Upgrading DLR´s GoA3+ Simulation Environment for the next Series of Studies

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Screenshot of the 3D simulated railway infrastructure presented to the participants during their remote control tasks (Source: DLR)

Railway Automation Status

Remote Train Operation (RTO) has been increasingly recognized as a viable option for future rail operations, mainly (a) as an additional fallback layer for **automatic train operation** (ATO) on the mainline in cases of disruption, and (b) for operation on non-centralized infrastructure. Consequently, much work has been done to identify and structure operational scenarios in national and European projects (e.g. ATO-Cargo, ARTE, R2DATO) for both application domains. Current research is focused on the use case of mainline operations.
Despite the fact that a consensus on which operational scenarios can be handled by the RTO staff is emerging throughout the railway sector, this consensus cannot readily be translated to staff planning and scheduling simulations and test cases, because a central assumption needed to test and simulate future ATO and RTO operations remains very difficult to grasp. This central assumption is about the quantity of remotely executed manual interventions to be handled by a single RTO operator in a specific amount of time.

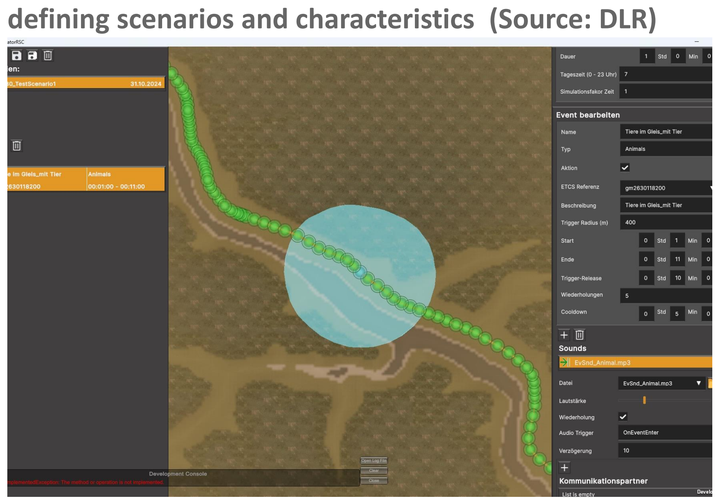
Major Research Questions

Therefore, the research question of the next series of studies is:

How do the amount of manual interventions at the RTO workplace per time unit as well as variations in task content relate to resulting workload levels?

This research question will be addressed by conducting simulator studies using the DLR GoA3+ Simulation Environment.
Independent variables include Number of manual interventions per hour and Modus of intervention assignment.
Dependent variables are subjective workload and fatigue as well as primary and secondary task performance.

Screenshot of the editor used for setting up studies by defining scenarios and characteristics (Source: DLR)



GoA3+ Simulation Environment

In order to conduct studies to answer these questions, the functionality of the DLR GoA3+ Simulation Environment has been increased to feature a **greater variety of manual intervention types** such as network connection checks or degraded driving to an evacuation access point, based on use cases described in the projects ATO-Cargo and R2DATO.
The expected results on workload in relation to amount and content of remote interventions hold great **implications for** operational procedures and planning as it is a central starting point to determining the baseline **quantity of RTO operators** in relation to scheduled train runs in a certain operational area. It is important to note that this quantity is unlikely to be static, but will rather be variable in a **demand-driven** way, given the specific operation´s infrastructure, timetable and operational context. Even more so, an assumption on the baseline quantity is needed.

Project Overview

The GoA3+ Simulation Environment has been evolved through and is employed in the following project contexts:

- 5G-Reallabor
- ATO-Cargo
- ARTE
- R2DATO
- Various DLR internal projects

Core Functionalities at a Glance

Immersive 3D Simulation
- Visual and operational fidelity

Multiple task categories
- Direct Remote Control Scenarios
- Monitoring Scenarios
- Diagnostic Scenarios
- Malfunction Mitigation Scenarios

Extensive Logging
- Post-hoc statistical analyses are enabled through logging and an individual participant level and a overall system performance level

Gefördert durch:
Bundesministerium für Verkehr und digitale Infrastruktur
aufgrund eines Beschlusses des Deutschen Bundestages