A Joint Venture of TÜV Austria and TU Wien

Safety and Security in Industry Research Lab „SafeSecLab“

#SafeSecLab

PhD 9: Automated safety & security assessment procedures for dynamically reconfigurable work systems

The project will investigate possible modification dimensions in dynamically reconfigurable direct human-machine working systems (not only cobots, but also assistance systems in general) and look at current standards to form a combined safety & security assessment process model. Based on this model and results of PhD 4, this project will implement the previously defined models into a software-based tool. Finally, the tool should automatically decide whether the planned modification is compliant to the laws and give recommendation if not.

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Education & Experience:
- UAS Technikum Vienna Mechatronics / Robotics

Interests:
- Human-Machine Interaction
- Safety & Security in Robotics

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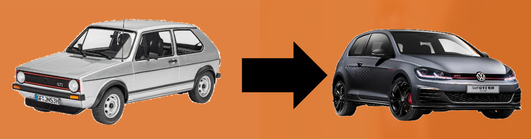
Motivation:

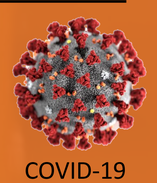
New product generation



Individual products

Temporary help

Alternative products



COVID-19

Need for Dynamically Reconfigurable Work Systems

Requirements for Human-Machine Work Systems:

Compliance with the criteria for **biomechanical limit** values according to ISO/TS 15066 & **conformation to laws** such as the Machinery Directive 2006/42/EC

Problem:

The whole conformity process may be **repeated in case of profound modification.** Further**,** they only take (functional) safety aspects into account and **neglect security**.
This extends and complicates the conformity process!

Research Questions:

How can the safety and security of dynamically reconfigurable human-machine work systems be automatically assessed, and appropriate protective measures derived?

State-of-the-Art:

This project is based on the preliminary project (DR.KORS) [1]

Safety:
- Safe human robot collaboration introduction and experiment using ISO/TS 15066 [2]
- Development and validation of guidelines for safety in human robot collaborative assembly systems [3]
- Digital twins [4, 5] and simulations [6] for safety studies
- Safety assessment of robotics systems using fault injection (RobMoSys) [7].

Security:
- Cybersecurity issues in robotics [8]
- Robot Vulnerability Database (RVD) [9]
- Penetration tests in robotics [10, 11]

First papers are directing into the direction of this topic by the alignment of safety and security risk assessment for modular production systems [12] -> Goals of this PhD are missing!

Expected Research Results:

- 2021: Definition of the modification dimensions and modelling the safety & security conformity processes
- 2022: Development of a software-based tool for the safety & security conformity for defined modifications
- 2023: Automated decision process on the acceptability of planned reconfigurations (based on PhD4)
- 2024: Recommendations for measures in the event of non-conformity through automated testing of a wide range of zoning concepts

Cooperation with other #SafeSecLab Projects

Picture by Michal Jarmoluk

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[3] Gualtieri, L., Rauch, E., & Vidoni, R. (2022). Development and validation of guidelines for safety in human-robot collaborative assembly systems. *Computers and Industrial Engineering*, *163*, 107801. https://doi.org/10.1016/j.cie.2021.107801.

[4] Fukushima, Y., Asai, Y., Aoki, S., Yonezawa, T., & Kawaguchi, N. (2021). DigiMobot: Digital twin for human-robot collaboration in indoor environments. *IEEE Intelligent Vehicles Symposium, Proceedings*, *2021-July*(Iv), 55–62. https://doi.org/10.1109/IV48863.2021.9575499.

[5] Khajavi, S. H., Jaribion, A., Knapen, A., & Abiedat, L. (2020). Digital Twin for Safety and Comfort: A Case Study of Sauna. *IECON Proceedings (Industrial Electronics Conference)*, *2020-October*(December), 167–172. https://doi.org/10.1109/IECON43393.2020.9254270.

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[9] Vilches, V. M., San Juan, L. U., Dieber, B., Carbajo, U. A., & Gil-Uriarte, E. (2019). Introducing the robot vulnerability database (RVD). In *arXiv*.

[10] Hollerer, S., Fischer, C., Brenner, B., Papa, M., Schlund, S., Kastner, W., Fabini, J., & Zseby, T. (2021). Cobot attack: a security assessment exemplified by a specific collaborative robot. *Procedia Manufacturing 54*, 191–196.

[11] Mayoral-Vilches, V., Juan, L. U. S., Carbajo, U. A., Campo, R., de Cámara, X. S., Urzelai, O., García, N., & Gil-Uriarte, E. (2019). Industrial robot ransomware: Akerbeltz. *ArXiv*, 1–4.

[12] Ehrlich, M., Dimitri, A. B., Auhagen-Meyer, H. T., Kleen P., Wisniewski, L., Trsek L., & Jasperneite J. (2021). *e & i Elektrotechnik und Informationstechnik Alignment of Safety and Security Risk Assessments for Modular Production Systems.*