RAILLIVE!

DigitalTrains™
VAMPIRE PRO

Using Digital Twins for Railway Project Planning

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DigitalTrains™
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INTRODUCTION TO DIGITALTRAINS

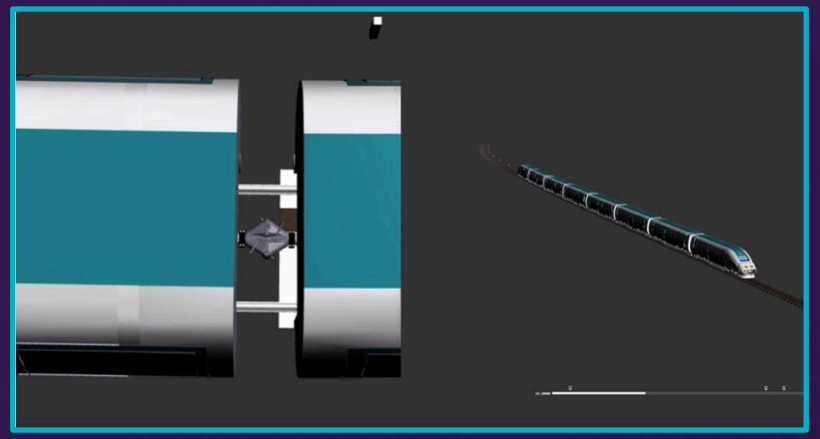
Introduction

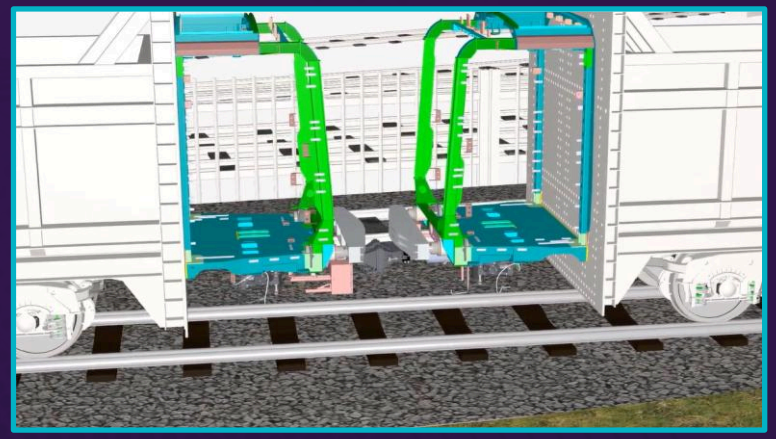
DigitalTrains™ VAMPIRE PRO

DigitalTrains™ is an advanced, cloud-based platform for building Digital Twins of railway infrastructure, rolling stock, and subsystems, and for simulating their performance – all within a single environment.

With intuitive, interactive tools, users can analyse and compare train performance across any route, supporting design, optimisation, and decision-making at every stage of a project.

What is DigitalTrains™





Introduction

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What is DigitalTrains™

Proven Rail Technology:

VampirePro

The world-renowned simulation tool developed by British Rail, trusted for accurate rail vehicle dynamics and ride simulation.

Oleo International

Industry leader in energy absorption technology, supplying libraries and tools for advanced simulation of couplers, buffers, and energy management systems.

Together, these foundations enable DigitalTrains™ to support real-world correlation and showcase project performance with clarity and confidence.

Introduction

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The Vision behind DigitalTrains

The vision behind DigitalTrains™ is to make railway Digital Twin technology widely accessible to the industry by providing extensive libraries and collaborative tools online, in a cost-effective manner.

To make advanced digital twin capabilities available to a broader range of stakeholders, not only specialists.

By taking a holistic approach to modelling the complete railway as a single system, DigitalTrains™ enables every stage of project modelling, simulation, and analysis to be undertaken collaboratively within one integrated environment.

DigitalTrains is a platform for total project collaboration

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A Tool for the Worldwide Railway Industry:

- Project Planners (project development, design, delivery and closure).
- Safety authorities (to support standards compliance, safety case assessments, and technical validation).
- Rail Operators (to assess real-world train performance, maintenance strategies, and infrastructure compatibility).
- Design consultants (enhances collaboration and accuracy in both planning and analysis).
- Trackwork and Infrastructure designer and contractors (for clearance studies and route planning).
- Rolling stock manufacturers (for rescue, gauging & crashworthiness analysis during design & approval stages).
- Sub-system suppliers (Buffer Stops, Bogies, Couplers, Anti Climbers, Gangways etc) (to simulate inter-vehicle dynamics, clearance analysis, validate energy absorption performance etc).
- Monitoring and Maintenance (to simulate repair scenarios and optimise lifecycle support).

DigitalTrains is a platform for total project collaboration

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Using DigitalTrains to design a complete Railway System….

- **Route planning** – map out required route using GPS or other Mapping tools. Tailored to reflect real-world terrain, curvature, gradients, and environments.
- **Infrastructure and Track** – the platform includes libraries of track components and infrastructure features such as curves, gradients, superelevation, tunnels and bridges.
- **Stations** – devise station lengths and define end of line safety devices such a Buffer Stops (Arrestors).
- **Rolling Stock** – build accurate digital twin of rolling stock (including door positions, suspension, drive & braking characteristics, define and optimise the crash energy management systems etc).
- **Buffer Stops / Arrestors** – design and specify end of line protection (for preventing rolling stock from going beyond the track's designated end at stations or depos).
- **Train Operation Analysis** – optimise train performance throughout a designated route (energy usage, intervehicle forces, wheel loading, wheel/rail wear, ride comfort, flange climbing & derailment, power consumption, speed analysis etc.)
- **Gauging Analysis** – to analyse clearances and identifying potential clashes or issues along rail infrastructure.
- **Train Impact Analysis** – analyse rolling stock safety performance during coupling and crash situations.

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Available modules in DigitalTrains™

DigitalTrains™ Train Running
Simulation of train dynamics and performance on real-world routes

DigitalTrains™ Gauging
Clearance analysis for trains and infrastructure

DigitalTrains™ Impact
Impact simulation and crash energy management

DigitalTrains™ Overview

DigitalTrains™ Train Running

- DigitalTrains is seamlessly integrated with the renowned Vampire software, uniquely extending its powerful simulation and analysis capabilities from individual vehicles to full trainsets.
- Accurate modelling of inter-vehicle dynamics, such as the influence and performance of energy absorbers across the entire train.
- Speed of Simulation - Minutes NOT Hours

DigitalTrains™ Overview

DigitalTrains™ Gauging

- Route planning and mapping.
- Track specification – curving, cant, max speed, irregularities etc.
- Comprehensive support for static, kinematic, and dynamic analysis.
- Allows users to simulate real-world train movements and assess clearances with high accuracy of new and existing infrastructure.
- Intuitive interfaces enable easy creation and comparison of custom vehicle and structural gauges, while visualization tools highlight potential clearance issues.

DigitalTrains™ Overview

DigitalTrains™ Impact

- With over 35 years' experience of simulating train collisions and service conditions.
- Proven correlation with dynamic test results.
- In built optimisation of velocity sensitive devices.
- DigitalTrains integrates Vampire Pro and Oleo's longitudinal dynamics code, creating a comprehensive rail simulation package on a collaborative online platform.

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A SELECTION OF KEY FEATURE WITHIN TO DIGITALTRAINS™

Rail Project Route Mapping & Planning

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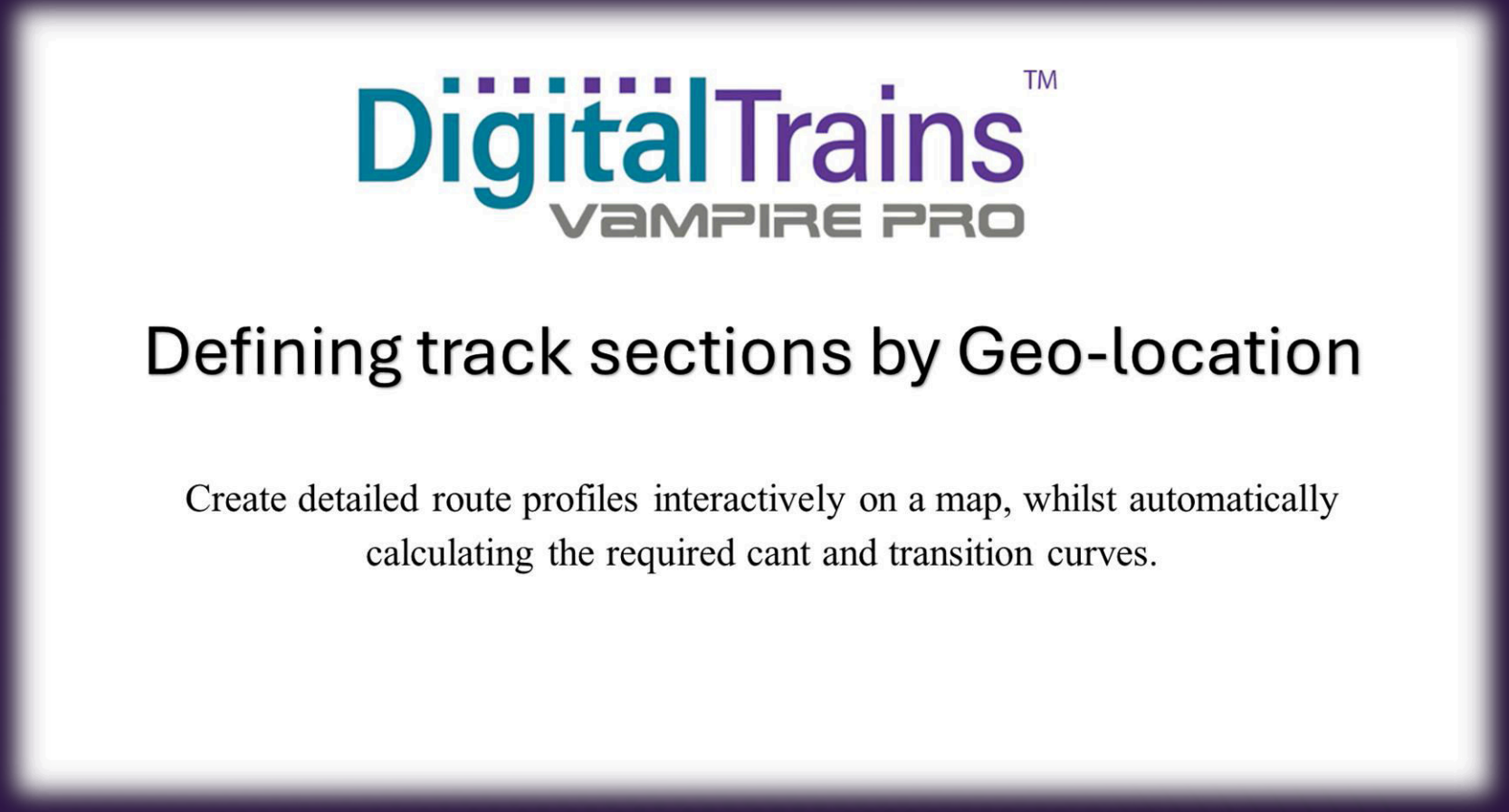
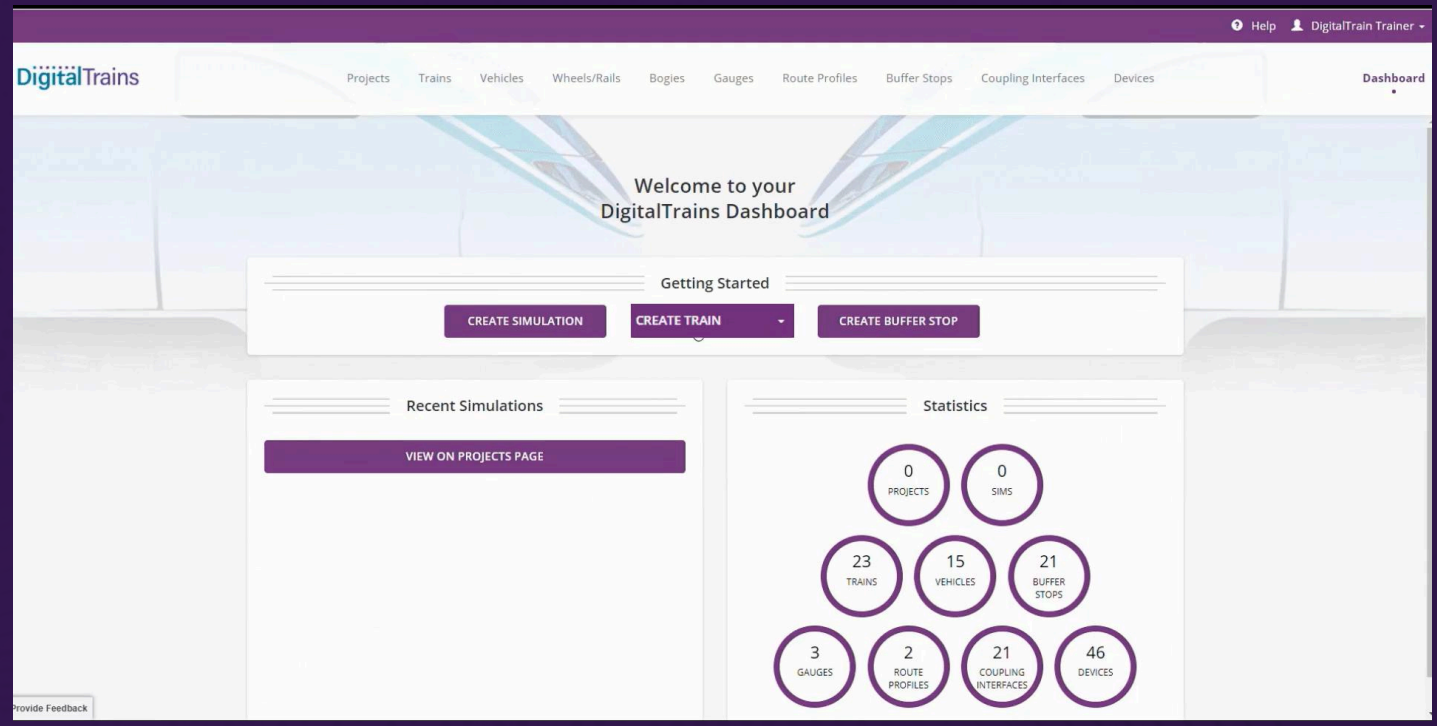
- DigitalTrains can create accurate long routes for evaluating options that influence train operations, projects costs and timescales.
- Route planning can start from existing railway maps, digital maps, to GPS, survey and other measured data.
- DigitalTrains includes options for elevated sections, tunnels, embankments, curves, cant and platform lengths.
- Markers can be placed on the route to replicate braking & traction events or speed limits.



Train Builder

DigitalTrains™ offers multiple tools to create trains for simulations. The train builder feature enables quick and easy assembly using default settings, while users can also build trains from libraries or from scratch.



Comprehensive Model Library:

- Trains are easily assembled from the DigitalTrains™ vehicle libraries.

- Vehicles can be created and saved
  - Detailed car body dimensions.
  - CAD model uploads.
  - Carbody deformation characteristics.

- Libraries and customisable models for:
  - Bogies built from suspension elements
  - Couplers built from pivots, coupler heads, deformation tubes, buffers and other energy absorbers
  - Side buffers, anti climbers and crash boxes,

Vehicle Builder

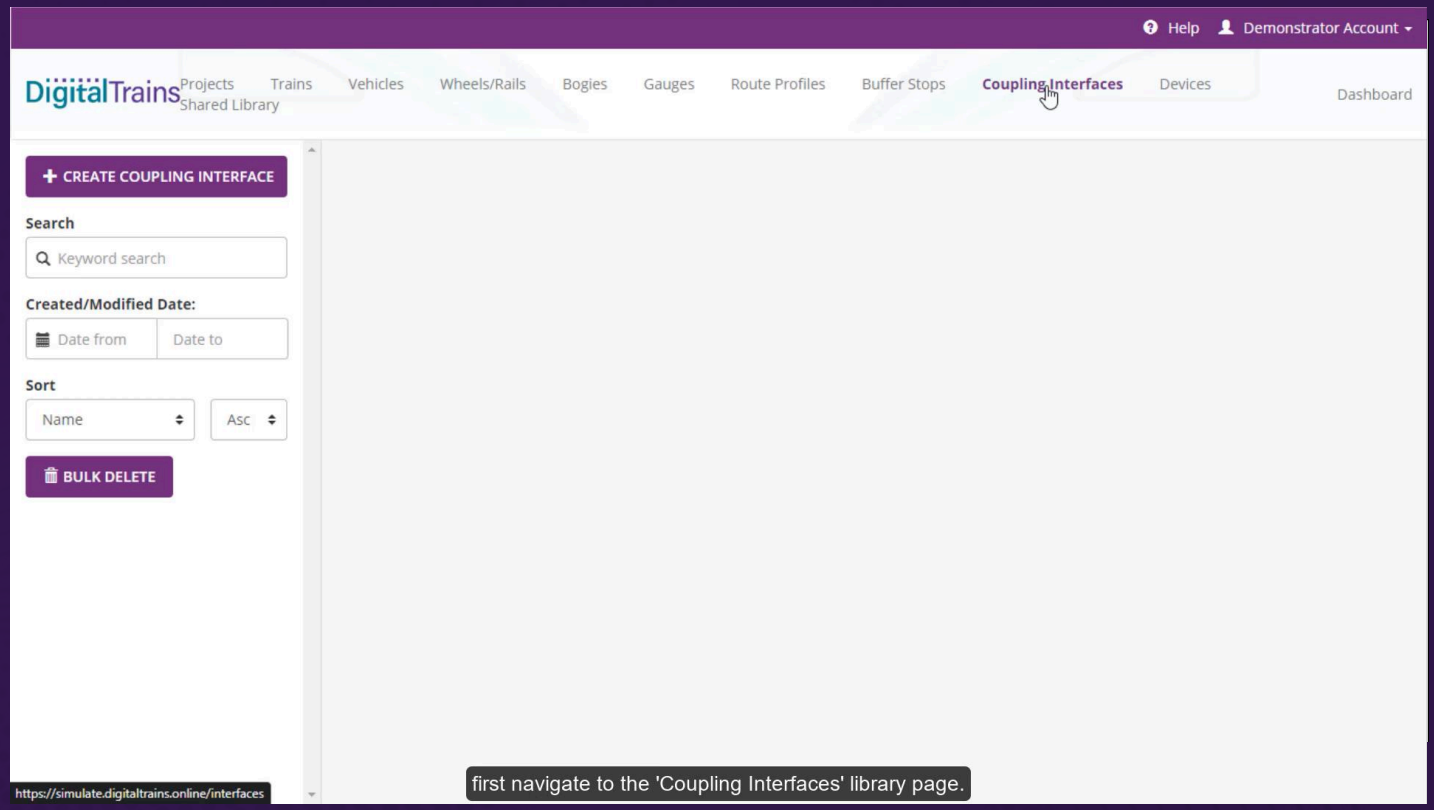
DigitalTrains™ provides libraries for standard vehicles as well as tools to build complex models, upload car body characteristics and build complex geometry for adding bogies, couplers, anti climbers etc.

Comprehensive Vehicle Model Library:

- User libraries can include detailed models for:
  - Manufacturers standard geometry
  - Specific car body designs

- Created bogies, couplers and anti climbers can be added to allow detailed and accurate head-to-head performance comparisons, across any specific route.

- DigitalTrains™ Vehicle Builder is designed to easily create complex Rail Vehicles than can be configured into complete Trains.



Kinematic Analysis

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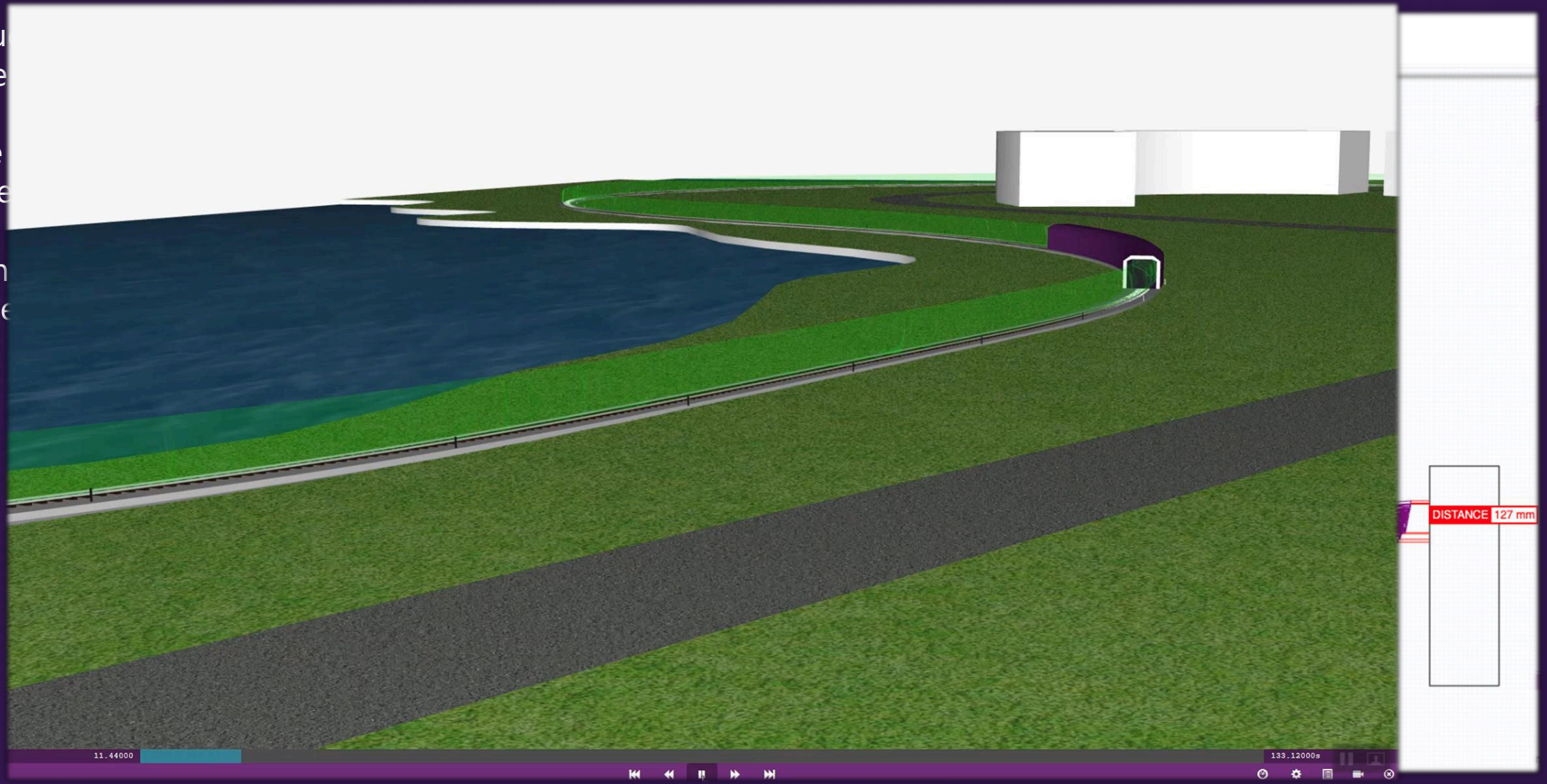

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PROJECT EXAMPLES

Simulating Train Operation and Intervehicle Forces

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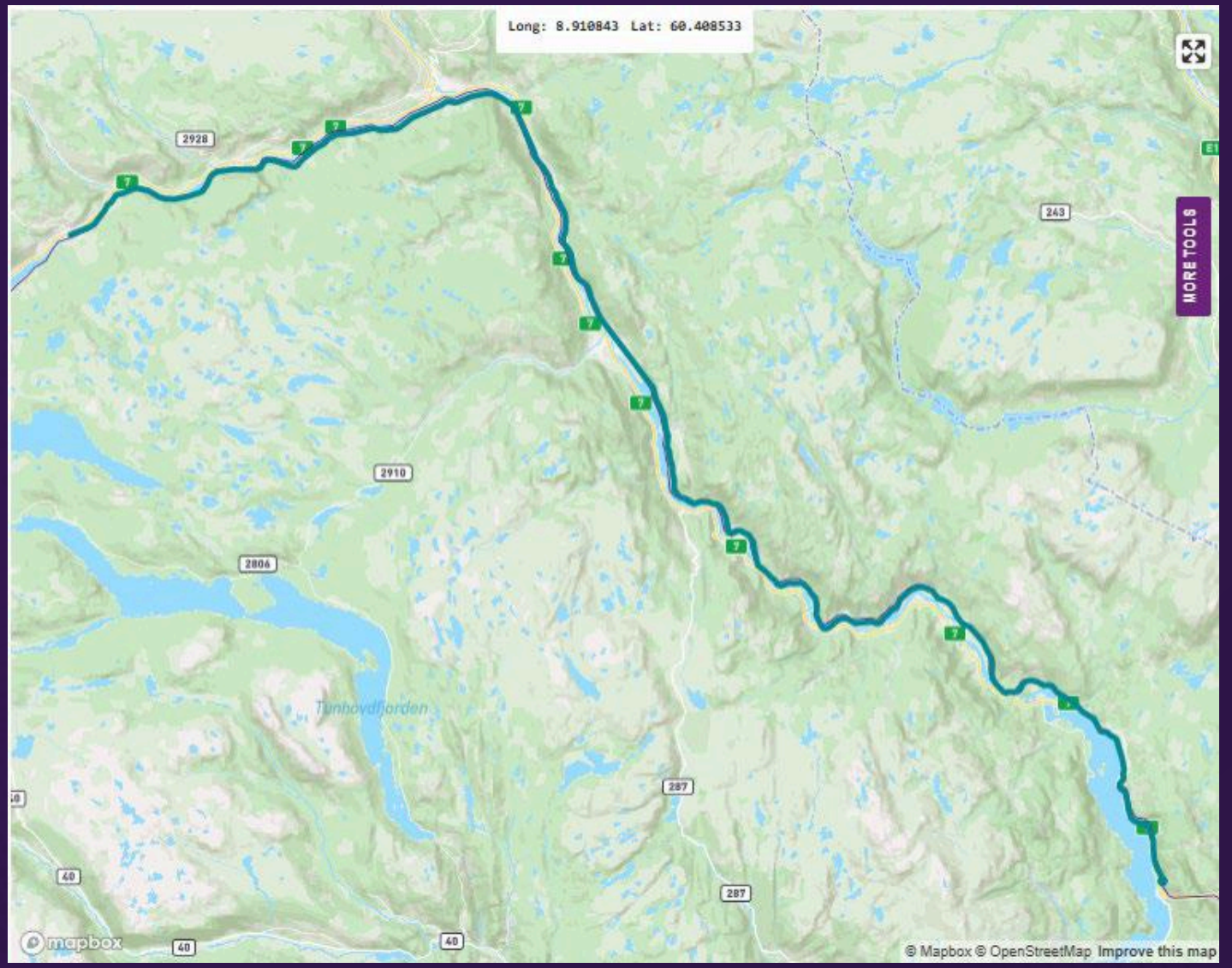
Recent project with European Rail Operator.

- Using Engineering Survey data provided by the customer, an accurate ~100km route was created within DigitalTrains™.
- Test data (for measuring buffer forces) was used to verify digital twin model and buffer performance **– showing good correlation between simulation & test.**
- Markers were placed on the route to replicated braking or traction events to meet line speed limits.
- Alternative energy absorption types were then analysed and compared to the existing with the aim to lower intervehicle forces and reduce vehicle damage during train operation.



Simulating Train Operation and Intervehicle Forces

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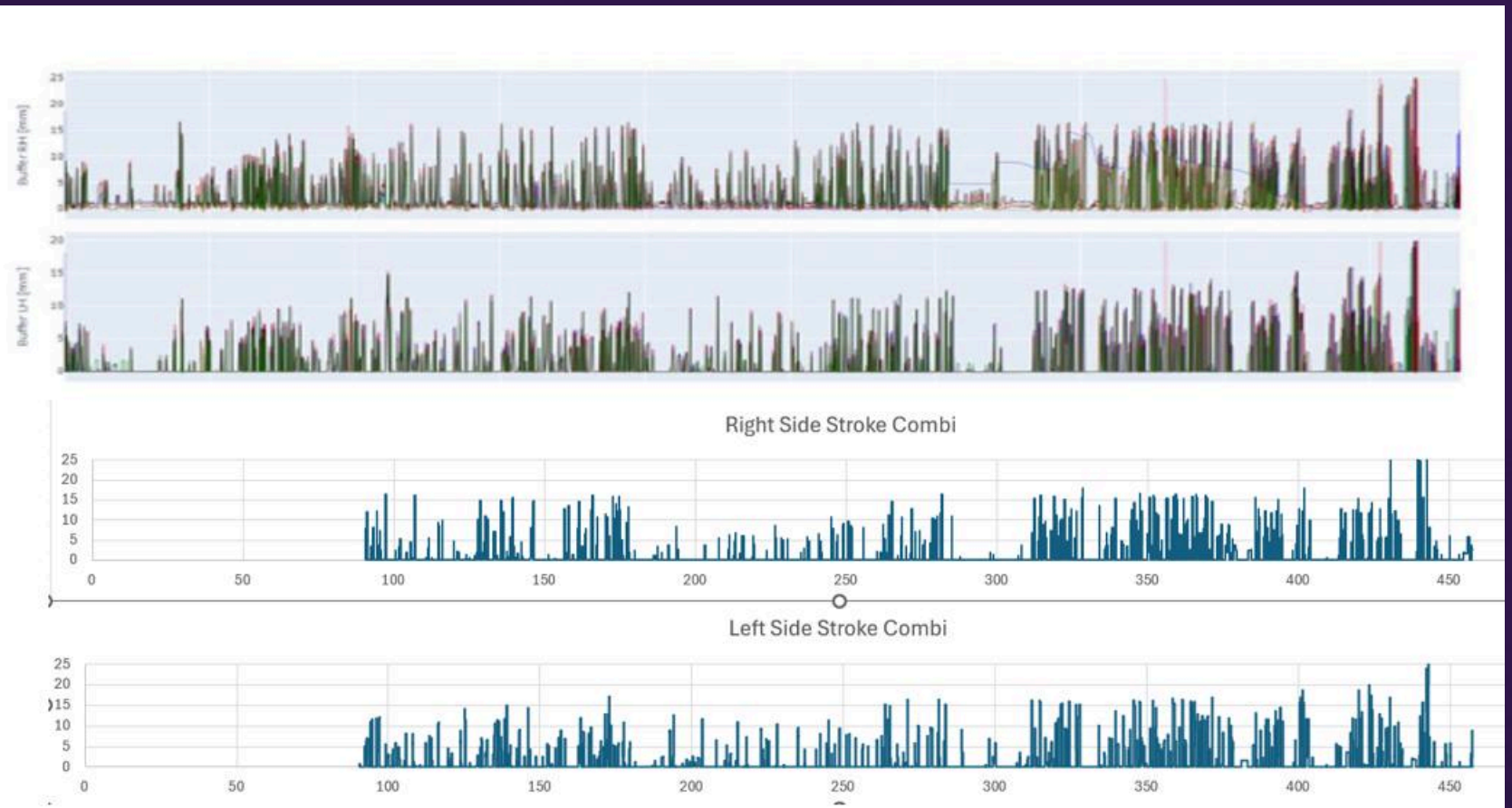
Comparison of DigitalTrains results with Test data.



To validate the modelling, the results of the DigitalTrains™ simulations were compared with the measured test results.

The top data shown are the strokes recorded during the test of the two side buffers (left and right).

These measurements were taken at the interface between the second and third coaches, and when compared to the results from DigitalTrains showed good correlation against the simulated section of the route.

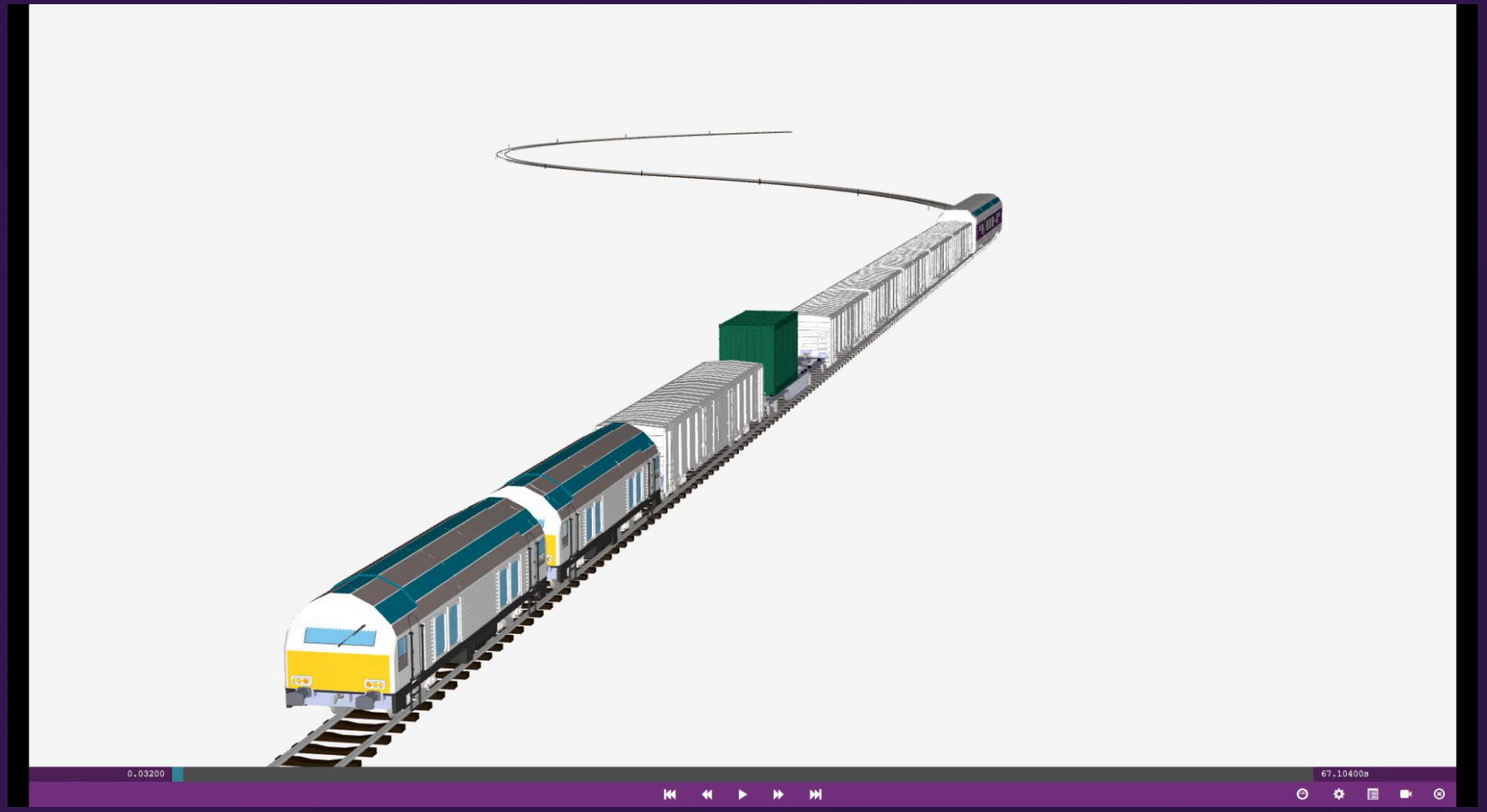
Train Running Analysis - DERAILMENT

DigitalTrains™ VAMPIRE PRO

We have recently simulated a generic freight coupler being propelled through an S-bend.

This simulation is based on a full-size test where a slow speed derailment occurred.

Using the tools demonstrated in this section, we were able to create a simulation which replicated the wheel lift and derailment as the test train travelled through an S-bend.



Train Running Analysis - DERAILMENT

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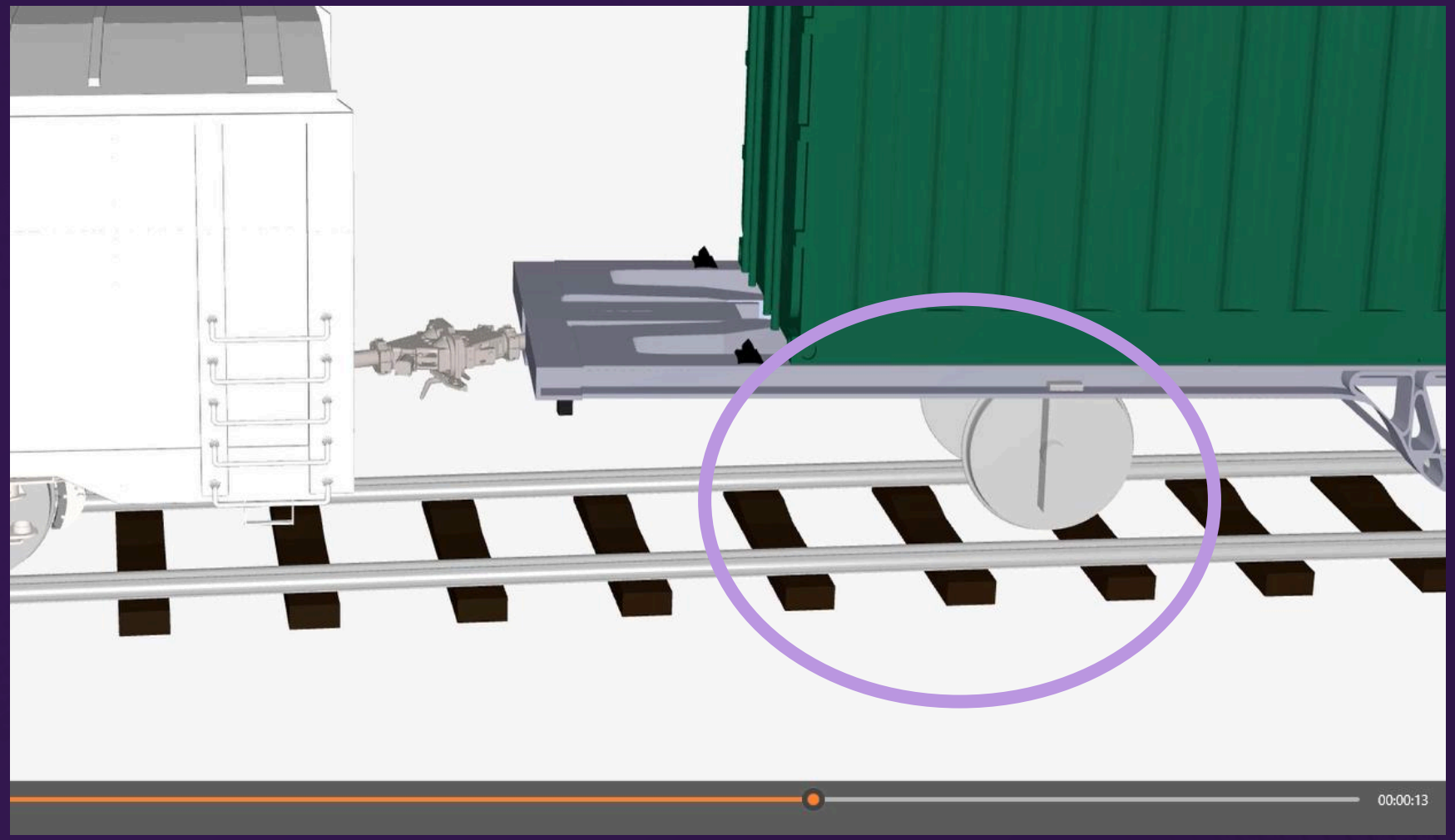

Simulating Train Impacts

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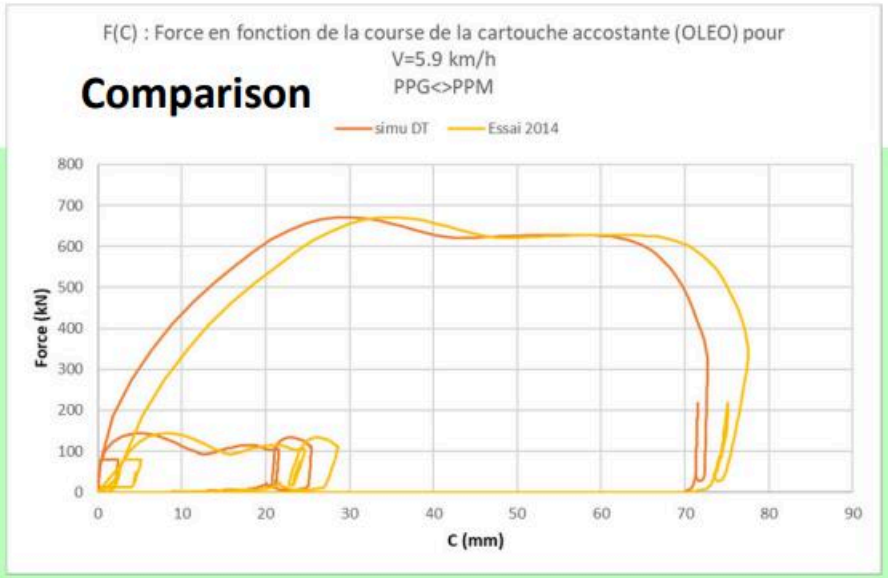

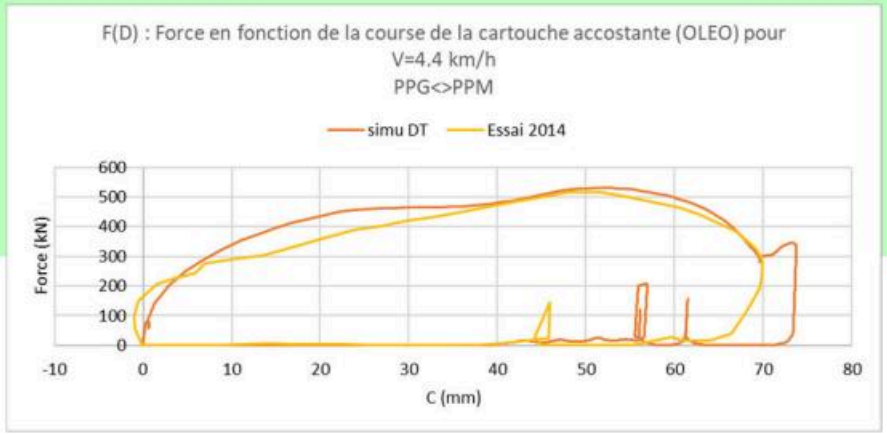

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SNCF VOYAGEURS

REGIOLIS : comparison 2014 tests and DT simulations

Good correlation to full scale testing.

- As an exercise to verify DigitalTrains™, digital twins of SNCF rolling stock were created and compared to actual coupling test data.
- Good correlation between test and DigitalTrains™ simulations were seen.

Reference Thierry Durand and Cédric Dunos, SNCF

Impacts on a Curved Track

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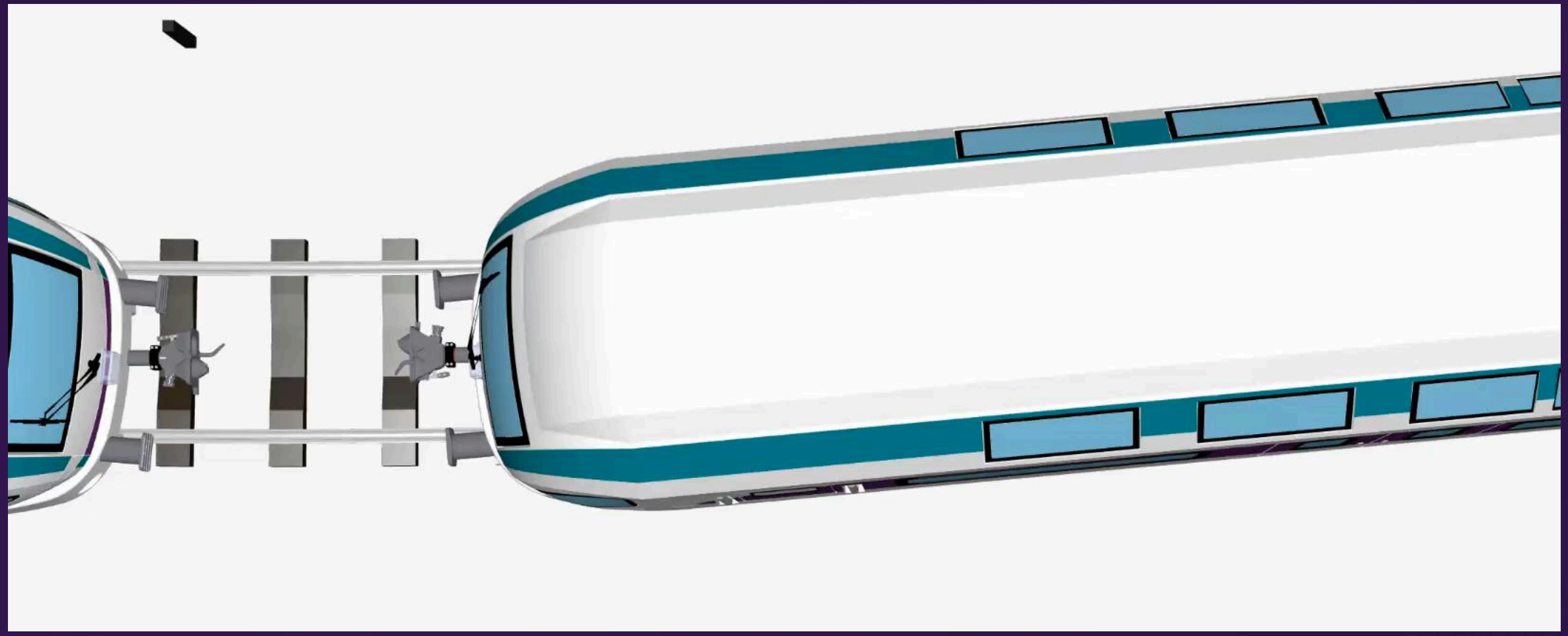
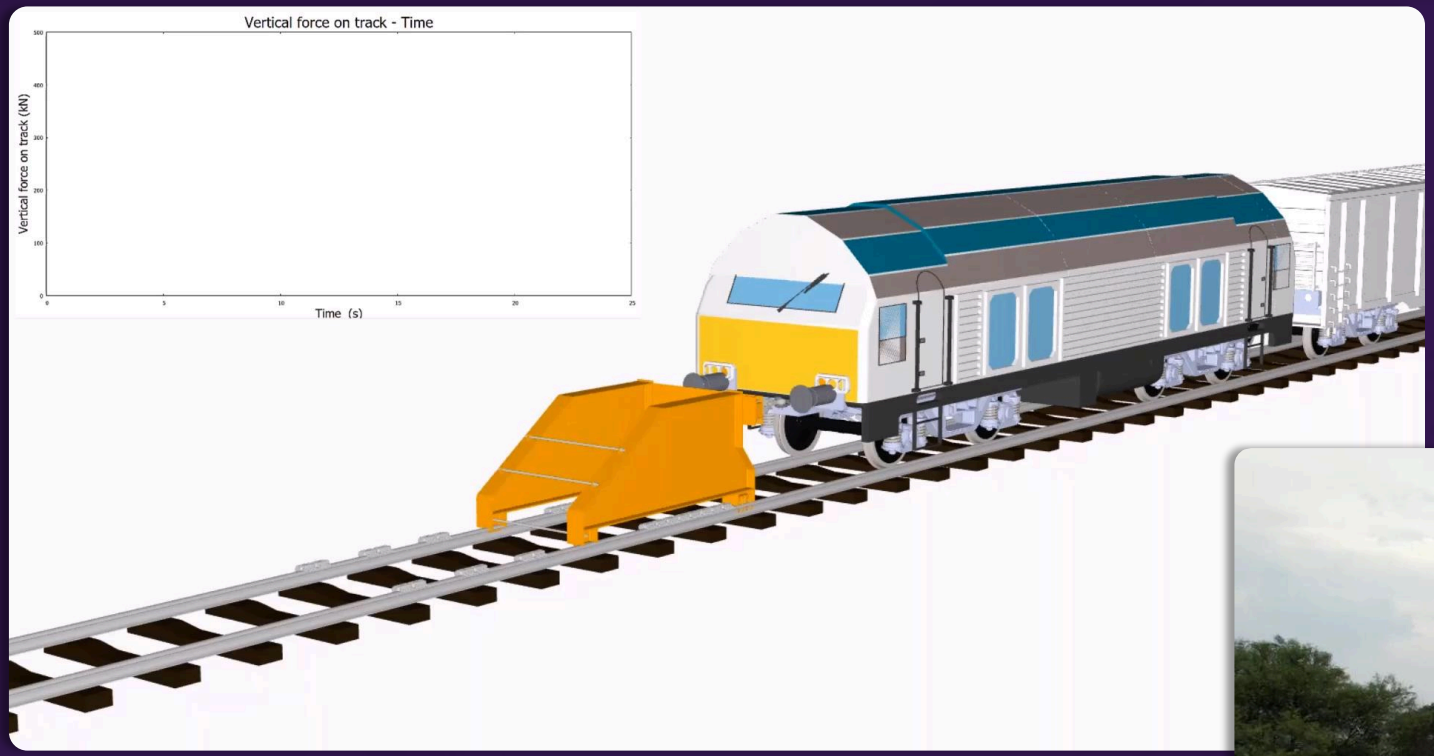
DigitalTrains™ offers a platform for comprehensive impact analysis by precisely simulating the interactions of inter-vehicle energy absorbers.

This includes examining collisions between vehicles on curved and super-elevated track sections, as well as analyzing the subsequent interactions between wheels and rails.



Buffer Stop Impacts

DigitalTrains™ VAMPIRE PRO



Summary

DigitalTrains™ **Gauging** offers a comprehensive suite of tools for analyzing clearances and identifying potential clashes in rail infrastructure. With the ability to create vehicle and structural gauges, run simulations, and perform clearance analysis. DigitalTrains Gauging is an essential tool for designing, testing, and optimizing rail systems safely and effectively.

DigitalTrains™ **Train Running** enables the creation of accurate digital twins of operational trains, allowing rail operators and engineers to simulate real-world performance on any track. It analyzes inter-vehicle forces, suspension behavior, ride comfort, wheel-rail dynamics, and energy consumption, providing deep operational insights for optimization.

DigitalTrains™ **Impact** is a simulation tool designed for crash energy management in railway vehicles. It helps manufacturers and operators comply with standards such as EN152277, the standard for rail vehicle crashworthiness. DigitalTrains Impact Simulation is widely used in the railway industry for crash energy management and impact analysis.

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ANY QUESTIONS?