

## The driving simulation program LOCSIM An example of the training simulator from RAILplus AG

To obtain a realistic image of a train ride from the perspective of a train driver, the following components must be available or simulated on a computer:

- Driver's desk,
- Vehicle control (locks, control circuits and control electronics),
- Drive part,
- Auxiliary brakes,
- Security systems,
- Line, security devices and catenary including,
- Hauled load and driving dynamics,
- Environment (view from the cab).

LOCSIM provides its customers with all these components as software or may connect the hardware components involved. The components of the simulator RAILplus are:

A driver's desk, which comprises all the switches and display elements of the railways involved (i.e. the usual switches for starting-up, driving direction, traction / braking, rack mode selection, signal control, etc.), as well as speedometer, manometers and a large number of signal lamps. All these elements are connected to a PLC which transmits and receives data on a RS232 bus which is connected to the the computer simulation.

The vehicle control system is fully implemented, with the exception of the mechanical interlock between start-up, reversing and control switch, on the computer. Similarly, the drive part (determination of tractive effort from control switch position, catenary voltage and speed) and the auxiliaries (eg ventilation, pressures) are reproduced on the computer.

The security features include vigilance device and the following train-protection systems, including their logical and temporal behaviour reproduced on the computer:

- Signum and derivatives in the versions of the SBB/CFF and Swiss narrow gauge railways. To this end, the release button and three illuminated controls of RhB are mounted in the driver's desk.
- Automatic continuous train protection system ZSL90 of RBS and WSB. Both ZSL90 devices (input and display) are originals and mounted in the driver's desk. They are connected to the computer via a converter and a RS232 cable.
- Automatic train protection system ZSI127 of ZB and BDWM. Both ZSI127 devices (input and display) are originals and mounted in the driver's desk. They are connected to the computer via a converter and a RS232 cable.

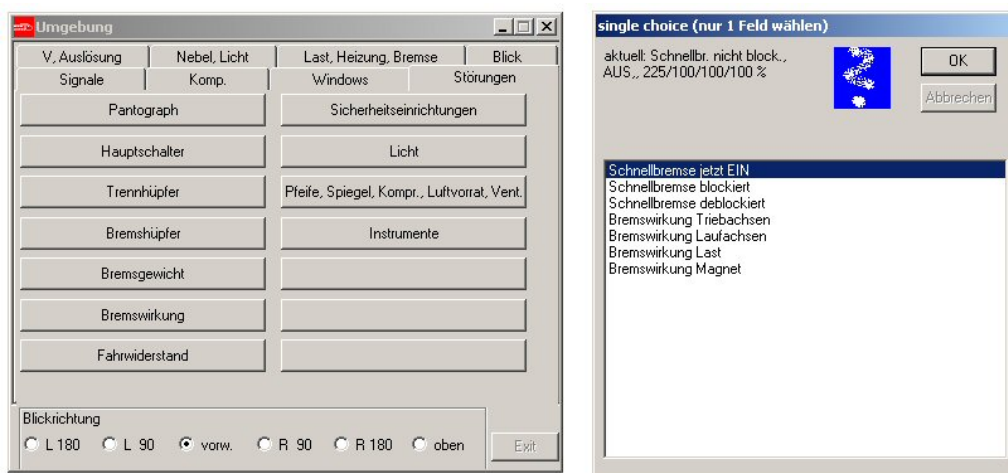
Since the RAILplus simulator serves primarily as a replication of specific operating conditions, the route is displayed in a virtual 3D landscape. Along this line, actual station facilities can be reproduced in any sequence or at any distance. The line should not include great steep gradients or tunnels. The choice fell on earlier work from the S-Bahn Zug. Despite initial concerns, the integration of the Malans station overlooking Lake Zug and view of the Rigi when passing through Zollikofen station have not created any problems for operators. It is possible to place along this virtual track any signals or indicators provided by Swiss or foreign traffic regulations. Objects (buildings, vegetation, as well as trains traveling

in opposite directions) can be installed without problems. Through an interface with the data format of Microsoft Train Simulator, these objects can be easily created with its editors.

The dynamics of train are determined from tractive and braking efforts, along with gradient, curve radius and train weight.

The display of the view from the driving position is done with the OpenGL graphics language that is independent of any operating system. In addition to the driver's forward view of the track, two rear-view mirrors can be viewed simultaneously.

The program is operated from the instructor's position, using a Windows interface with menus and dialogs. On two screens are shown the view from the driving position (forward and mirrors), the main switch position and instrument displays, and a track plan. This track plan is drawn to scale with all indicators and signals, level crossings, platforms, simulated train as well as trains traveling in the opposite direction. Signals and the front lighting of oncoming trains can be changed simply by clicking. It is possible to vary adhesion values, catenary voltage and the loading of the train. It is also possible to produce disturbances of the vehicle (non-response or blocking devices, loss of compressed air) or those caused by travelers (halt request or emergency brakes).



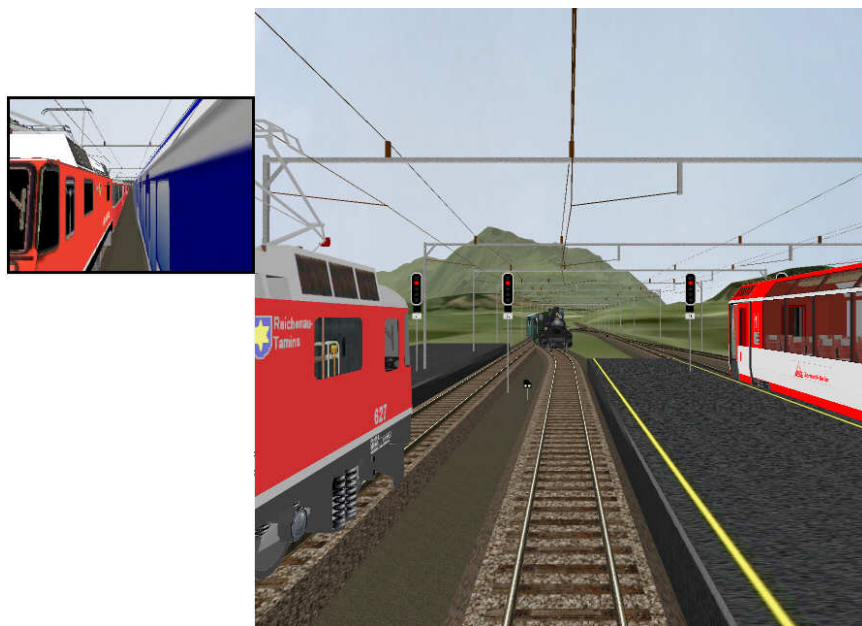
Dialogue for fault input



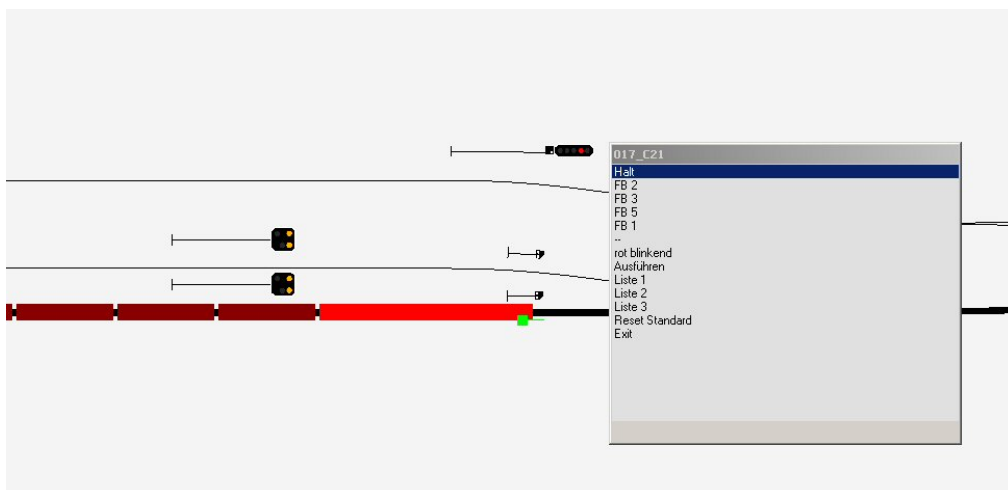
Track plan with signals and other features:

Thick line: simulated train route,

Bright red: simulated vehicle; dark red: other trains; green arrow: driver's location and viewing direction.

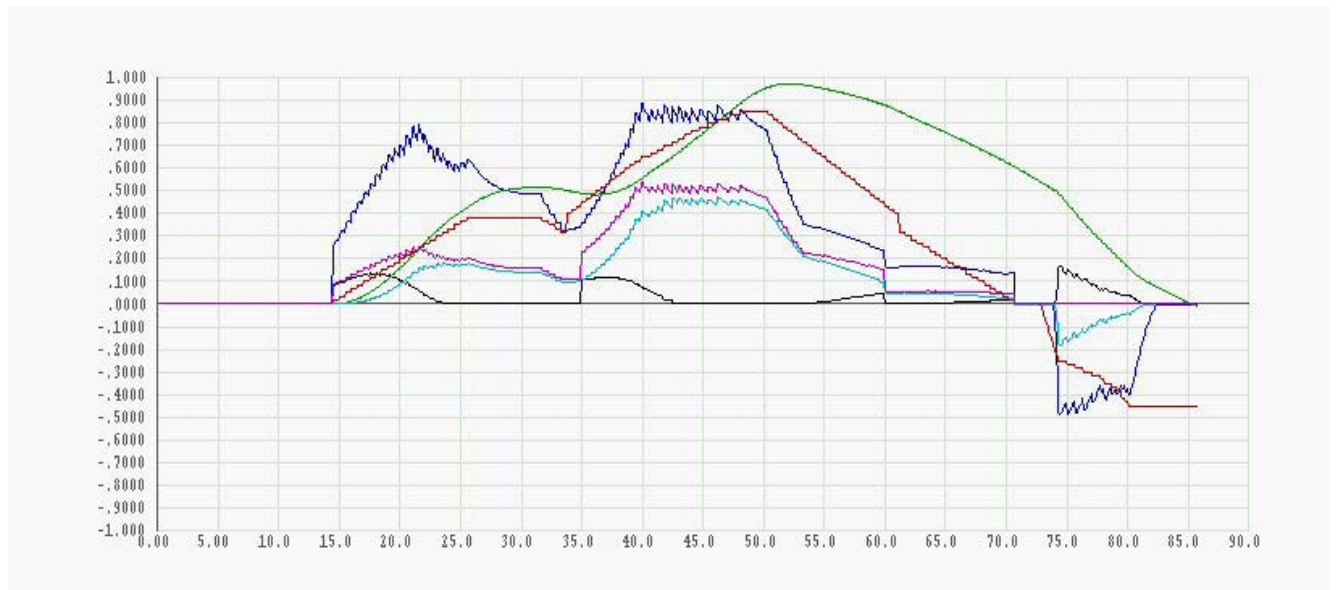


Same situation in 3D image (view from the cab) and mirror



Selection list to change the signal lights

The simulation program LOCSIM works with Windows XP and requires a computer with a fast internal bus, quick access to the harddrive as well as a high-end graphics card with a 3D accelerator. The image processing rate varies from 15 to 40 frames per second, depending on the complexity of the image being displayed. The lower value applies to stations with many tracks. During the simulation, all physical quantities (such as speed, tractive effort, energy consumption) and all operation commands and limit values (controller, dead-man pedal, speed limits) are stored in a file. At the end of the simulation, these quantities can be visualized in graph or table form or be exported to other analysis programs (e.g. Excel).



Acceleration and braking of a DC railcar  
Green: speed; red: step; blue: motor current  
Violet: power at the pantograph; light blue: power at the wheel,; black: losses in the resistor  
in function of time

The proper functioning of the program LOCSIM was verified by various comparative test runs (energy measurements on the AB-/SGA-BDeh 4/4 11-17, speed and temperature measurements on the RBS-Be 4/8 41-62, regenerative current measurements on ABDe 4/4 11-16 of Mittelthurgaubahn, current measurements on the Be 8/8 21-32 Forchbahn, speed and tractive effort measurements on the Re 460 SBB, energy and motor temperature measurements on the GTW1 and GTW2 of Thurbo).

RAILplus is using this program for the continuing education and training of train drivers. It is mainly used for specific operating conditions (eg, failure of signaling, failure of train protection, shunting between stations, entry on occupied track, etc.), in combination with correct radio communication.