

Road safety aspects of teleoperation

A decorative graphic in the bottom right corner features a central white circle with a blue outline. From this circle, several thick, stylized arrows radiate outwards. The arrows are colored in shades of blue and orange, with some having a double-line effect. The background of the slide is white with a faint, light blue and orange geometric pattern.

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Teleoperation or remote driving

Increasingly popular in the autonomous vehicles domain:

The logo for ottopia, featuring the word "ottopia" in a lowercase, orange, sans-serif font.The logo for designated driver, consisting of a stylized "dd" in teal and black, followed by the words "designated driver" in a teal, lowercase, sans-serif font.The logo for Phantom Auto, featuring a white stylized "P" icon on a black background, followed by the words "Phantom Auto" in a white, sans-serif font.The logo for roboauto, featuring the word "roboauto" in a lowercase, white, sans-serif font on a dark blue background, with the tagline "DRIVE ANYTHING FROM ANYWHERE" in a smaller, white, uppercase font below it.The logo for vay, featuring the word "vay" in a lowercase, dark blue, sans-serif font on a light orange background.The logo for FERNRIDE, featuring the word "FERNRIDE" in a bold, black, uppercase, sans-serif font, with a green and blue arrow icon pointing right at the end of the word.The logo for Halō, featuring the word "Halō" in a large, blue, sans-serif font with a macron over the 'o'.The logo for voysys, featuring the word "voysys" in a lowercase, black, sans-serif font.

What really is teleoperation?

Three ways of remote intervention:

- Remote management (providing remote route planning etc.)
- Remote assistance (helping autonomous systems to understand the situation)
- Remote driving (actually driving a car from afar)



Need for research

There is a need for human factors research into remote driving. Fortunately, there is already a slowly growing body of research:

- Royal Holloway, University of London – research led by professor Polly Dalton
- Remote Driving Operations (REDO project) – led by VTI with seven other partners
- Situation Awareness in Drivers of Teleoperated Vehicle (TELEOP project) – led by CDV



TELEOP Project

- National project supported by Technology Agency of the Czech Republic
- Duration: 3 years (2020-2022)
- CDV together with Roboauto (providing their teleoperation solution)
- The objective is to understand situation awareness of drivers who control cars through computer interfaces (almost like a computer game)
- Results so far, one publication (Situation Awareness Measurement in Remotely Controlled Cars in *Frontiers in Psychology*), one publication under review, one publication near its finish, design of an optimized control station coming next year.





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Issues with teleoperation

- Difficulty to assess the speed correctly (feels faster than it really is)
- Difficulty to assess the slope correctly (teleoperator can't tell if the car is going up/downhill)
- Difficulty to assess the distance correctly (objects around are shown in non-linear way)
- In case of higher latency, teleoperators tend to end up in oscillating the car
- Insufficient quality of camera (low Dynamic Range creates problems around tunnels)
- High quality wireless connection is vital (required latency below 100 ms)



Main takeaways

- Steep learning curve (novice teleoperators learn very quickly in just one hour)
- Wireless connection quality is crucial for safety (prevents oscillations and is in general necessary for safe driving)
- Quality of camera, especially High Dynamic Range, is very important
- Existing issues for teleoperators are: difficulties in perception of speed, slope and distance
- Teleoperation seems feasible for lower speed environments (30 km/h zones) with premapped connection quality, but is most likely insufficiently safe for speeds above 50 km/h, definitely unsafe for highway speeds



Thank you for your attention.

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