

permanent teamwork

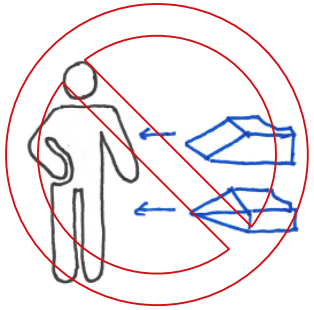
Examples of protection principles according to ISO 10218-2:

Fence*	(may be possible)	**Speed and Separation Monitoring**	Hand guidance
Safeguard Stop	?	(may be possible)	**Power and Force Limitation**

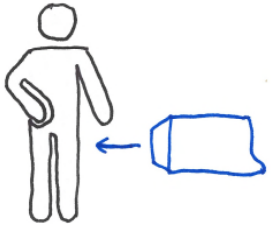
Mechanical Hazards

Shear point

Crush point

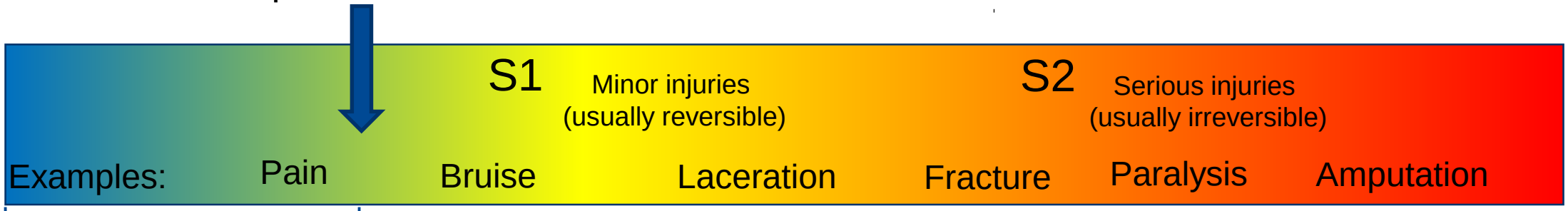


Puncture point

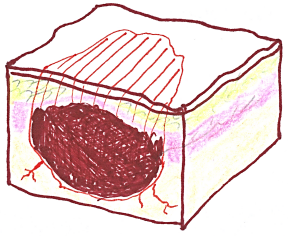


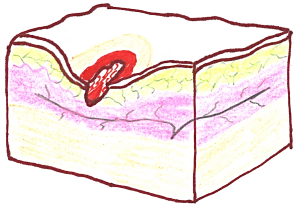
Impact point

load limit based on 75th percentile of pain threshold



reasonable load





Avoid pointed or sharp contours

Background Biomechanical Thresholds

Researchprojects:

- FP317: Experimental assessment of pain thresholds in major parts of the human body due to mechanical exposure in human-machine interface (2011-2014)
- FP411: Follow-up tests to the BGHM Study "Collaborative Robots: Determination of Pain Thresholds at the Human-Machine Interface« (2015-2018)
- FP430: Human-robot collaboration – supplementary suitability tests of recent results for incorporating them into white papers of the DGUV and standards (2019)

Literatur:

- Melia et. al. 2019: Pressure pain thresholds: Subject factors and the meaning of peak pressures DOI: 10.1002/ejp.1298
- Melia et. al. 2014: Measuring mechanical pain: The refinement and standardization of pressure pain threshold measurements DOI:10.3758/s13428-014-0453-3
- Ottersbach, H.J.; Huelke, M.:Requirements for hazard analyses referring to mechanical exposure in workplace applications with collaborative robots. 6th International Conference on Safety of Industrial Automated Systems – SIAS 2010. 14.-15. Juni 2010, Tampere/Finnland
- Behrens et al. 2022: A Statistical Model to Determine Biomechanical Limits for Physically Safe Interactions With Collaborative Robots DOI: 10.3389/frobt.2021.667818

Development and evaluation of a metrological concept for collaborative robots

IFA-Project No.: 5160

Commissioner:

- Expert Committee Woodworking and Metalworking of the German Insurance Association (BGHM)

Research institutions:

- Fraunhofer Institute for Factory Operation and Automation (IFF)
- Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA)

Background:

- new research results are to be considered in standardization

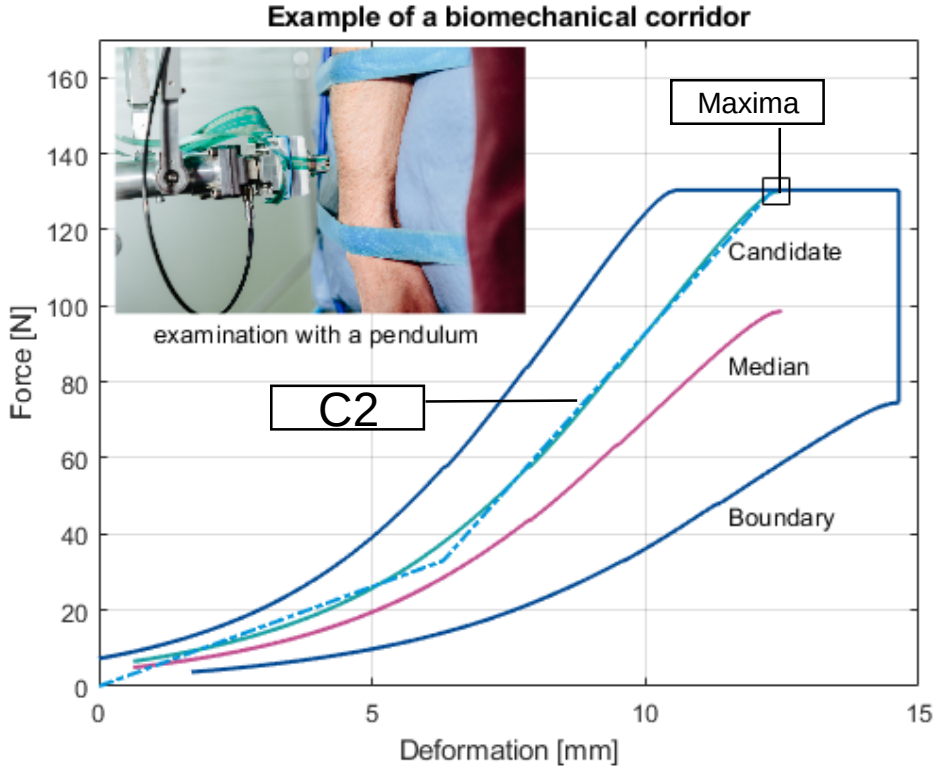
Bilder: @DGUV (Volker Lannert Fotos)

Determination of biomechanical corridors

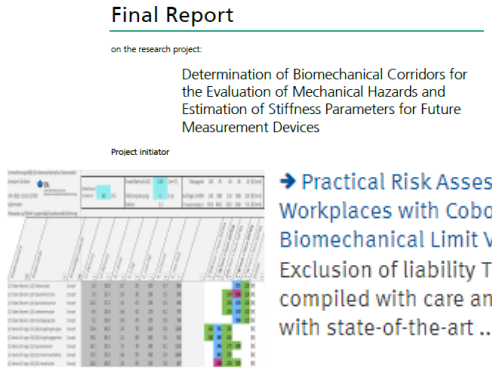
Evaluation of the human subject studies according to the stiffness curves

- Force-deformation analysis

Determination of biomechanical corridors incl. a percentile-dependent **candidate** line and **clustering** of similar body parts



➢ Final Report


Final Report

on the research project:

Determination of Biomechanical Corridors for the Evaluation of Mechanical Hazards and Estimation of Stiffness Parameters for Future Measurement Devices

Project initiator

➢ Practical Solution

➔ Practical Risk Assessment Guide for Workplaces with Cobots: Conversion of Biomechanical Limit Values

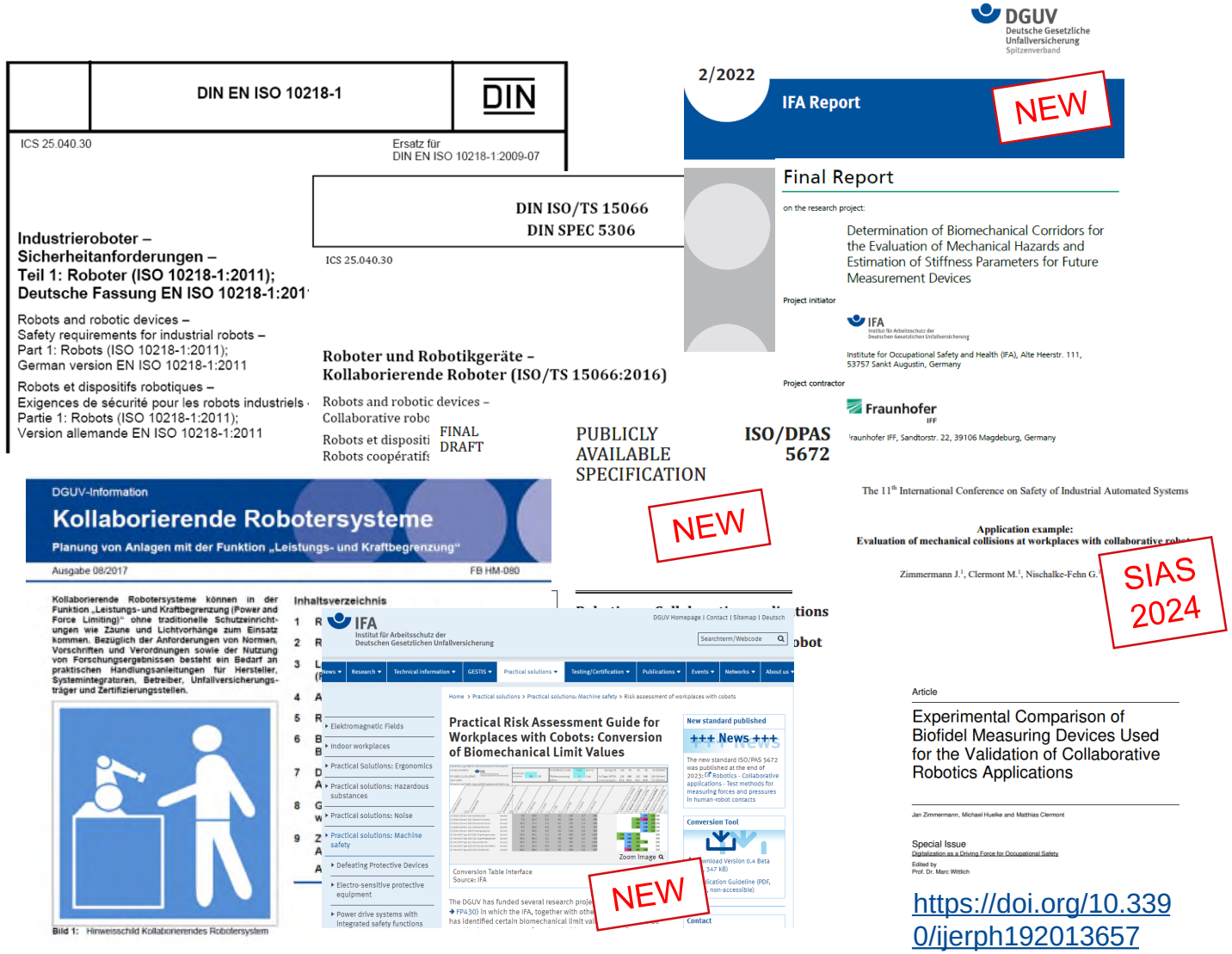
Exclusion of liability The table was compiled with care and in accordance with state-of-the-art ...

Bilder: @DGUV & ©Fraunhofer IFF

Standards & co

- EN ISO 10218: Robots for industrial environments - Safety requirements - Part 1&2
- TS 15066: Robots and robotic devices - Collaborative robots
- DGUV-Information FB-HM-080

- **new:** ISO PAS 5672 Collaborative robotic devices – Test methods
- **new:** Final Report & Practical Solution & SIAS2024



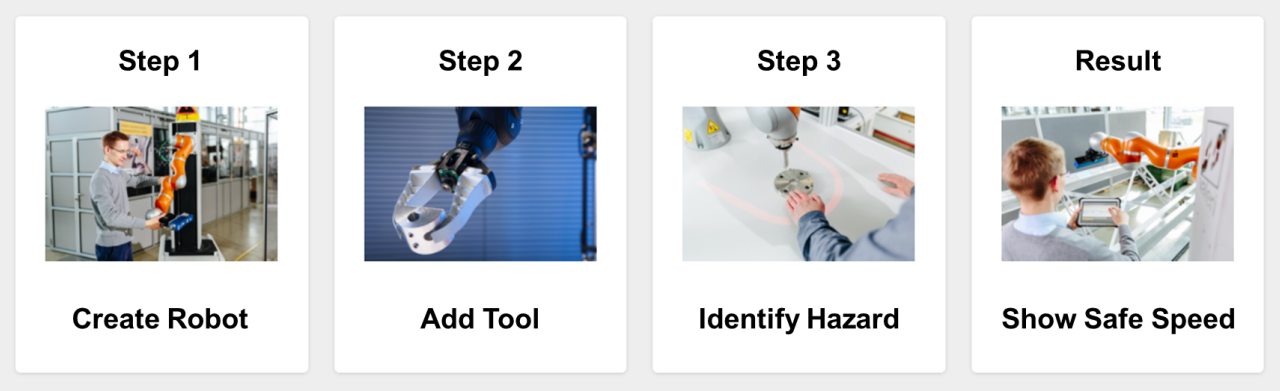
Outlook

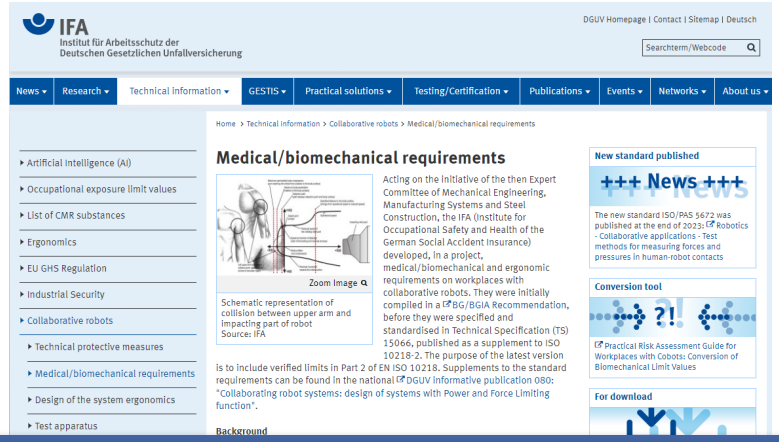
Use of scientific findings for simplified applicability (special case vs. standard applications)

Richness of variants in digital models (accuracy) vs. simplifications for measurement practice (controllability, comparability)

Digital planning tool:

www.cobotplaner.com





more information→

www.dguv.de/ifa
Technical information -> Collaborative robots ->
Medical/biomechanical requirements

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Thank you very much!