8. Pro²Future Partner Conference

Wednesday, September 13, 2023

Graz University of Technology, Campus Alte Technik

Rechbauerstraße 12, 8010 Graz

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Cohabitation, Cooperation and Complementation of Humans and Robots in the Factories of the Future

Abstract

For many applications of mobile robots with partial or complete autonomy in industrial applications, it is crucial that humans do *not* have to be banned from the operation space, i.e., that space is shared between robots and humans. In this presentation, I will talk about several aspects that are important for the introduction of mobile robots in shared environments and contribute to cohabitation, cooperation, and complementation of humans and robots in future factories. Primarily referring to robots that act as flexible elements of intralogistics chains, I will highlight the following four points:

- Autonomous mobile robots near humans need to be *safe*. This means, among others, that the robots need to reliably know where they are, which calls for accurate and robust localization algorithms. Further, approaches to introspection are required that allow the mobile robots to discover if their localization is not correct any longer.
- The introduction of autonomous mobile robots in a given or only mildly modified industrial environment needs to be as *simple* as possible in order to reduce deployment time and cost. Correspondingly, I will also discuss ways to reduce the deployment time and facilitate the robots to blend into their environment smoothly based on their own learned understanding of the motion they observed in a new environment (learning implicit of "traffic rules").
- The interaction between humans and robots should be *legible and efficient*. Every point at which an autonomous vehicle meets a human or a human-driven vehicle is crucial in this respect. In this presentation, I will talk about different ways a robot can communicate its navigation intention to a human and, vice versa, can understand and predict the spatial intention of humans.
- An advantage in shared environments is that robots can take on dull routine tasks or contribute with complementary capabilities. As an example, I will present how robots, in combination with stationary sensor networks, can densely monitor particulate matter concentrations in work environments such as foundries where the health of human workers is otherwise at risk.

The presentation will end with an overview of the "KI.Fabrik" concept and its current realization in the German Museum ("Deutsches Museum") in Munich.

Short Bio

Achim J. Lilienthal is professor of Computer Science at TU Munich, Germany, where he leads the chair "Perception for Intelligent Systems". He is also manager of the "KI.Fabrik" at the German Museum in Munich and guest professor at the University of Örebro, Sweden, where he established the Mobile Robotics and Olfaction lab and two spinoff companies: Retenua and QTPIE.
His core research interest is in perception systems in unconstrained, dynamic environments. Typically based on approaches that leverage domain knowledge and AI, his research addresses mobile robot olfaction, rich 3D perception, navigation of autonomous transport robots, human-robot interaction, eye-tracking support systems, and mathematics education research. Achim J. Lilienthal obtained his Ph.D. in computer science from Tübingen University with a thesis about gas distribution mapping and gas source localization with mobile robots. He has published more than 300 refereed conference papers and journal articles, has co-edited several special issues, is senior member of IEEE and evaluator for several national funding agencies and the EU.