

Rail4Future



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1 Executive Summary

This document details the requirements of the visual analysis framework for the Rail4Future platform. This is a living document. We will integrate new insights and knowledge generated in the course of this project, and adapt and extend it as required.

The visual analysis framework should be designed in a way that facilitates adding new use cases and assets. A flexible user interface in the shape of an interactive dashboard should be provided. Point cloud visualisation, maps, charts and simulation planning should be available and linked where the data allows it. Simulation results should be visualised in a spatiotemporal context.

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3 Requirements

This document details the requirements of the visual analysis framework for the Rail4Future platform. This is a living document. We will integrate new insights and knowledge generated in the course of this project, and adapt and extend it as required.

The visual analysis framework should adhere to the following principles:

- Where possible, third-party libraries or tools used by the visual analysis framework should have permissive licences to allow project partners to use results independent of the Rail4Future project.
- The visual analysis framework should be designed in a way that facilitates extension for new use cases and new types of data or simulations.
- The visual analysis framework should be designed in a way that allows restricting features to predefined user groups, for example expert and non-expert users.
- A focus should be to make features accessible to non-expert users, keeping visualisations and interactions simple and intuitive.

The user interface of the visual analysis framework shall be a dashboard that combines different visualisations of various assets. We first discuss general requirements for the dashboard and then requirements for specific visualisation modalities.

The visual analysis framework should provide the following general capabilities:

- where the data allows it, that data should be linked across views in the dashboard
- visualisations should be interactive
- visualisation of data in different geospatial reference systems
- smooth transitions between overview visualisations and details

The visual analysis framework should provide the following visualisations:

- visualisation of point cloud data
- visualisation of geographical maps
- charts for visual analysis like scatter plots, bar charts, time series or heat maps
- visualisation of BIM data
- visualisation for simulation steering and exploring simulation results

3.1 Dashboard

The visual analysis framework shall provide a dashboard as main graphical user interface. The dashboard should be configurable, so it can be adjusted for specific use cases. The layout of the dashboard should be flexible and allow users to arrange and resize individual components of the dashboard to their liking.

The dashboard should allow users to browse and select available assets for further use. Whether the dashboard should also allow users to add new assets to the Rail4Future platform is not specified as of February 2022.

3.2 Point Clouds

The user should be able to explore large sets of point cloud data interactively.

The following capabilities should be provided:

- displaying other georeferenced data as overlays
- highlighting areas where data is selected in another view
- selecting areas to display additional data for that location
- displaying simulation results as colour overlays (e.g. track colour encodes track health parameters)

3.3 Maps

The visual analysis framework should be capable of displaying interactive maps.

The following capabilities should be provided:

- zooming and panning
- maps should be linked to data in other views (e.g. location of data in other views as interactive marker)
- selection of an area or location
- visualisation of encoded parameters on a map (e.g. railway infrastructure health encoded as colour on train lines)

3.4 Charts

The following charts should be available (this list will be extended according to the requirements of new use cases):

- scatter plots
- bar charts
- time series
- heat maps

Charts should allow zooming, brushing and selection. Defining and visualising thresholds should be possible. Charts should show error margins if the necessary data is available.

3.5 Simulation Planning

For simulation planning, the visual analysis framework should provide an interface using a visual programming approach. In this approach, input data can be mapped to simulation inputs visually. Simulation outputs can in turn be mapped to visualisations.

As with other parts of the visual analysis framework, simulation planning should be designed in a generic way to allow new use cases to be added later.

This section will be extended once the interface with the simulation framework is specified.

3.6 Simulation Results and Simulation Run Comparison

The various visualisation modalities mentioned above (point clouds, maps, charts) should be capable of visualising simulation results in a spatiotemporal context.

The platform should provide specialised, interactive tools for comparing simulation runs and studying parameter sensitivity of simulations.

The provenance of simulation results should be communicated to the user. A user should understand how simulation results were achieved. If the relevant data is available, data provenance of simulation inputs should also be taken into consideration.