The Future of Swiss Railway Dispatching. Deep Learning and Simulation on DGX-1.

Adrian Egli & Erik Nygren
Research and Innovation Platform
SBB AG, Switzerland
Swiss Federal Railways.
Complex dynamics in the heart of Europe.
Basic train dispatching.
Reordering of trains.
Basic train dispatching.
Rerouting of trains.
Train runs.
A simple chain of dispatching decisions.
Interacting trains.
The source of railway complexity.
Train runs.

A path in a decision tree.
Most dense mixed train network in the world.
Exponential growth of complexity.

1 2 4 80 >80

30 900 8 Mio. ~10^{80} Mio.
Sensitive dynamical system.
Finding the needle in the haystack.
Increasing future mobility needs.
Destabilizing effects of traffic density.
Maintaining robust traffic flow.
Increased man- and computational power.

Future
Maintaining robust traffic flow. Infrastructure enhancements.
Future projections.
Inevitable challenges.
Overcoming future challenges.
Making the railway network antifragile.

Antifragility
Antifragility.

Improvement through failure.
Antifragility.
Improvement through failure.
How to fail in a safe way.

Extending the railway network beyond reality.
Swiss Railway Digital Twin.
Infinite possibilities.
Reinforcement learning.
Mastering complex games.
Reinforcement learning.
Playing the dispatcher game.
Super human performance.
Learning from 65 million years of experience.
High performance simulations.
The power of parallel computations.
Digital Twin.
Moving beyond the physical boundaries.
Digital Twin.
Moving beyond the physical boundaries
High performance simulations. State of the art.
Learning from 65 million years of experience.
Time as a limiting factor.

\[ 65M \text{ years experience} \times 17s = 12K \text{ years training} \]
Limited time resources.
Scaling with innovative ideas.
Railway simulation.
Learning on subregions.
Railway simulation.
Reinforcement agents view.
High performance computing.
Parallel training on alternative worlds.
Diversity, curiosity, passion and team work.
The evolution of a digital twin.
Deep learning and simulation.
The (r)evolution of the Swiss Federal Railways.

Reality

Digital

Trial & Error
Research Team.
Pushing railway to the next level.

Adrian Egli
adrian.egli@sbb.ch
HPC Expert

Erik Nygren
erik.nygren@sbb.ch
AI Researcher

Dirk Abels
dirk.abels@sbb.ch
Head of Research Lab