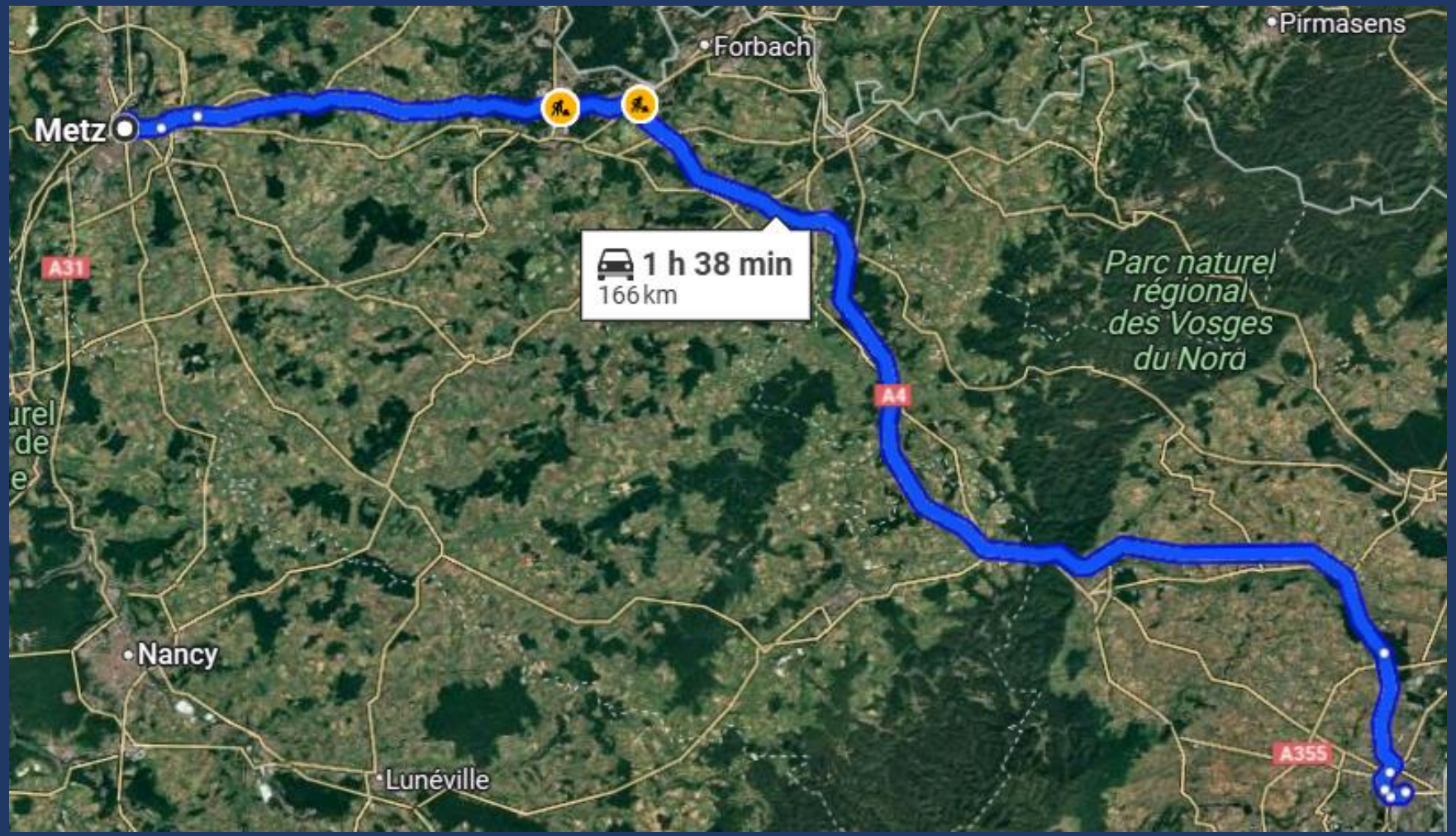
1ère Conférence Franco-Allemande sur le Système Ferroviaire

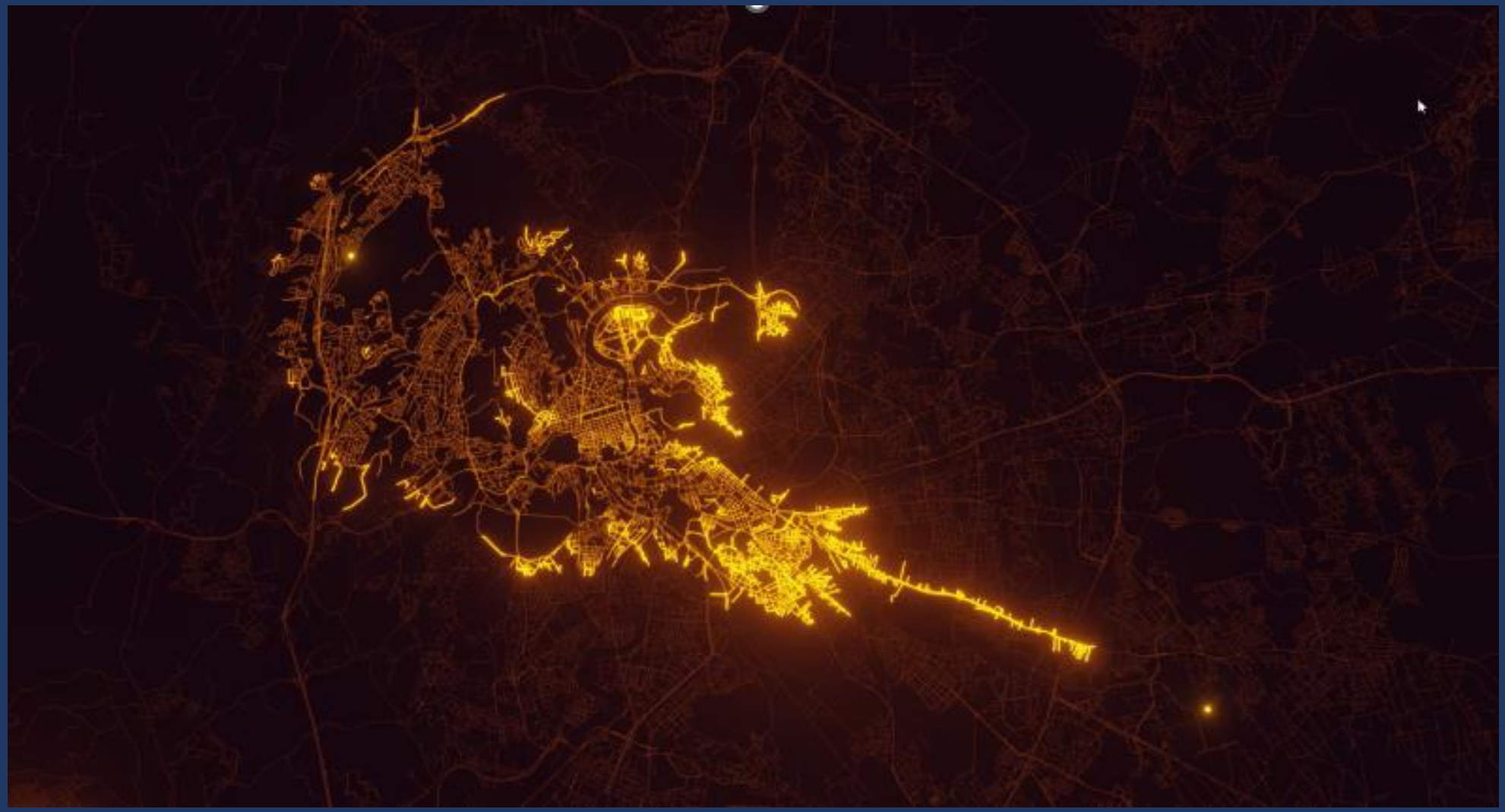
Modeling & Simulation - ATO GoA2

FASF 2025

2025 DFBS

Modeling & Simulation - ATO GoA2


Pirmasens
Forbach
Metz
1 h 38 min
166 km
A31
Parc naturel régional des Vosges du Nord
A4
Nancy
A355
Lunéville



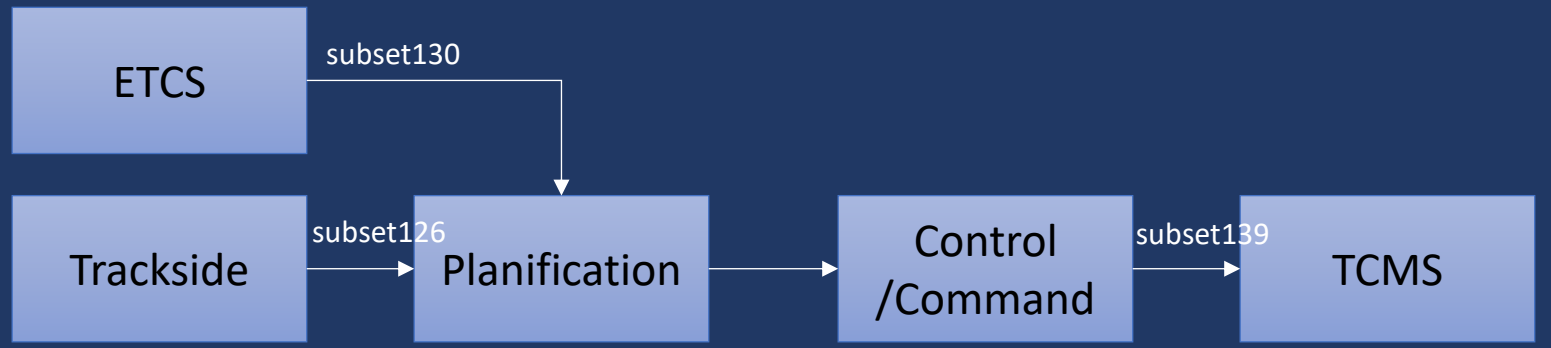
https://www.youtube.com/watch?v=CgW0HPHqFE8

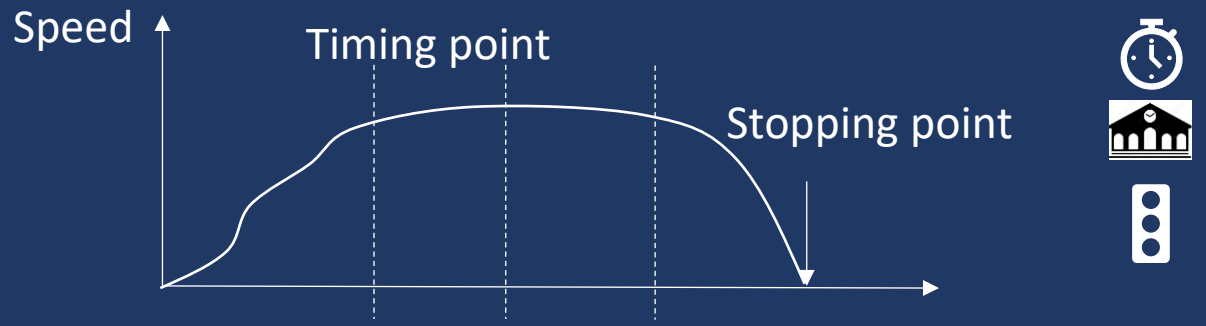
setpoint

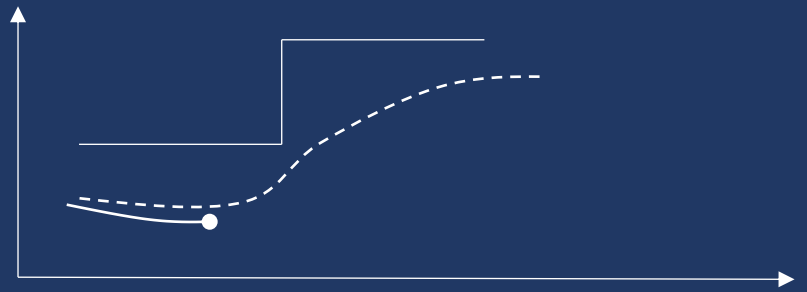
measurement

+

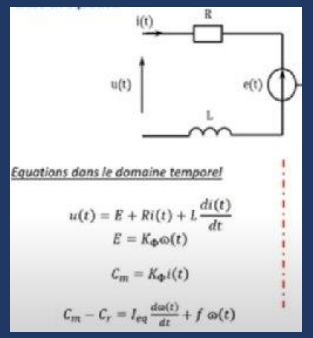
-

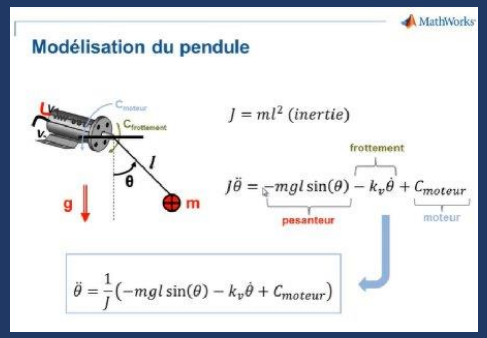

ETCS
subset130
Trackside
subset126
Planification
Control /Command
subset139
TCMS

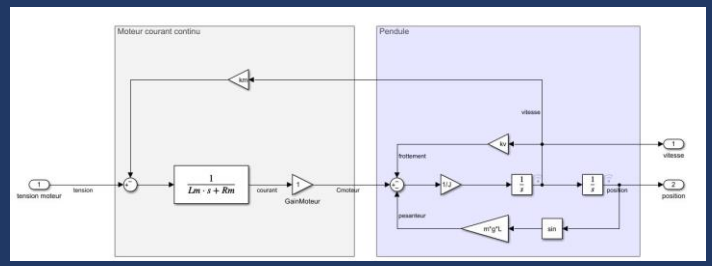

Speed
Timing point
Stopping point
Distance

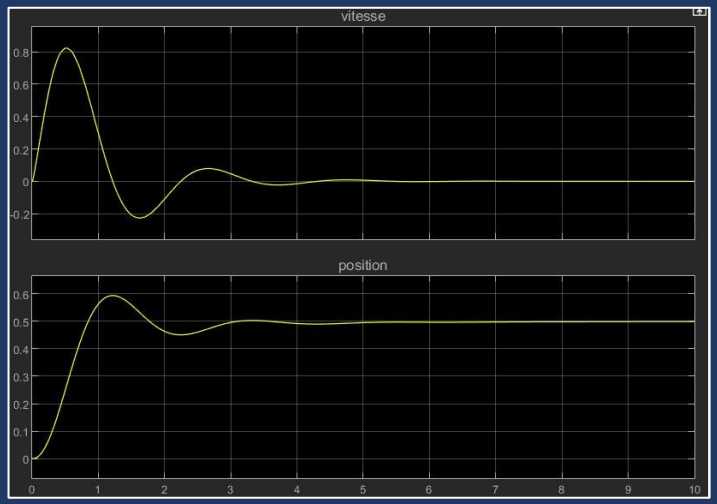


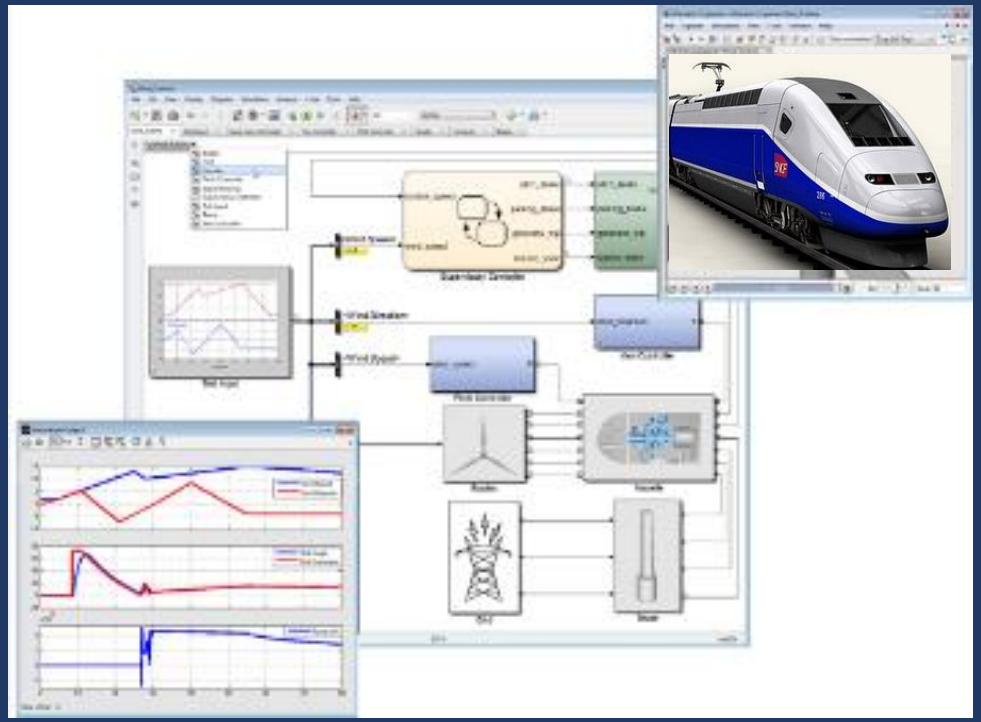
Model Based Design



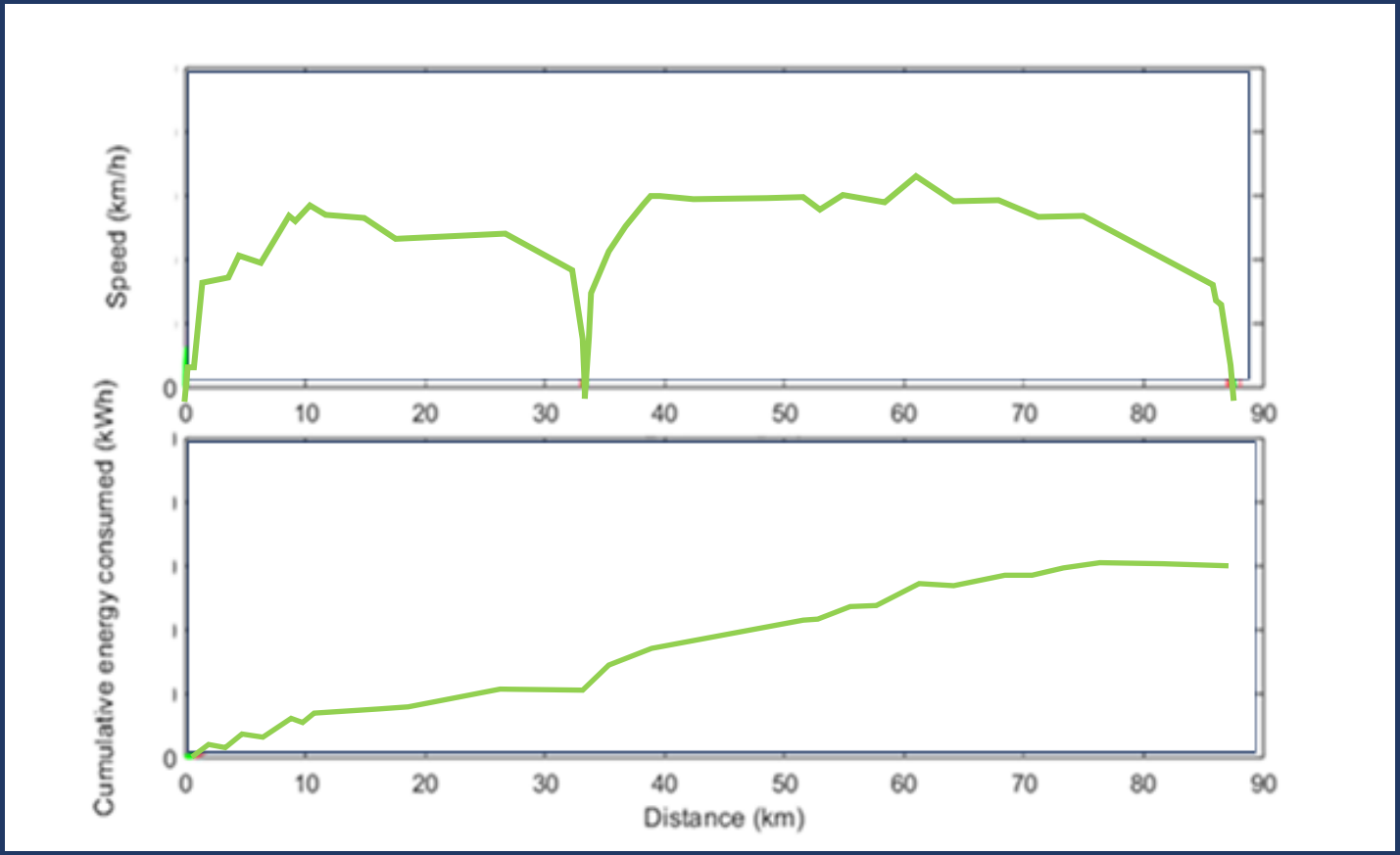




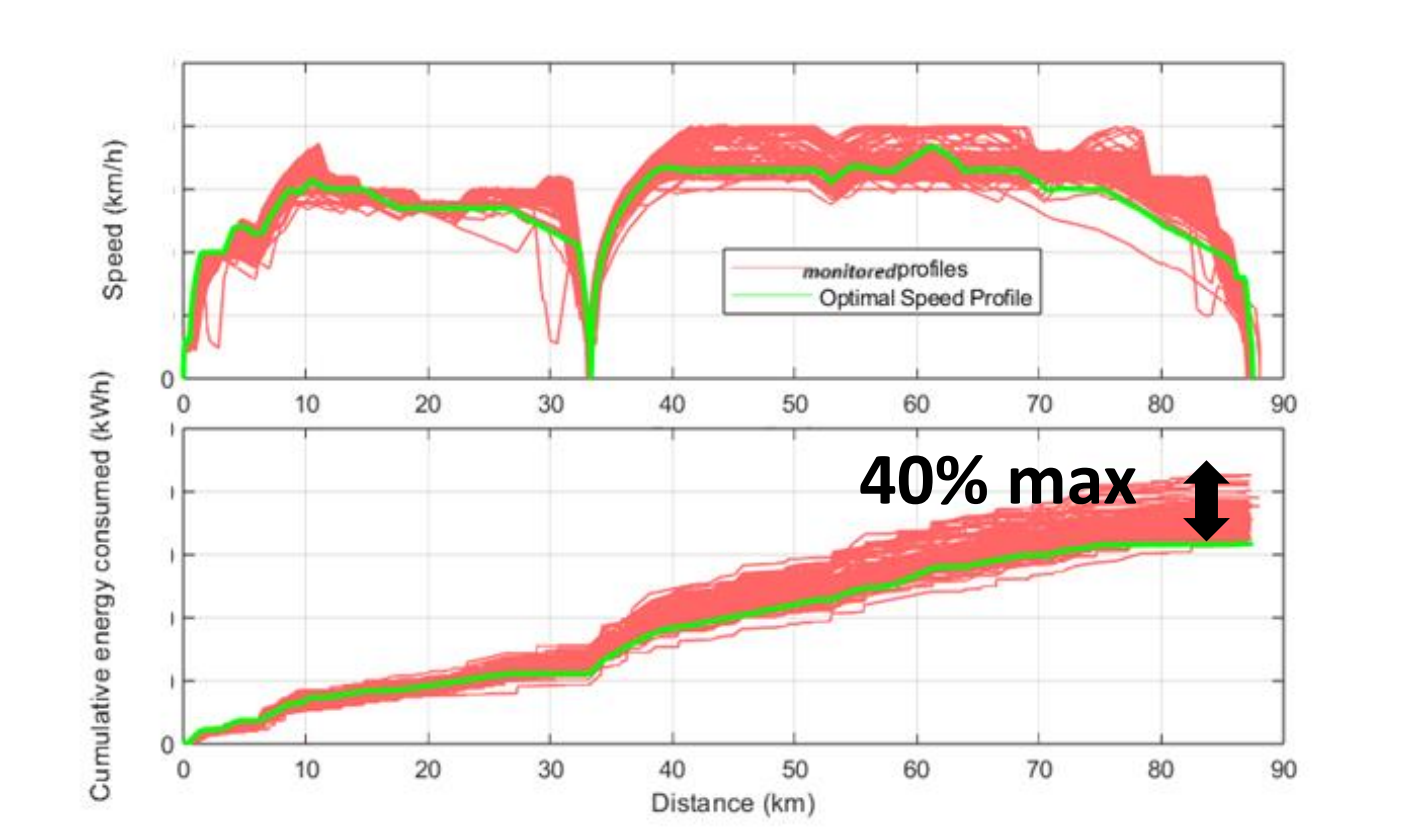




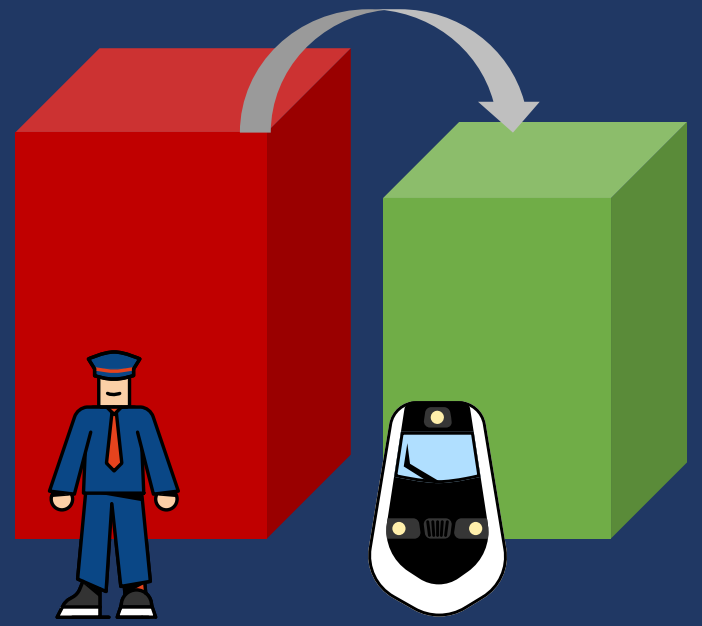
SIMULATION RESULTS



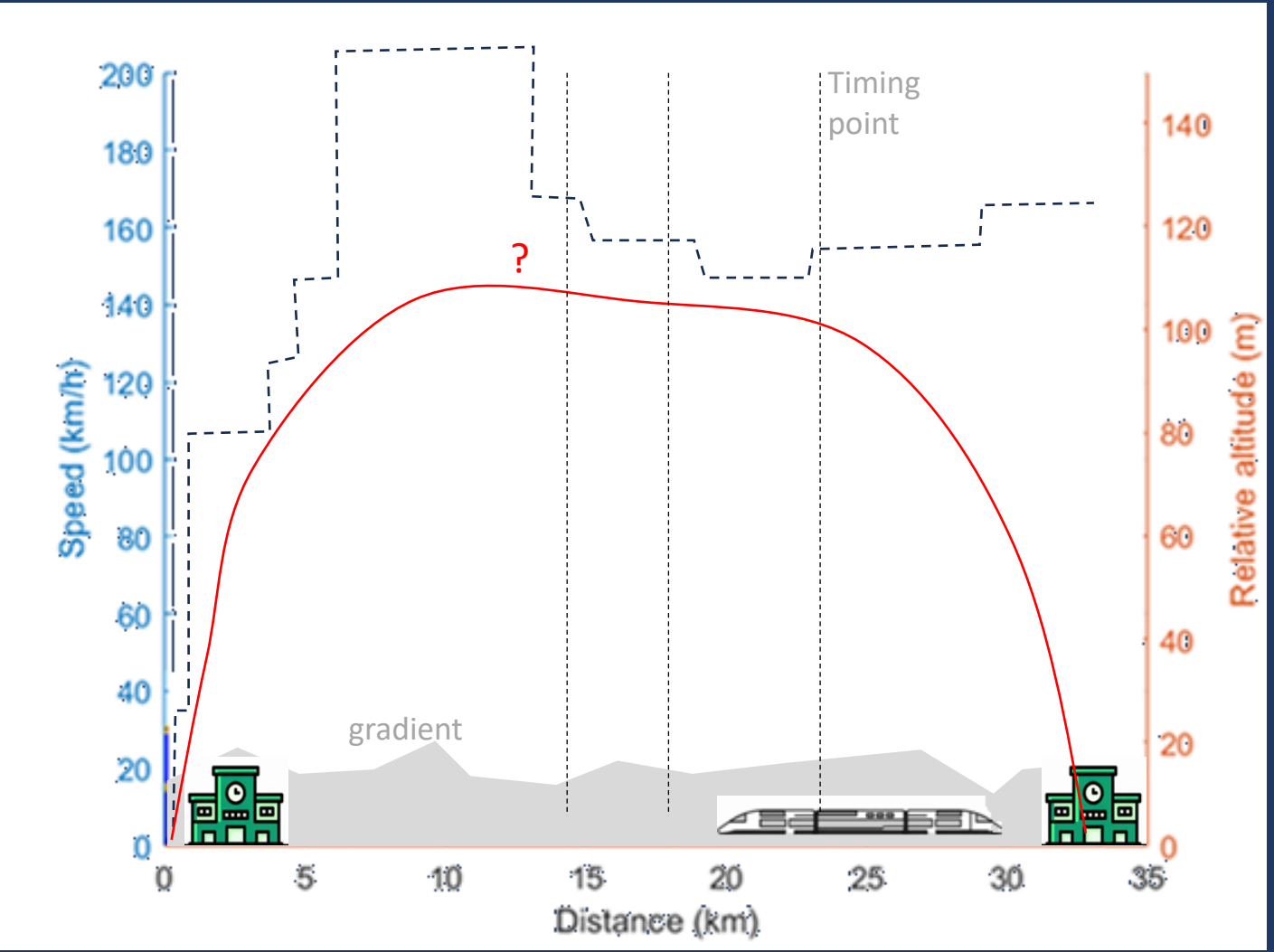
SIMULATION RESULTS



-10%
average

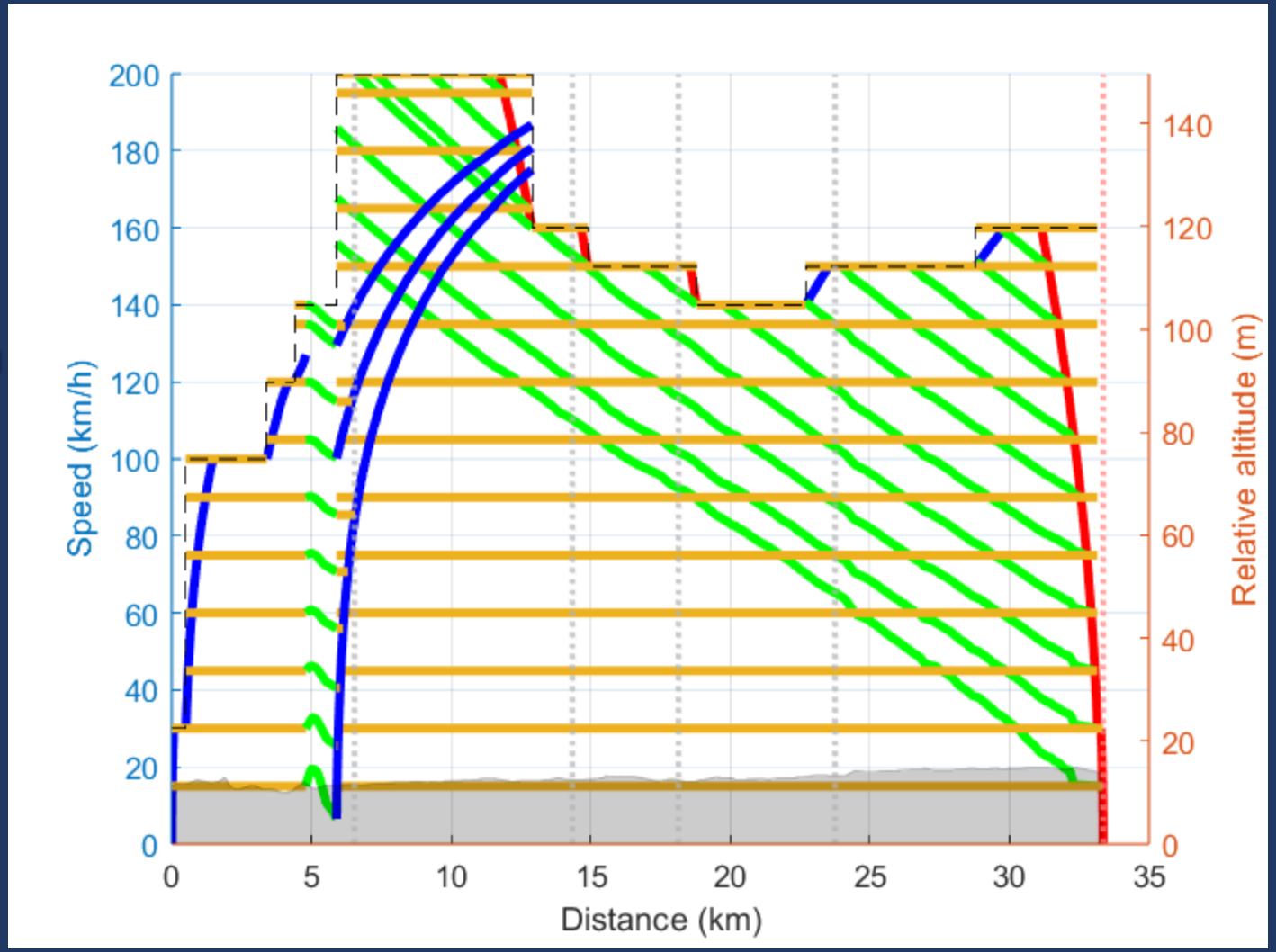


PLANNING


Timing
point
?
gradient
Speed (km/h)
Relative altitude (m)
Distance (km)
0
20
40
60
80
100
120
140
160
180
200
0
5
10
15
20
25
30
35

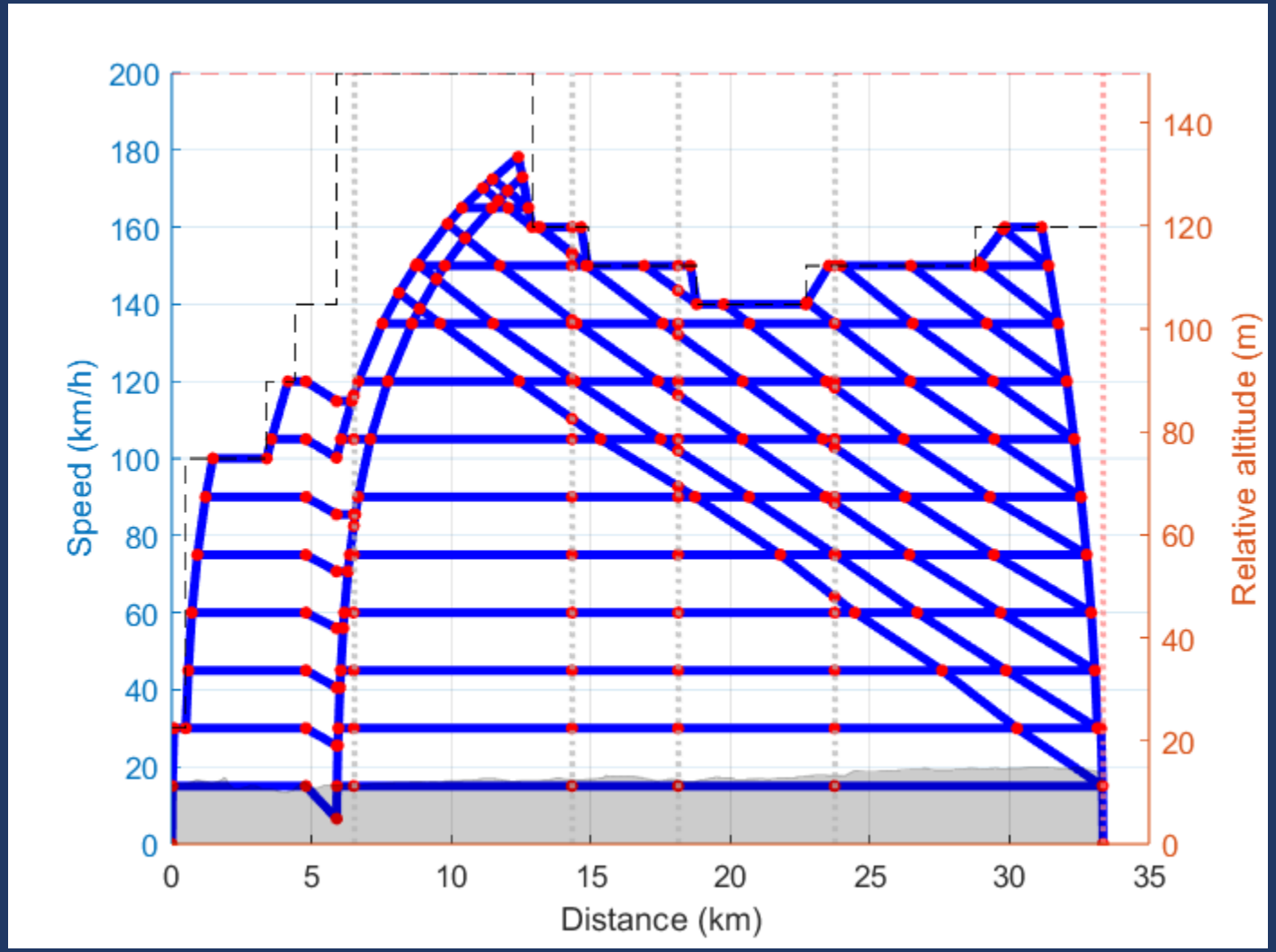
PLANNING

- ❑ Maximum traction
- ❑ Maximum brake
- ❑ Cruising
- ❑ Coasting

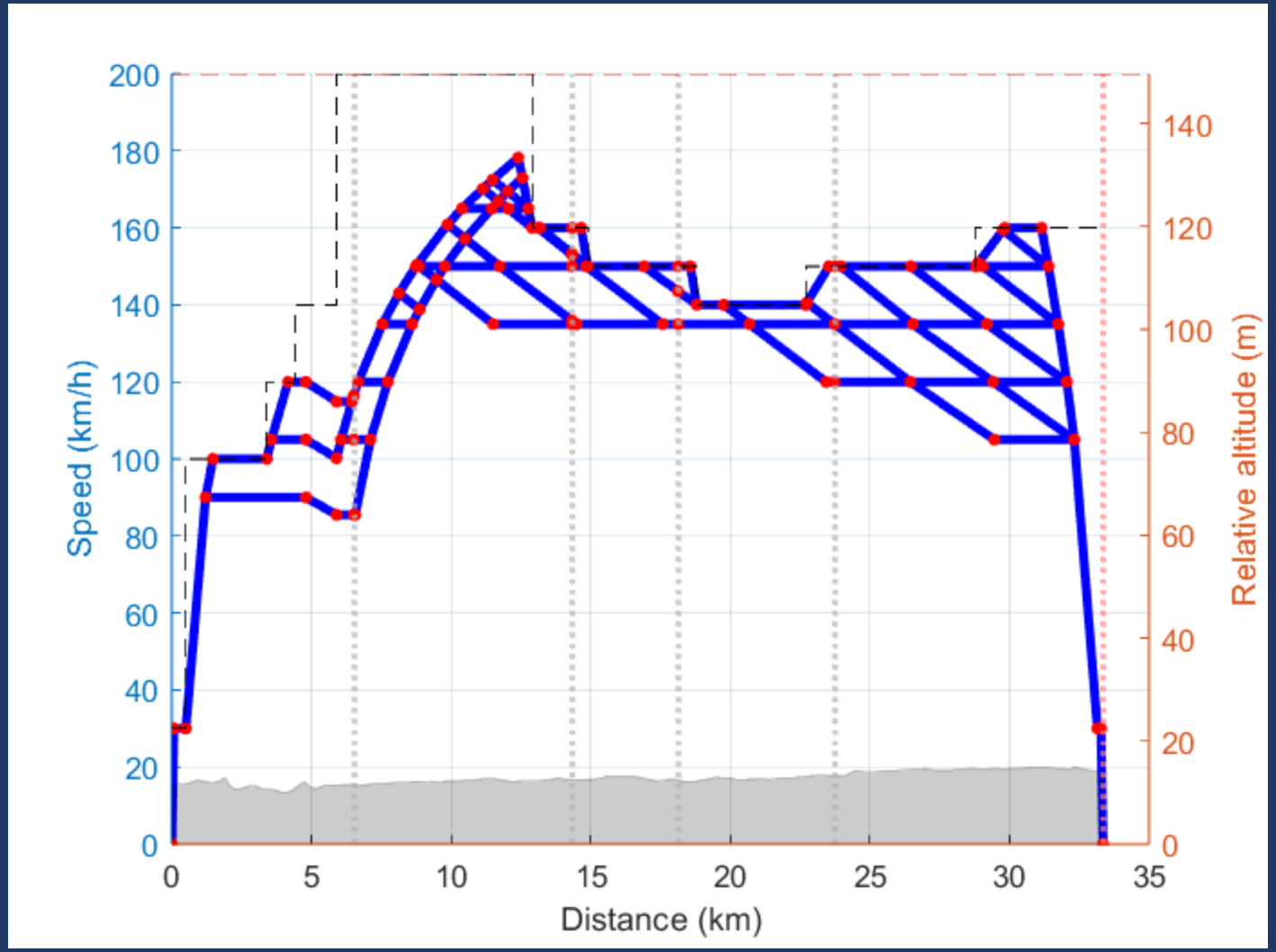


J. T. Haahr, D. Pisinger et M. Sabbaghian. "A dynamic programming approach for optimizing train speed profiles with speed restrictions and passage points"

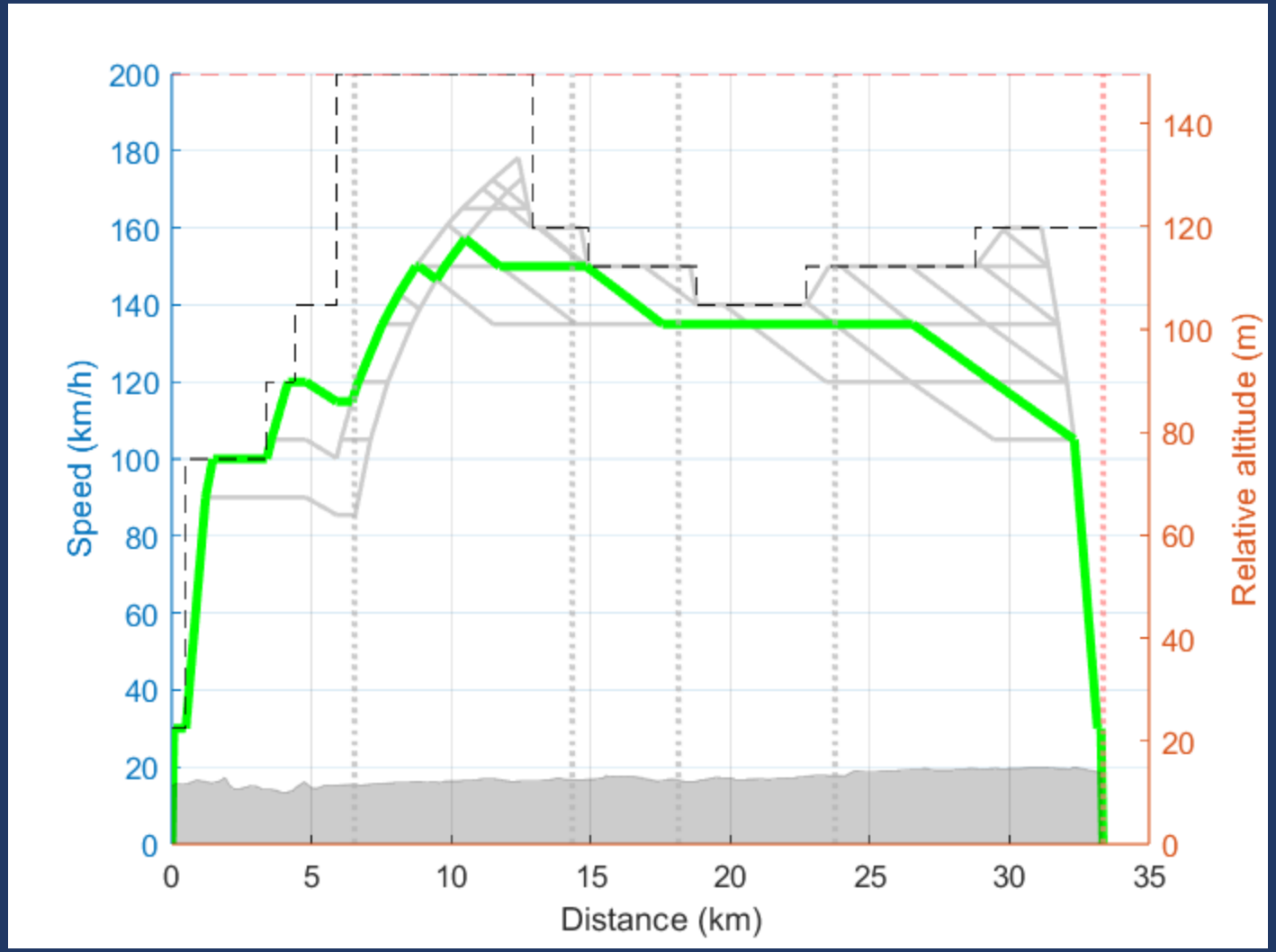
PLANNING


Speed (km/h)
Relative altitude (m)
Distance (km)
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
120
140
0
5
10
15
20
25
30
35

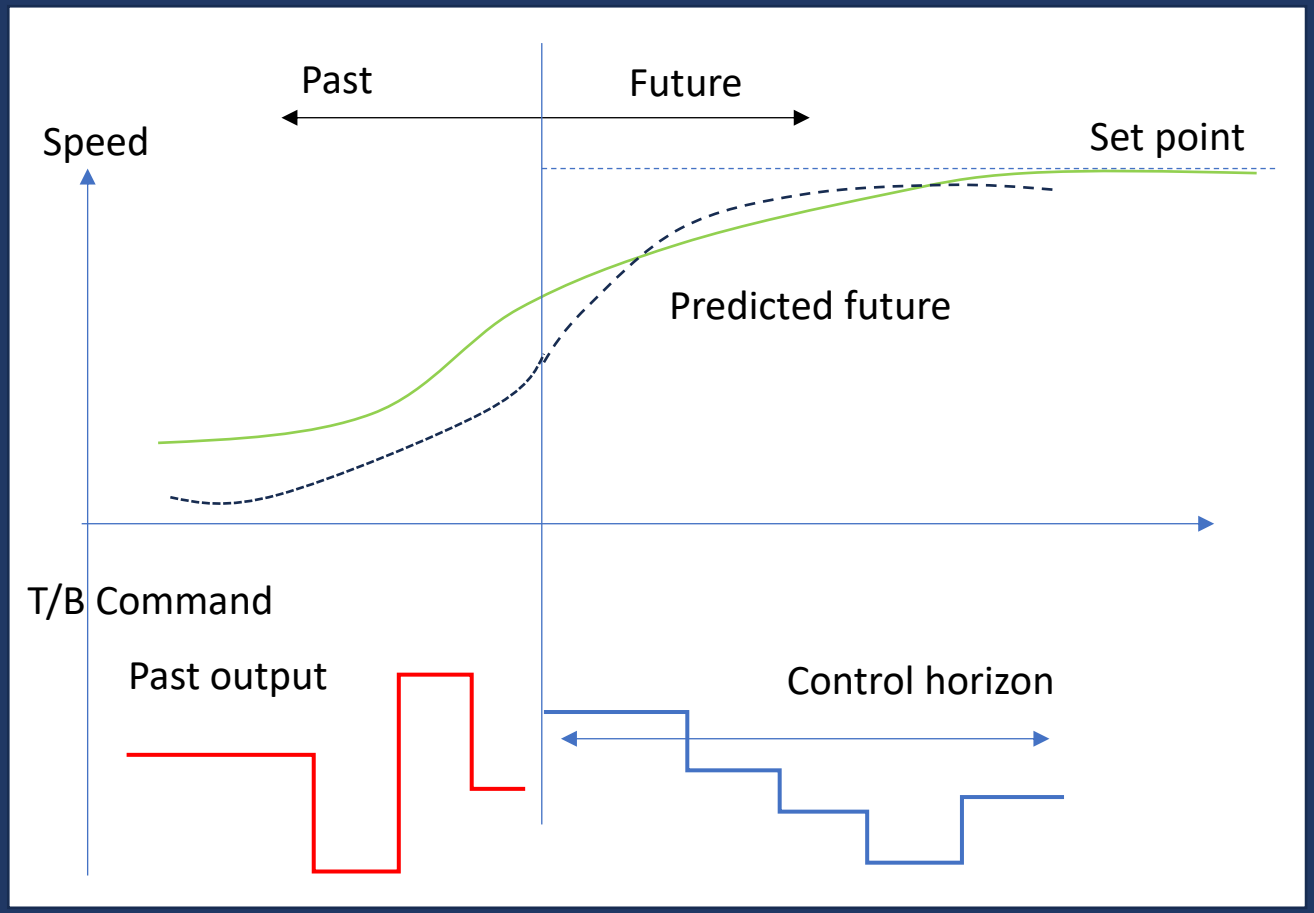
PLANNING


Speed (km/h)
Relative altitude (m)
Distance (km)
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
120
140
0
5
10
15
20
25
30
35

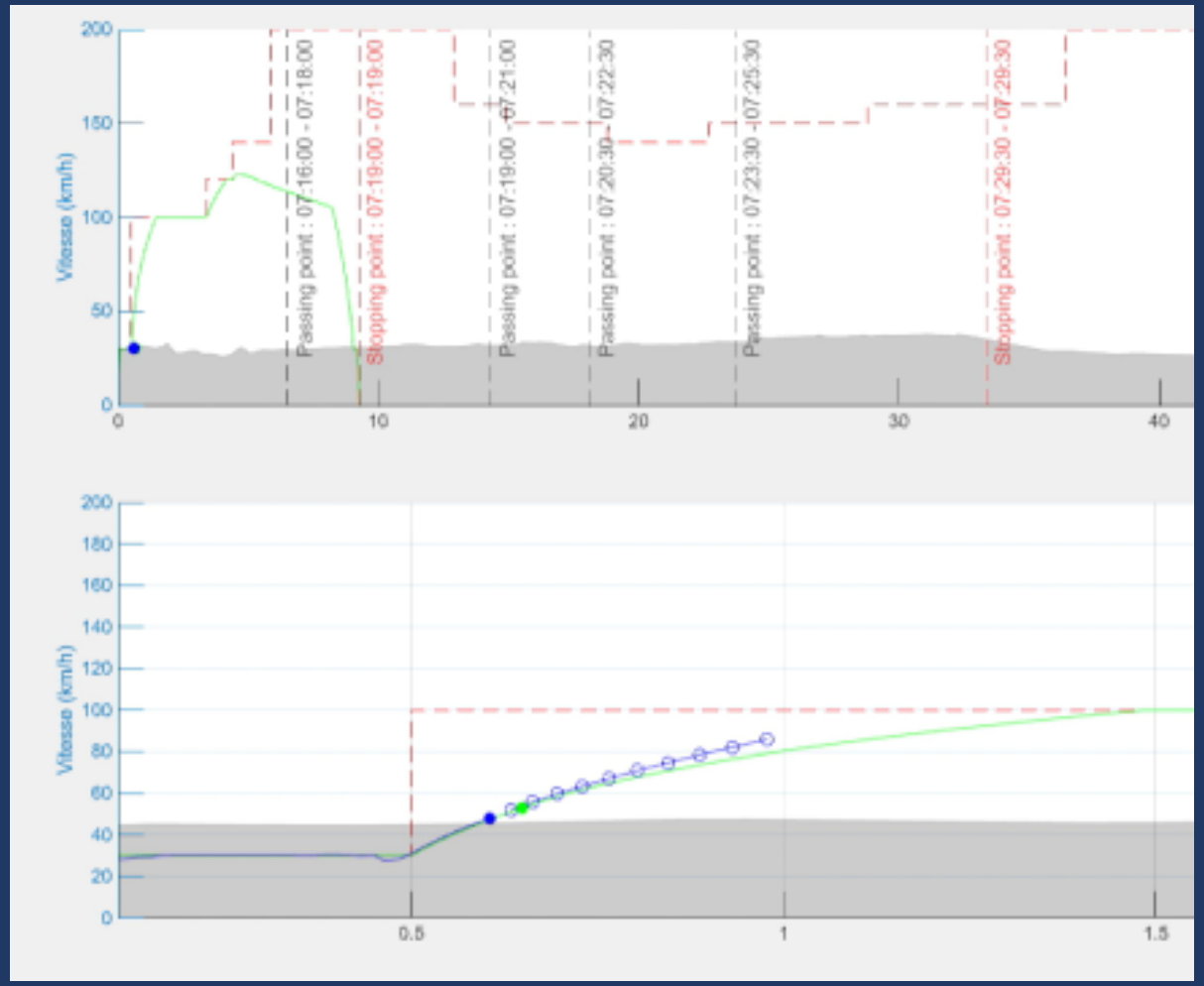
PLANNING


Speed (km/h)
Relative altitude (m)
Distance (km)
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
120
140
0
5
10
15
20
25
30
35

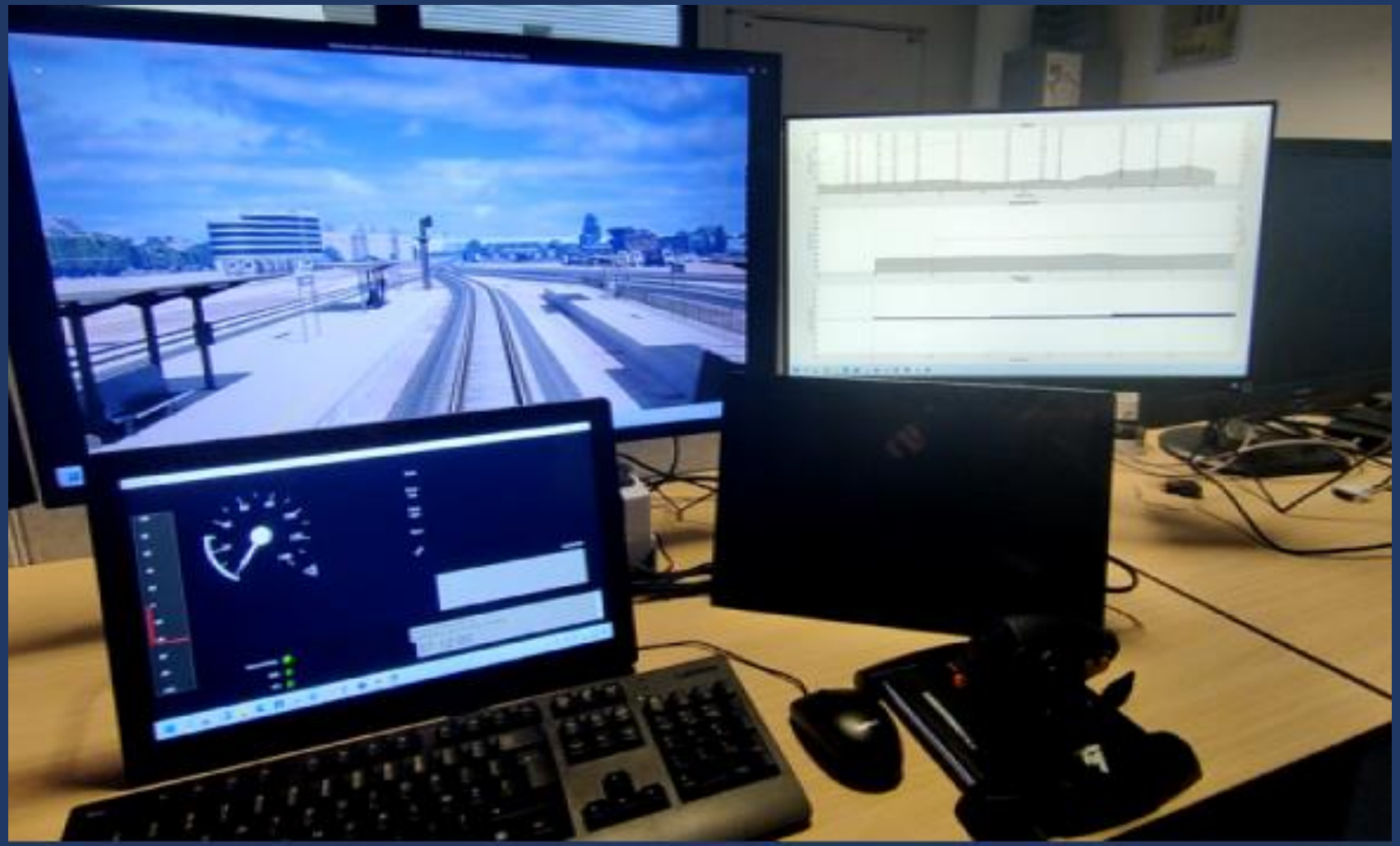
MPC


Past
Future
Speed
Set point
Predicted future
T/B Command
Past output
Control horizon

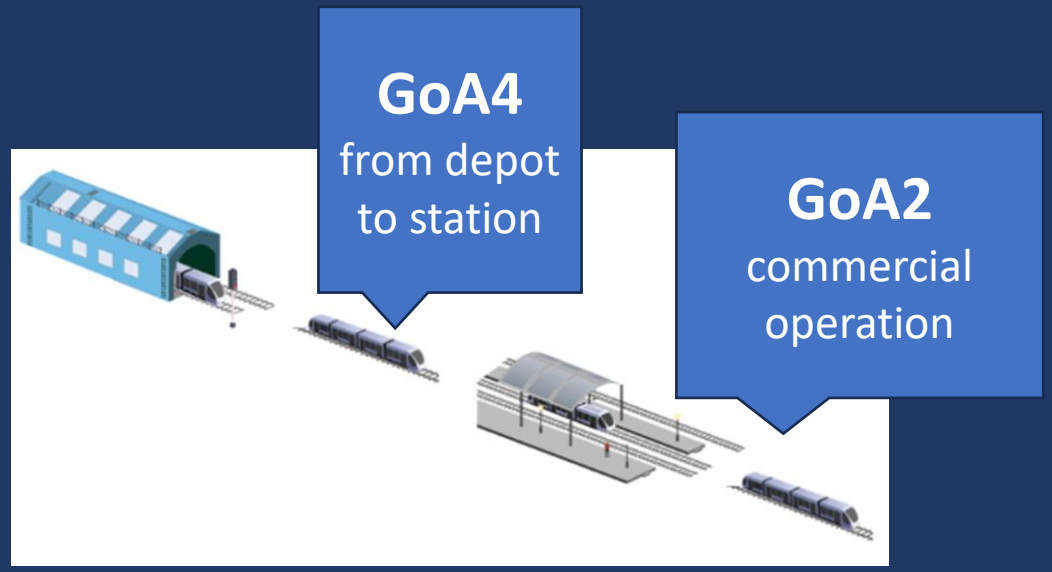
MPC

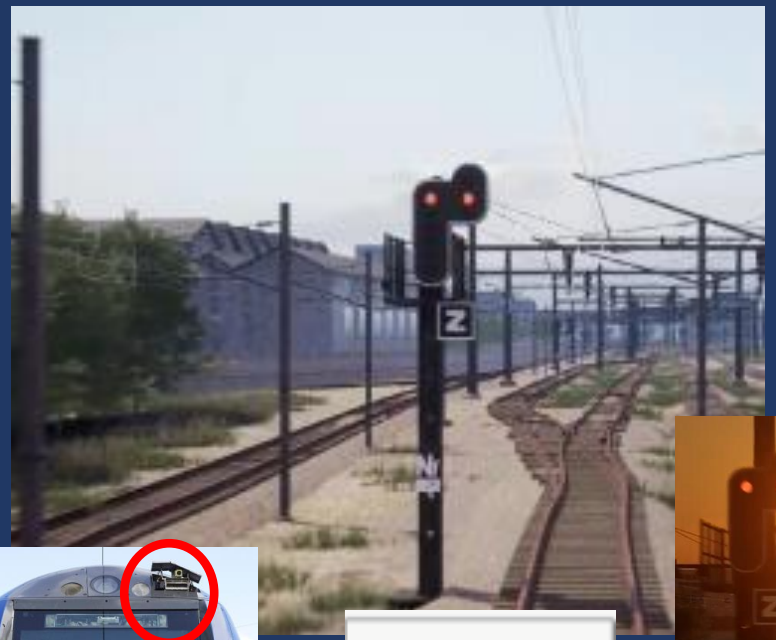

Vitesse (km/h)
200
150
100
50
0
0
10
20
30
40
Passing point : 07:16:00 - 07:18:00
Stopping point : 07:19:00 - 07:19:00
Passing point : 07:19:00 - 07:21:00
Passing point : 07:20:30 - 07:22:30
Passing point : 07:23:30 - 07:25:30
Stopping point : 07:29:30 - 07:29:30
Vitesse (km/h)
200
180
160
140
120
100
80
60
40
20
0
0.5
1
1.5

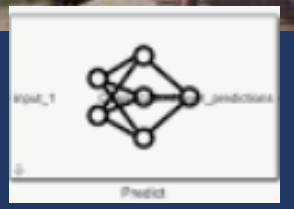
DRIVING SIMULATOR



R2DATO WP31
Modeling techniques







Deep learning

- Simulation as a **technical enabler** for effective evaluation, design, V&V
- GoA2 ready
- Up to GoA4

QUESTIONS ?

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