Edugame Railway Operations

"Gaming is an activity that cannot be taken seriously enough!"

Jacques-Yves Cousteau

Contents

Aim and Materials

The aim of the learning game is to simulate and experience the driving dynamics of trains in the context of block division. This requires:

- two trains with different driving dynamics
- a track consisting of spaces
- train berths
- signals for block division
- if necessary, turnouts

Real continuous dimensions time (t) and distance (s) are assigned to discrete units of laps (t) and spaces (s). Thus, the simulation is round-based in order to imitate the steps of a computer.

Version 1.0 from 2020-06-20

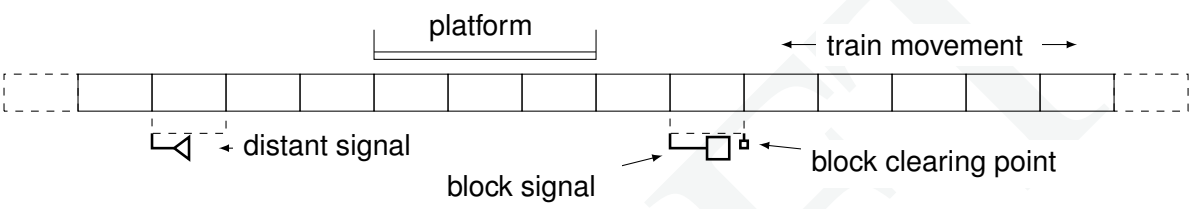
Part I.

Manual

1. Simulation

1.1. Line setup

The line consists of any number of spaces. Signals or platforms can be arranged along the line.



left-hand-driving

1.2. Trains

(nur Zugfahrten, keine Rangierfahrten)

1.3. Round sequence

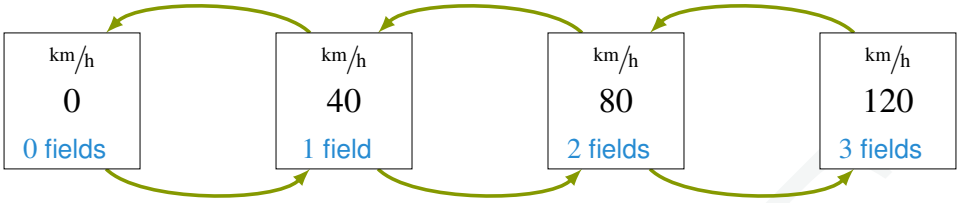
The simulation is based on rounds. Each round consists of at least two consecutive steps:
Sequence per round:

1. calling of routes (optional)
2. Set signals to CLEAR (optional)
3. Select control lever position (optional)
4. *move all trains according to the control lever position!*
5. *Execute stop case for signals!*
6. release of routes (optional)

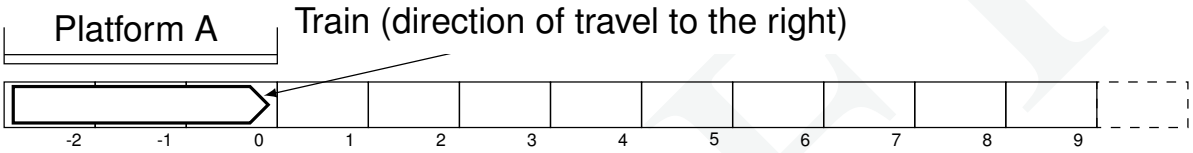
At the start of the game, the train stands still. control-lever positions start at the “0” field. The different train dynamics are depicted by different possible movements of the shift lever.

1.4. Example of a simulated train movements

The control-lever is moved along the green arrows. control-lever positions for a passenger train:

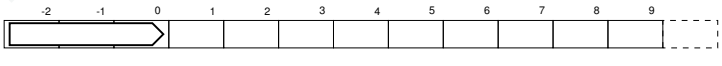
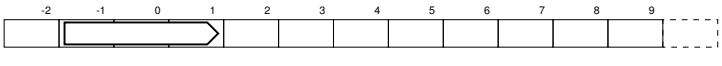
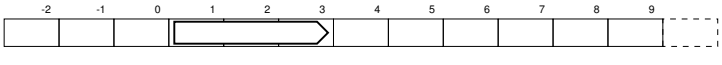
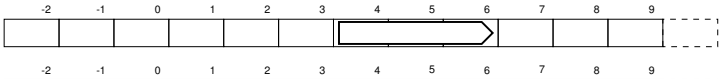


A train is supposed to accelerate on the following track:



For the course of the learning game, we start with the first round and follow the process from the previous section *Simulation*. In the first round, the train from the initial condition stands still. In the example there are no signals that can be set. We can move the control-lever by one position to 40 km/h forward. The round is over.

The second round begins with the execution of the movement one field to the right. The control-lever can be moved on and the round is over. The third round begins with the execution of the movement by *two* fields to the right. The control-lever can be moved on again and the round is over. Continue until the position of 120 km/h is reached and the train moves evenly with three fields per round.

Round	current speed	Move	
0	0 km/h	0 fields	
1	40 km/h	1 field	
2	80 km/h	2 fields	
3	120 km/h	3 fields	
4	120 km/h	3 fields	
etc.			

2. Block section

2.1. Block section setup

The main signal may only show the proceed aspect if there is no train in the following block section (from track vacancy detector to track vacancy detector). The distant signal is located in front of the main signal in braking distance and reflects the signal aspect of the main signal.

	stop	clear
main signal		
distant signal		

2.2. Example of a train running through a block

3. routes

3.1. route setup

3.2. Example of a train using a route

Part II.

Challenges

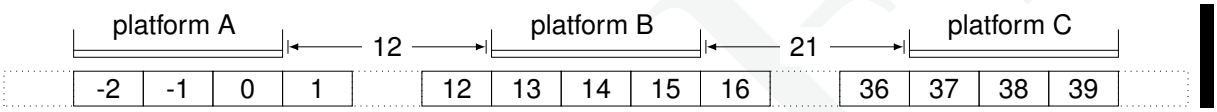
4. First Stage

4.1. Introduction to Driving Dynamics

Setup

A train is to run on a single track. You need:

- infrastructure as shown below
- train on field 0 towards 39.



Task 4.1

The train stands still and has its control-lever at $0\,^{\mathrm{km}}/_{\mathrm{h}}$.

a) If the train accelerates as much as possible, where can it get in *nine* laps?

b) How many laps are needed minimally, if the train stops at every platform?

The train passes the first platform and has its control-lever on maximum speed.

c) How many laps are needed if the train shall leave the track completely without stopping?

Note the solution steps in a protocol!

4.2. Visibility and Braking Distance

Setup

Unknown line with different visibility conditions:

Visibility	range in fields
Very good	3
Normal	2
Bad	1

Task 4.2

a) What is the maximum speed for a train in order to stop in front of an obstacle with very good visibility?

b) How many laps does it take to get safely into a 12 fields away station under normal visibility conditions?

c) How far (in fields) would you have to be able to see in order to drive 160 $^{\mathrm{km}}/_{\mathrm{h}}$?

5. Second Stage

5.1. Block Segmentation

Setup

Different trains should be able to run consecutively on a track with block logic! You need:

- a track of any length,
- 3 complete blocks with distant signal, main signal and a block clearing point,
- at least one train.

Task 5.1

a) Place distant signals, main signals, and block clearing points in such a way that bad visibility does not lead to impairment and trains can run with 160 $^{km}/_{h}$!

b) What is the minimum and maximum block distance?

c) What happens if the distance of the main signals are less than the minimum block distance?

d) How many laps does the blocking time for running through a block last (signal watch time, approach time, time between block signals, clearing time)?

5.2. Traffic Flow

Setup

Different trains should be able to run consecutively on a track with block logic! You need:

- Two different trains with different train dynamics,
- The track from section 5.1.

Trains enter the system at the beginning of the track; trains exit the system at the end of the track. The infrastructure before and after the line is neglected.

Task 5.2

a) How many laps are needed from the first train entering to the second train leaving if both trains are to run unimpeded and the *fast* runs in front of the *slow* train?

b) How many laps are needed from the first train entering to the second train leaving if both trains are to run unimpeded and the *slow* runs in front of the *fast* train?

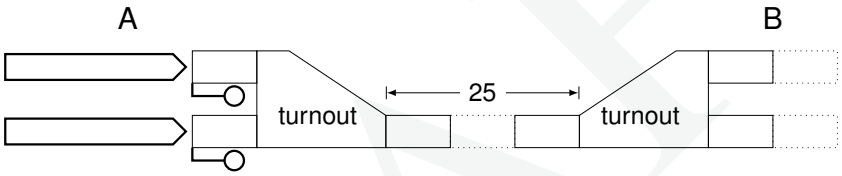
6. Third Stage

6.1. Route Locking

Setup

The sequence of trains between two stations with turnouts should be examined! You need:

- Infrastructure as shown below with at least *two* complete blocks,
- Two different trains with different vehicle dynamics in station A.



The turnouts may only be passed at 80 $^{km}/_{h}$ along the branching track. The speed in the straight track is not limited.

Task 6.1

a) Complete the infrastructure with distant signals, block signals, route signals, block clearing points and route clearing points!

b) Pick a train to leave and explain why not the other one!

c) How many laps does it take for the second train to depart?

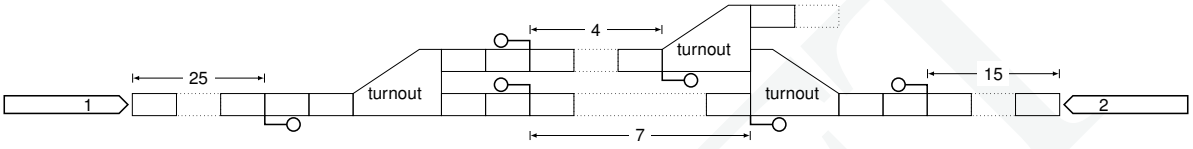
d) How many laps does it take for both trains (sum of the laps of train 1 and train 2) to arrive at the destination station?

6.2. Overlap

Setup

Two trains are too cross in a station! You need:

- Infrastructure as shown below with at least *two* complete blocks,
- two different trains with different vehicle dynamics running at maximum speed,
- train 1 runs non-stop; train 2 has a service stop of 2 laps at the station.



The turnouts may be passed at 80 $^{\mathrm{km}}/_{\mathrm{h}}$ at the branching track. The overlap requires 2 fields.

Task 6.2

a) Complete the infrastructure with distant signals, block signals, route signals, block clearing points and route clearing points!

b) Decide which train to run on which track. Which problems can occur?

c) After how many laps did train 2 stop at the station?

d) After how many laps did train 1 leave the station completely?

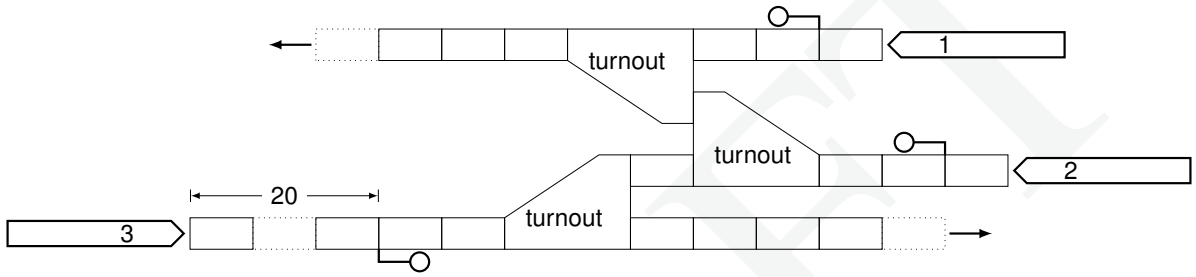
e) Make a locking plan of the station!

6.3. Dual protection points

Setup

Trains meet in a station with a dual protection points. You need:

- Infrastructure as shown below (right-hand traffic),
- three trains: train 1 and 2 standing; train 3 running at maximum speed.



Task 6.3

a) Lock the route for train 1!

b) Lock the route for train 3!

c) Lock the route for train 2 after train 1 has left the station. What is the problem? How can it be solved?

Revision History

Revision	Date	Author(s)	Description
0.1	2018-04-17	MS, FN, LG	First prototype created with driving dynamics
0.2	2018-05-15	MS, LG	Educational game with block logic extended
0.3	2018-09-03	MS	Handbook created
0.3.1	2018-10-17	MS	Handbook with neutral design
0.4	2018-11-16	MS, LE, SZ	Translation into english
0.5	2019-03-29	MS	Minor improvements and craft sheets
0.5.1	2019-03-29	MS	Adaptation of track length and tasks
0.6	2019-05-20	MS	Added routes and route locking
0.6.1	2019-08-26	MS, LP	Extended tasks for routes
0.7	2019-09-09	MS, LP	reworking of game mechanics together with tasks and figures
0.7.1	2019-09-17	MS	Adapted signals for left- and right-hand traffic
0.7.2	2019-09-20	MS	Supplemented tasks in English from version 0.6.1
1.0	2020-06-20	LP, MS	Revision and new conceptual design

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