

# ANDRE. AutoNOMous DRIVING Ethics.

**A**utonomous vehicles (AVs) are expected to play a key role in future transportation systems. They will have a global impact that will change society and roadway and transportation system safety. Although AVs are assumed to increase overall road safety, they will not be able to eliminate all risks, which is flagged by accidents that have emerged due to AVs over the past few years.

Therefore, a pressing question – that is also guiding the research of this project – is: How can a fair distribution of risk be realized in the trajectory planning of automated vehicles? The research project is a collaboration between the Institute of Automotive Technology and the Chair of Business Ethics at Technical University Munich. The interdisciplinary composition of the research team allows the creation of synergies and the combination of expert knowledge. The technical development within this project is the creation of software parts of autonomous vehicles. The developed software framework consists of four different modules, namely the trajectory planning, a risk assessment, trajectory prediction and a simulation environment. The focus here is on trajectory planning, which considers ethical aspects as part of a risk distribution. Finally, this software allows to test and empirically evaluate different ethical concepts.

**Additionally, in terms of ethics related developments, the ANDRE-project aims at providing practical recommendations and guidelines for the automotive sector to serve as a checklist and moral compass on how to proceed and what to consider when developing AVs.**

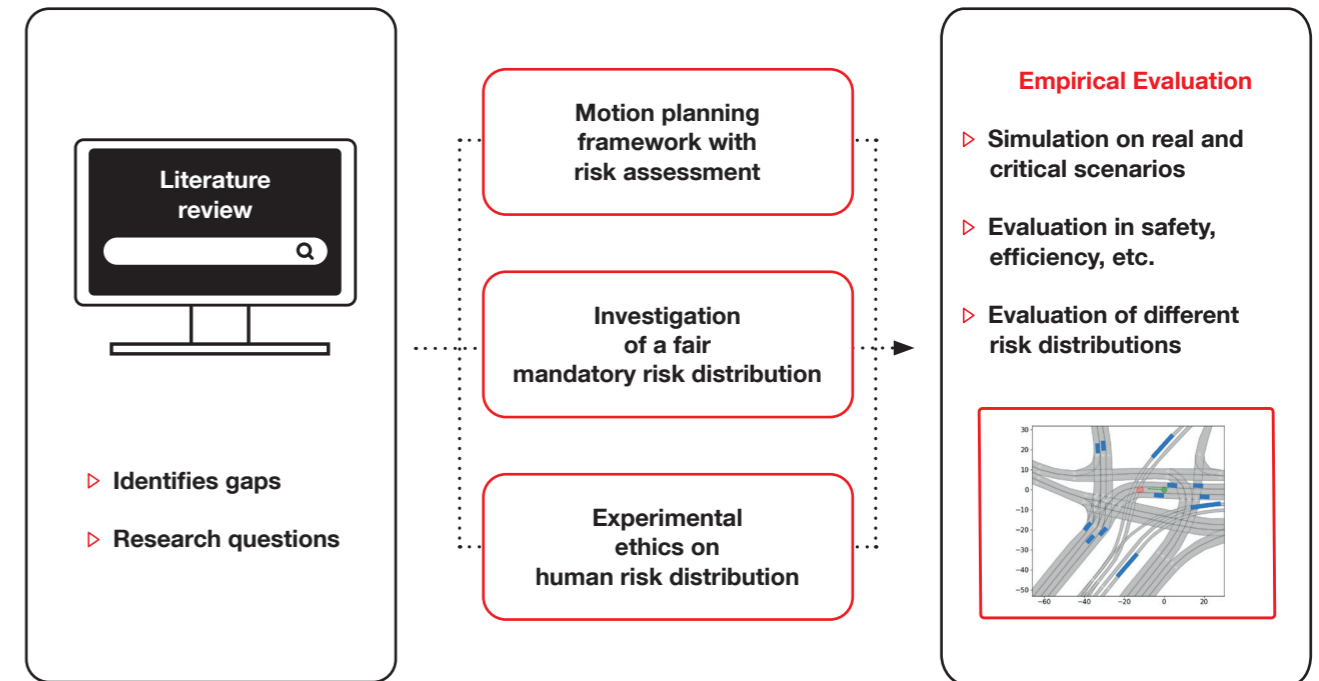
## Preliminary findings from the project include:

- ▷ The discussion in the field autonomous driving ethics needs to refocus: Instead of decision metrics for dilemma situations, as demanded by the trolley problem, a concept of responsible assessment and balancing of risks should be developed, especially for mundane traffic scenarios.
- ▷ Risk assessment can be integrated into the trajectory planning of AVs in the form of (a) an optimization problem and (b) validity checks (e.g., for maximum acceptable risk). A corresponding mathematical formulation of risk in the context of AVs is established within this project.
- ▷ First results show three maxims that are important for a responsible assessment and balancing of risks in the context of autonomous driving: Minimization of the overall risk, priority for the worst-off and equal treatment of people.
- ▷ Enforcing these maxims in practice would translate, amongst other, into the prohibition to base balancing of risks on personal features of individuals but instead to base it on more objective factors that determine (a) collision probability and (b) estimated harm. Such factors can be the speed of particular traffic participants or the impact angle under which a collision would occur.

## Plans for 2021

In 2021, the research team will finalize more publications, as well as conduct an experiment with the aim to investigate individuals' risk distribution preferences and detect potential thresholds of acceptable risk in traffic scenarios. Furthermore, the research team plans to organize a public roundtable to present and discuss the mid-term results of the ANDRE-project with key stakeholders in the automotive sector such as manufacturers, policymakers and consumers. ●

## Project overview



## 2020 Paper and Project Highlights

- ▷ AI4People-Ethical Guidelines for the Automotive Sector: Fundamental Requirements & Practical Recommendations for Industry and Policymakers, International Journal of Technoethics (Lütge, C., Poszler, F., Joaquin Acosta, A, Danks, D., Gottehrer, G., Mihet, N. L., Naseer, A)
- ▷ Programming away human rights and responsibilities? The Moral Machine Experiment and the need for a more 'Humane' AVs Future, Nano Ethics (Kochupillai, M., Lütge, C., Poszler, F.) Autonomous Driving Ethics: From Trolley Problem to Ethics of Risk, Philosophy and Technology (under review) (Geißlinger, M., Poszler, F., Betz, J., Lütge, C., Lienkamp, M.)
- ▷ Holistic overview of the applicability of traditional ethical theories on autonomous vehicles. (under review)
- ▷ Arguing for the adopting 'ethics of risk' in the field of autonomous driving and accordingly, proposes a new framework for the trajectory planning (under review)

## 2020 Conferences

- ▷ 12th annual Forum for Humane Economic Order "Menschenwürdige Wirtschaftsordnung" at the Academy for Political Education in Tutzing, March 2020
- ▷ DiVA – Gesellschaftlicher Dialog zum vernetzten und automatisierten Fahren, February 2020
- ▷ Inaugural meeting of the ITU-T Focus Group on AI for Autonomous & Assisted Driving (FG-AI4AD)
- ▷ The Responsible AI Forum (TRAIF) Preview 2020, November 2020
- ▷ Virtual AI4People 2020 Summit

## Principal Investigators

- ▶ Prof. Dr. Markus Lienkamp, Institute of Automotive Technology, TUM
- ▶ Prof. Dr. Christoph Lütge, TUM School of Governance

## Researchers

- ▶ Maximilian Geißlinger, Institute of Automotive Technology, TUM
- ▶ Franziska Poszler, TUM School of Governance