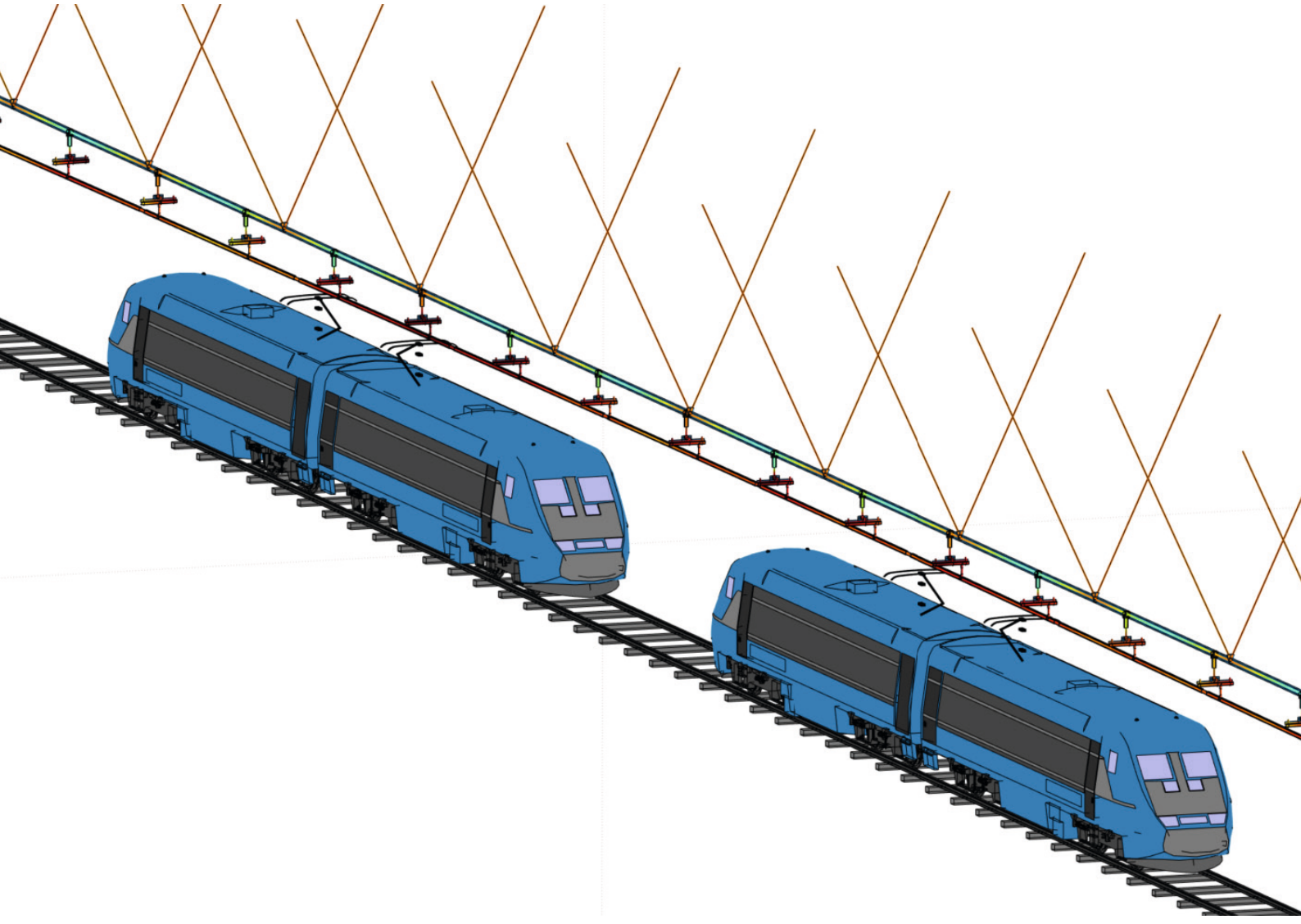
Rail Power Systems

Made in Germany

TracFeed® OSSCAT

Simulation Tool
A Simulation service from Rail Power Systems for your overhead contact line system



TracFeed® OSSCAT

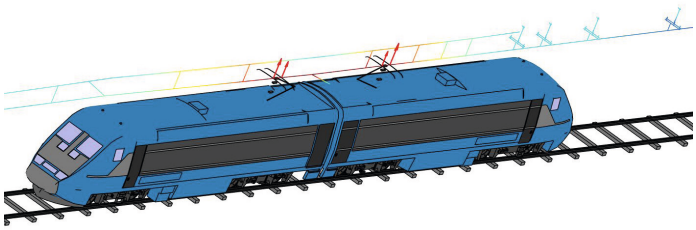
The Validated Simulation Tool For The Dynamic Interaction Between Pantograph And Overhead Contact Line

Norm

The simulation tool TracFeed® OSSCAT is validated based on the following standard: EN 50318:2018 „Railway applications - Current collection systems - Validation of simulation of the dynamic interaction between pantograph and overhead contact line“ (English title).

This European Standard was developed under a mandate from the European Commission to CENELEC and supports the Interoperability Directive EU/2016/797. In this context we explicitly refer to the Technical Specification for Interoperability of the Energy Subsystem (TSI Energy) of Railway Systems in the European Union. The Technical Specification for Energy Subsystem Interoperability (No 1301/2014 of 18 November 2014) was published in the Official Journal of the European Union L 356/179 12.12.2014.

For the issue of the EC design examination certificate for interoperable overhead contact line constituents according to module CH or CH1 of the Energy TSI, evidence of compliance with the criteria for dynamic interaction of overhead contact line and pantograph shall be provided (Energy TSI, Chapter 6.1.4.1.). This requires a simulation tool validated according to EN 50318:2018.



3D visualisation of the FE model of the transition from catenary (FOCL) to overhead conductor rail (ROCL)

Key features

The optimisation and development of the operating performance of overhead contact line systems based on empirical measurements is very complex, time-consuming and limits the number of possible variants. The results of such investigations are also technically and economically unreliable due to the large number of environmental variables (e.g. wind, rain) and to the fact that their effects cannot be reproduced.

Using the simulation program TracFeed® OSSCAT, many variants can be investigated and optimised without great effort in time and cost. With TracFeed® OSSCAT, even very complex overhead contact line system concepts can be investigated. A special feature of TracFeed® OSSCAT is the modelling and simulation of rigid overhead contact line systems (ROCL) and flexible overhead contact line systems (FOCL) as separate models or both systems together in one model. Overhead contact lines attached to cables and traverses can also be investigated.

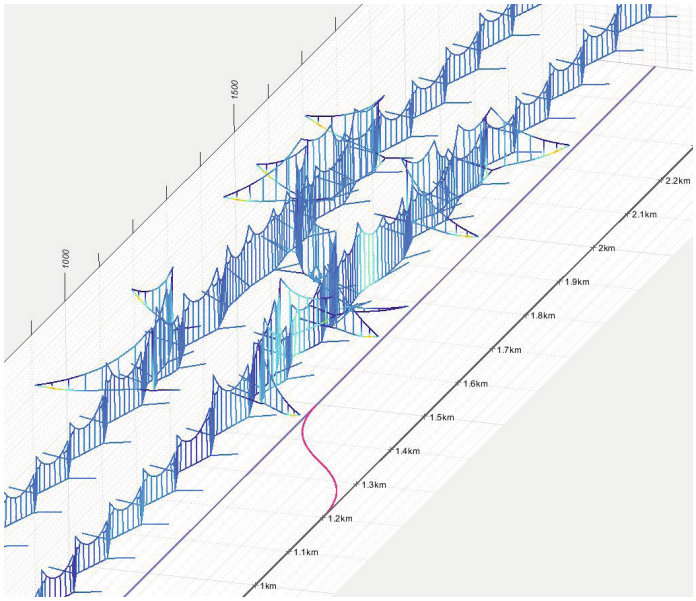
The modelling capabilities of the overhead contact line are very wide. The most important features are summarised below:

- Simulation of rigid overhead contact line systems (ROCL)
- Simulation of flexible overhead contact line systems (FOCL)
- Simulation of hybrid overhead contact line systems (mixing elements of FOCL and ROCL)
- Simulation of ROCL and FOCL in one model to investigate the transition between both systems
- User-defined elements of OCL are available (e.g. section isolator, dilatation, transition beams)
- No limitation on train length to be modelled
- Overhead contact lines with stich wires, supporting wires at support points and additional auxiliary contact wire
- Different tension forces for contact wire, messenger wire and supporting wires
- Intersecting point wiring with crossing bar and crossover droppers
- No limitation of pantographs per train
- Pantograph models with up to eight degrees of freedom and different numbers of contact strips and spring systems
- Influence of climatic effects on the overhead contact line such as wind and ice as well as pressure waves on the pantograph

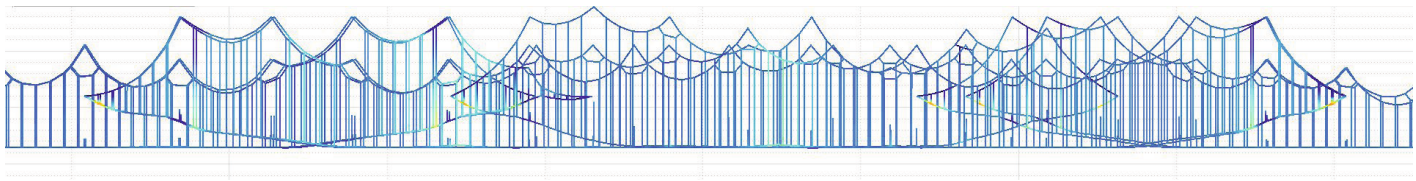
Mathematical basis

For the simulation of the current collection of the overhead contact line system it is necessary to create a mathematical model for the overhead contact line system and the current collectors. TracFeed® OSSCAT is an FEM (Finite Element Method) based simulation system.

A parser reads the model files and stores the data in a database. The two independently operating solvers for the FE model of the OCL and the pantograph models are connected through a contact algorithm. The results can be visualised in 2D or 3D using a post-processor. TracFeed® OSSCAT works completely three-dimensionally and enables curves and track cannot to be taken into account.



3D visualisation of a track connection with a section insulator



Side view of a track connection with a section insulator

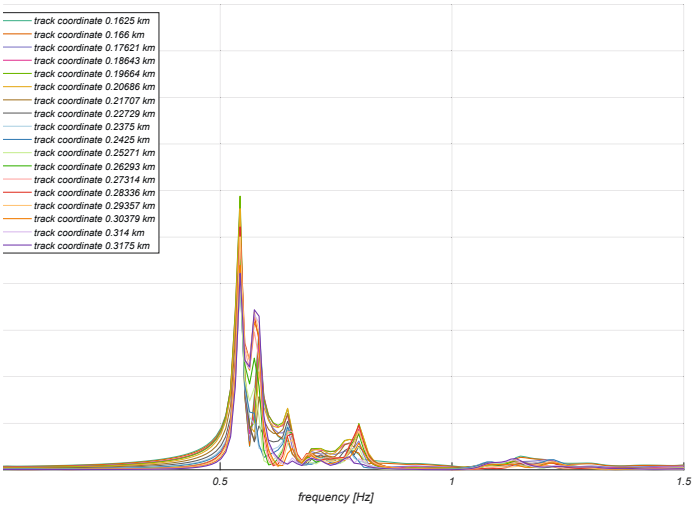
Analysis options

Substantial simulation studies can be carried out with the help of TracFeed® OSSCAT. The analysis options include:

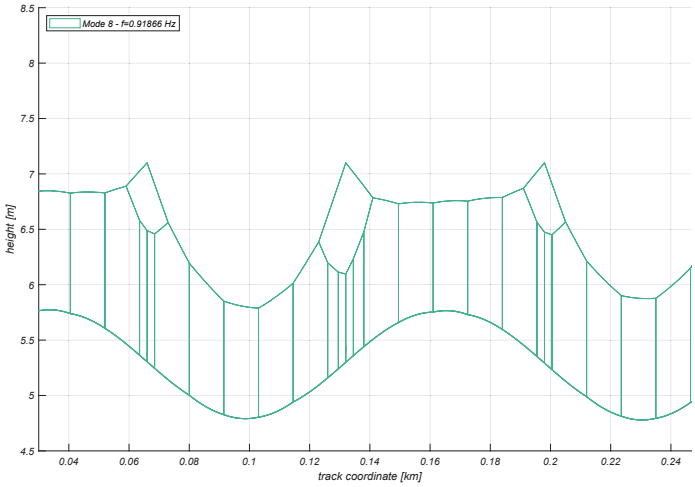
- Statistical evaluation of the contact force (e.g. key figures according to EN 50367).
- Graphical visualisation of the assembly state, the contact force and the movements of the pantograph
- Graphical illustration of the movement of selected nodes in the overhead contact line model, their time curve and frequency analyses
- Location and duration of the arc for each contact strip of a pantograph
- Distribution of contact points on the contact strip of the pantograph, e.g. for life-cycle-prediction
- Elasticity of the overhead contact line

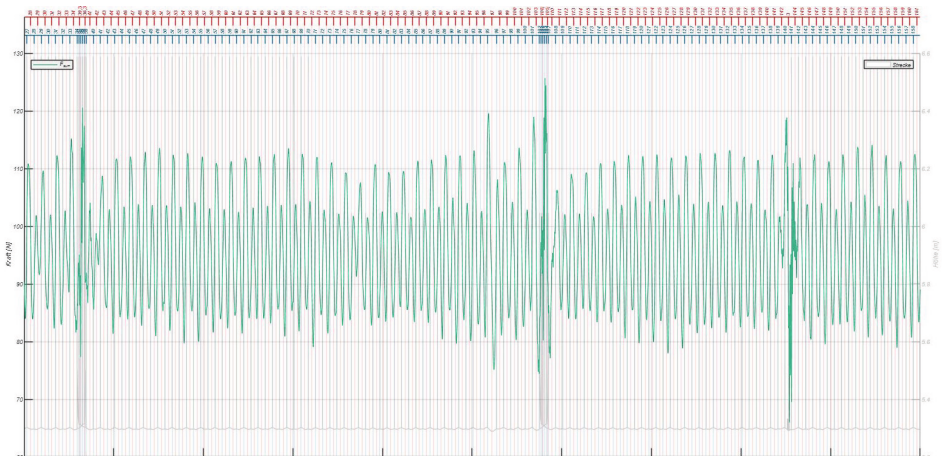
The possible applications for the simulation tool TracFeed® OSSCAT are very various:

- Optimisation/simulation of existing overhead contact line systems
- Development of new overhead contact line systems
- Development/optimisation of special designs
- Investigation/determination of assembly tolerances and their influence on the quality of energy transmission
- Increase of speed in existing lines by changes in the design of pantographs or overhead line system.
- Investigation of operation with multiple pantographs
- Development/optimisation of pantographs
- Frequency analyses of catenary systems, determination of natural frequency and natural mode



Frequency analysis of catenary





Curve of contact force with mounting condition of the overhead contact line conductor rail

Validation process

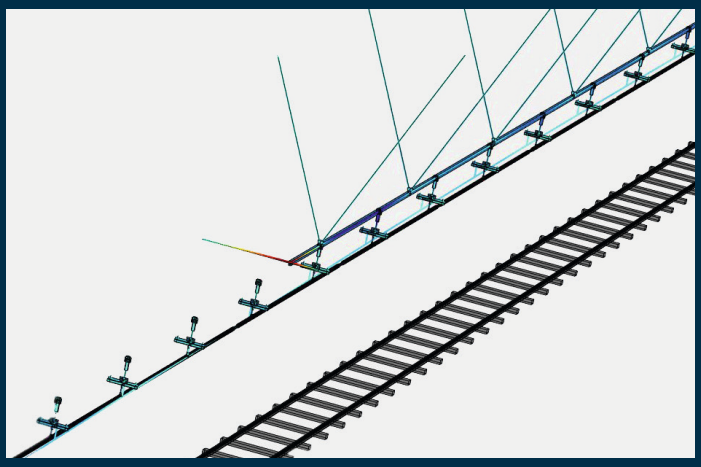
The validation of the simulation tool TracFeed® OSSCAT was carried out according to EN 50318:2018.

As required by EN 50318:2018, chapter 11, the first validation step of the simulation tool TracFeed® OSSCAT is a comparison with a reference model to check the accuracy of the simulation. If the results are within the limits specified in EN 50318:2018, the simulation method can be used for the next validation step (comparison with line tests/measurement runs).

The further steps for validation of the TracFeed® OSSCAT simulation tool include the comparison of measured values resulting from different line tests. For the validation with measured values according to EN 50318:2018, section 10, measured values from line tests shall be provided, which were determined with pantograph measuring systems according to EN 50317:2018.

For the validation of rigid overhead contact lines and if models with the data listed in Annex A of EN 50318 can not be used, the „desk assessment“ may be omitted.

TracFeed® OSSCAT was validated using the measurement data of the City Tunnel Leipzig. The selected curves from the measurements of the track tests and simulations were compared with the requirements of EN 50318:2018

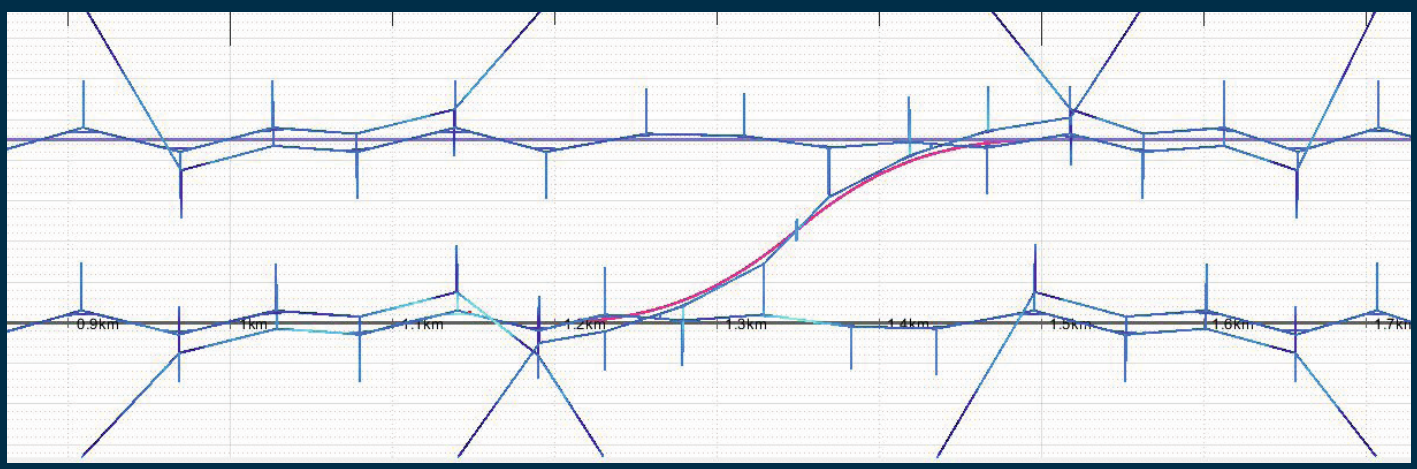


Rigid overhead line fixed under a suspended and tensioned beam

The results of the simulation calculations for the selected comparisons are within the permissible limits according to EN 50318:2018, Tables 1 and 2. The simulation tool TracFeed® OSSCAT can provide all output values required in EN 50318:2018.

This confirms the reliability of the simulation tool TracFeed® OSSCAT. The simulation tool TracFeed® OSSCAT is validated for the simulation of the dynamic interaction between overhead contact line and pantograph.

Top view of a crossover with a section insulator



RPS/EN/435/0824

The specifications set out in this document apply to conventional applications. They do not represent performance limits.

This means that divergent specifications may be attained in specific applications. The contractually agreed specifications alone shall apply. We reserve the right to effect technical modifications.

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