Tehran Urban & Suburban
Railway Operation Company

Metro Cars Propulsion Design & Production Project

Traction analysis for 4 lines

JDEVS-MPDP-PS-PY-165-00

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SHEET	REVISION					REMARK	SHEET	REVISION					REMARK	SHEET	REVISION					REMARK
	0	1	2	3	4			0	1	2	3	4			0	1	2	3	4	
1	X						31	X						61						
2	X						32	X						62						
3	X						33	X						63						
4	X						34							64						
5	X						35							65						
6	X						36							66						
7	X						37							67						
8	X						38							68						
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26	X						56							86						
27	X						57							87						
28	X						58							88						
29	X						59							89						
30	X						60							90						

In The Name of Allah

Vehicle Data

Train Configuration The train configuration is according to Mc-T-M-M-M-T-Mc.

Mc Motor car with driver's cab

T Trailer car

M Motor car

n_car 7

Num_motor 20

Weight

according to the proposal of the Metran working group is as follows:

Dynamic Weight 22 Ton Rotational mass

AW0 = 256.584 Ton

AW1 = 278.004 Ton

AW2 = 320.494 Ton

AW3 = 348.284 Ton

Total Train Resistance

The Davis formula is used for running resistance

$Frr = A + B \cdot v + C \cdot v$ [N]

	AW0	AW1	AW2	AW3
A	5282	5419	5691	5868
B	35.91	38.91	44.86	48.75
C	0.81	0.81	0.81	0.81

Wheel Diameter

New: 860 mm

Half worn: 825 mm **(**base of Performance Calculations)

Fully worn: 790 mm

Gear parameter

efficiency gear: 0.98

gear ratio: 7.06

Motor

F base:56 [Hz]

motor nominal torque: 1036 [N.m]

nominal line voltage: 585 V .: 825 Vdc , Propulsion: 750Vdc

nominal power 180 Kw braking

Line parameter

Max Acceleration :1 m/s2 on Propulsion and 1.1 m/s2 on braking

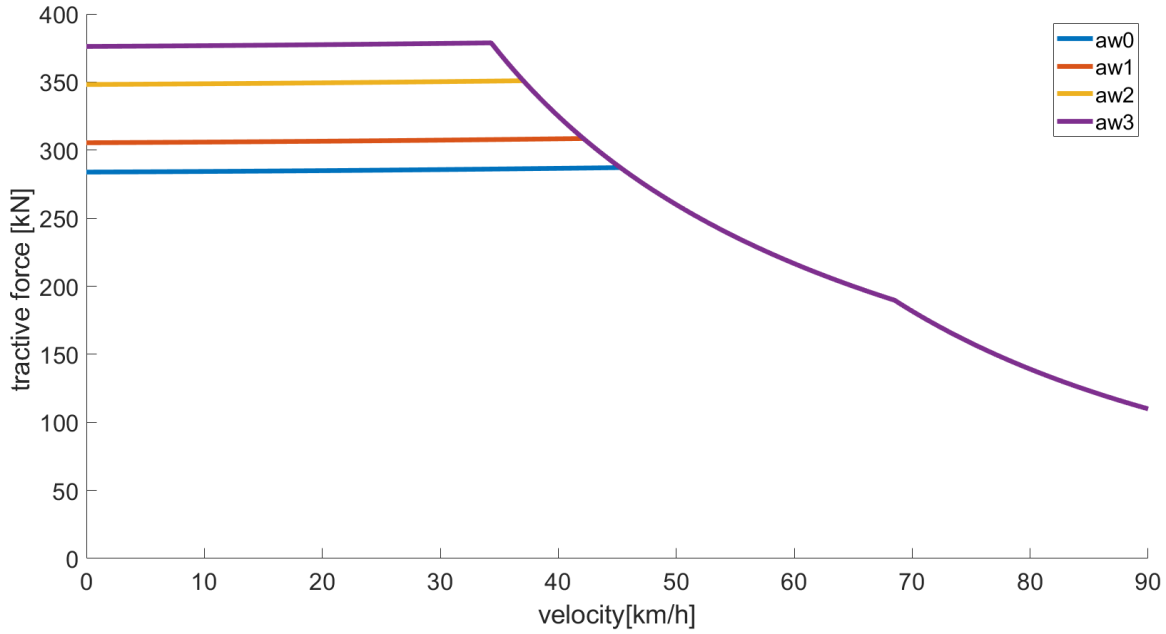
Max gradient: 5%

Adhesion Coefficient

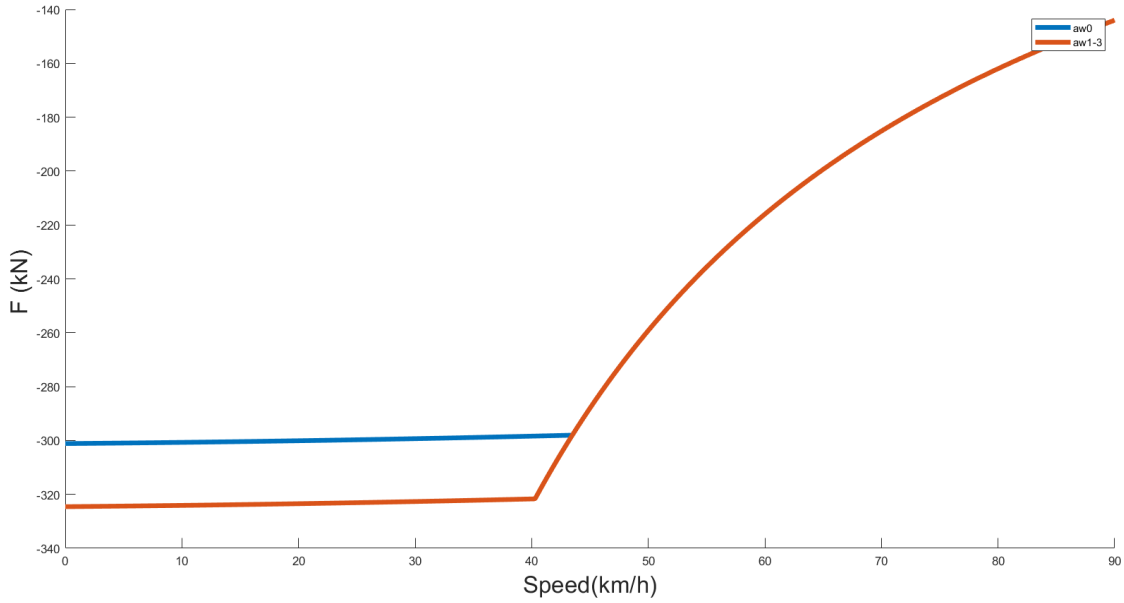
The adhesion coefficient according to the proposal of the Metran working group is as follows:

$\mu_{AD} = \frac{25}{100+V}$ V: Km/h

1.Tractive force at different car weights e.g. a $_{max}$=1 m/s^2



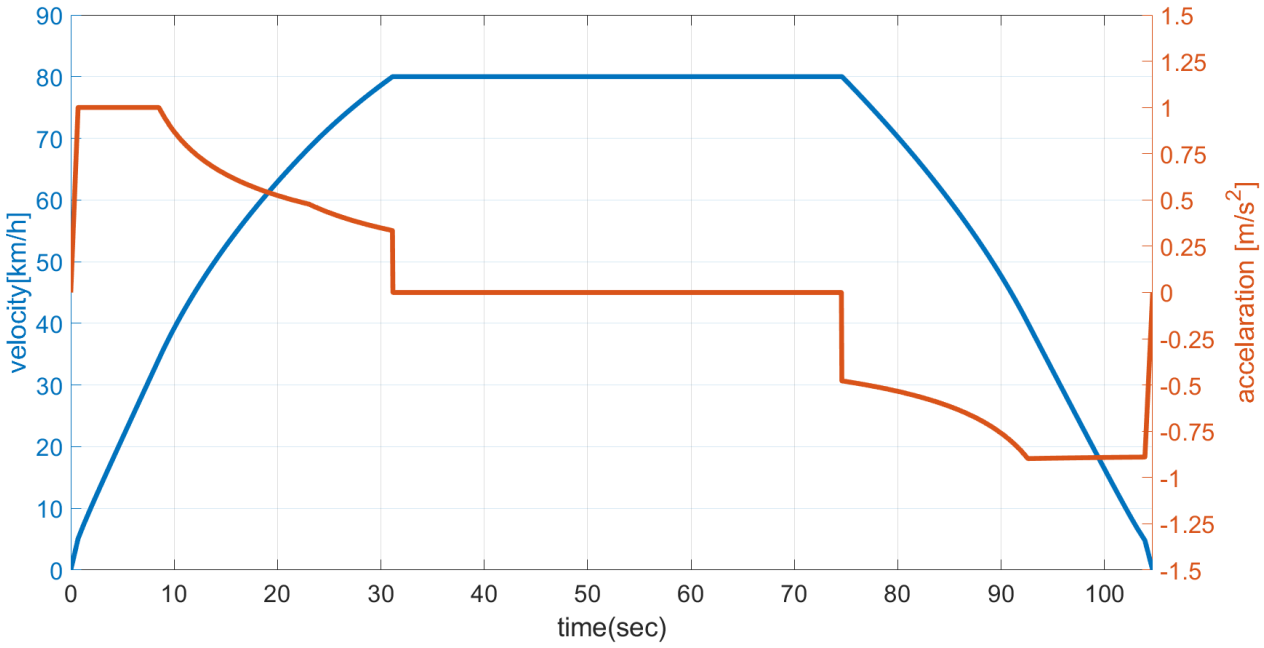
2.Braking force at different car weights e.g.



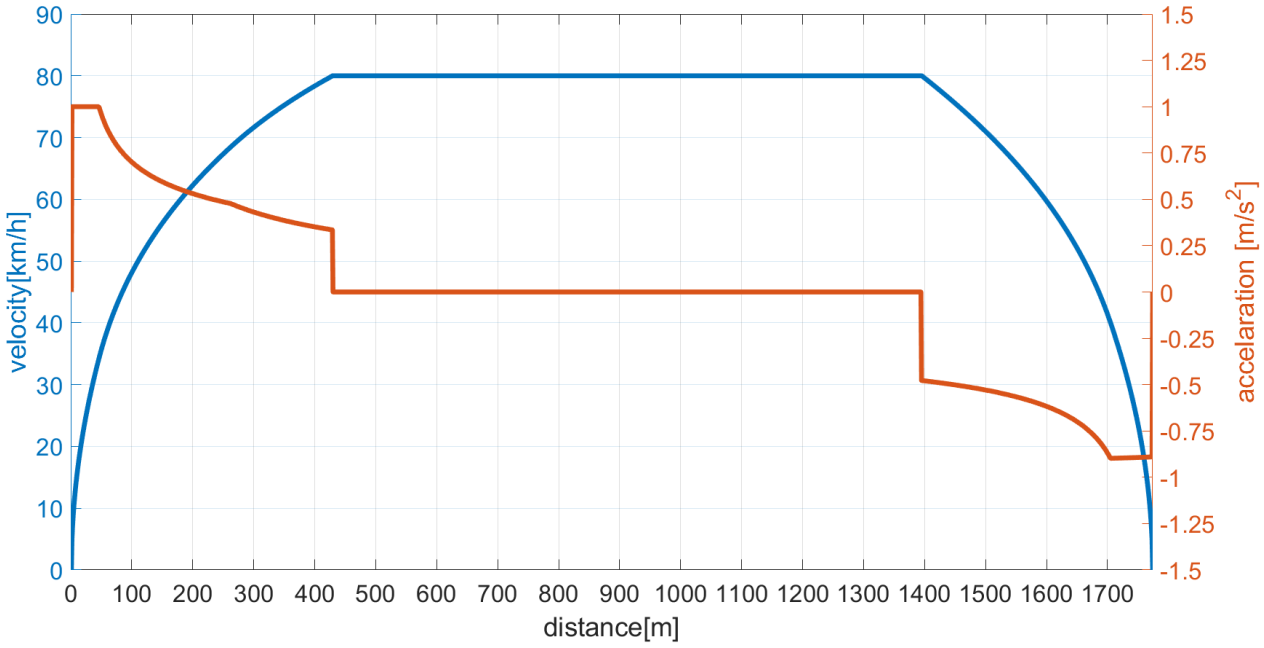
a $_{max}$=1.1 m/s^2 at aw $_0$/aw$_1$

From 10 to 5 km / h reduced in the form of ramps, the amount of electric braking force is reduced and from 5 to 0 km / h only air braking is applied. (See Fig. 27)

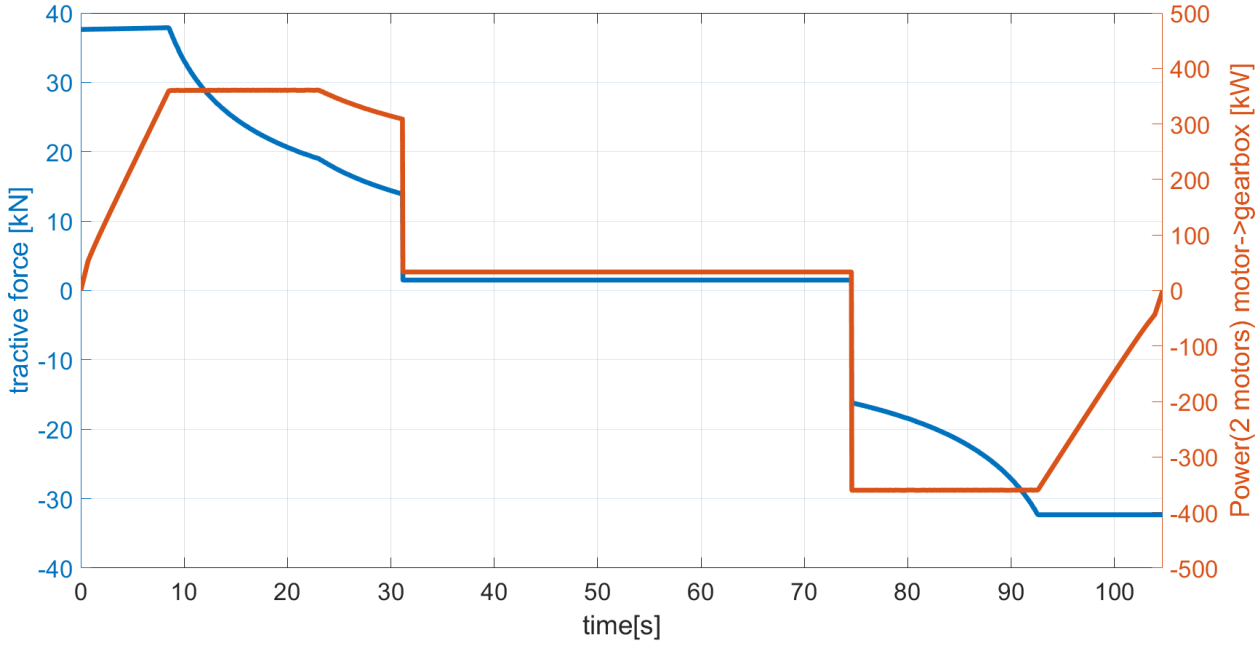
3. Standard duty cycle at AW3 & Gradient 0% - velocity and acceleration as a function of time e.g.



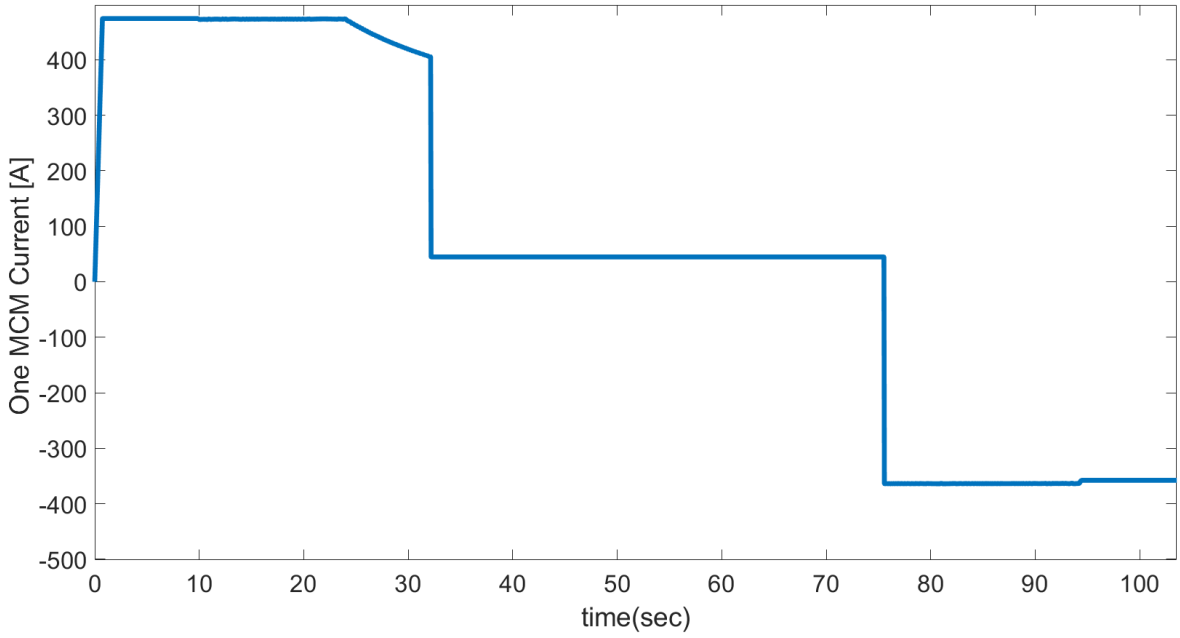
4. Standard duty cycle at AW3 & Gradient 0% - velocity and acceleration as a function of distance e.g.



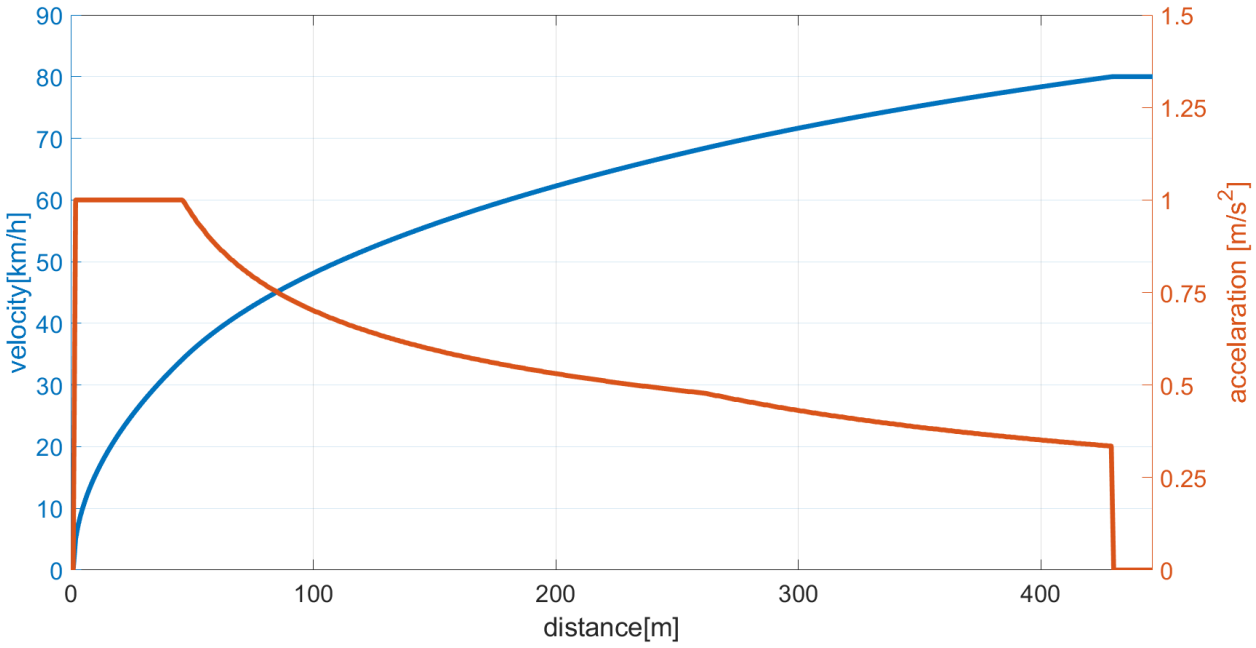
5. Standard duty cycle at AW3 & Gradient 0% – Traction force and power of one MCM as a function of time e.g.



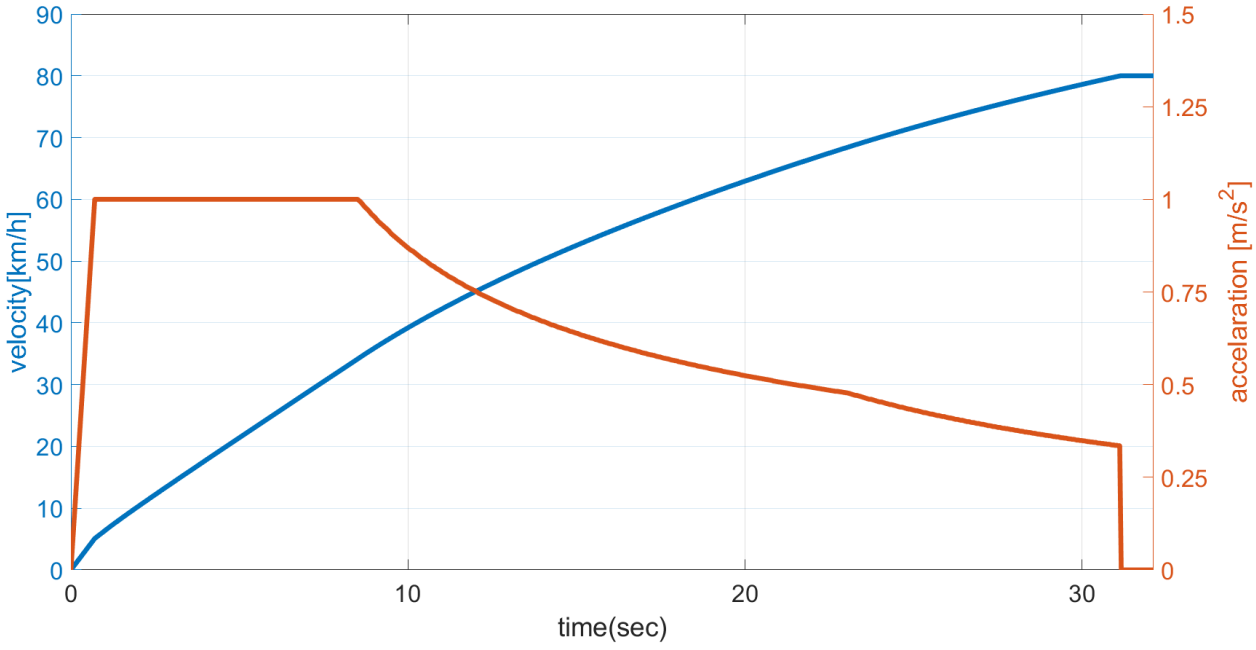
6- Standard duty cycle at AW3 & Gradient 0% –Current as a function of time e.g.



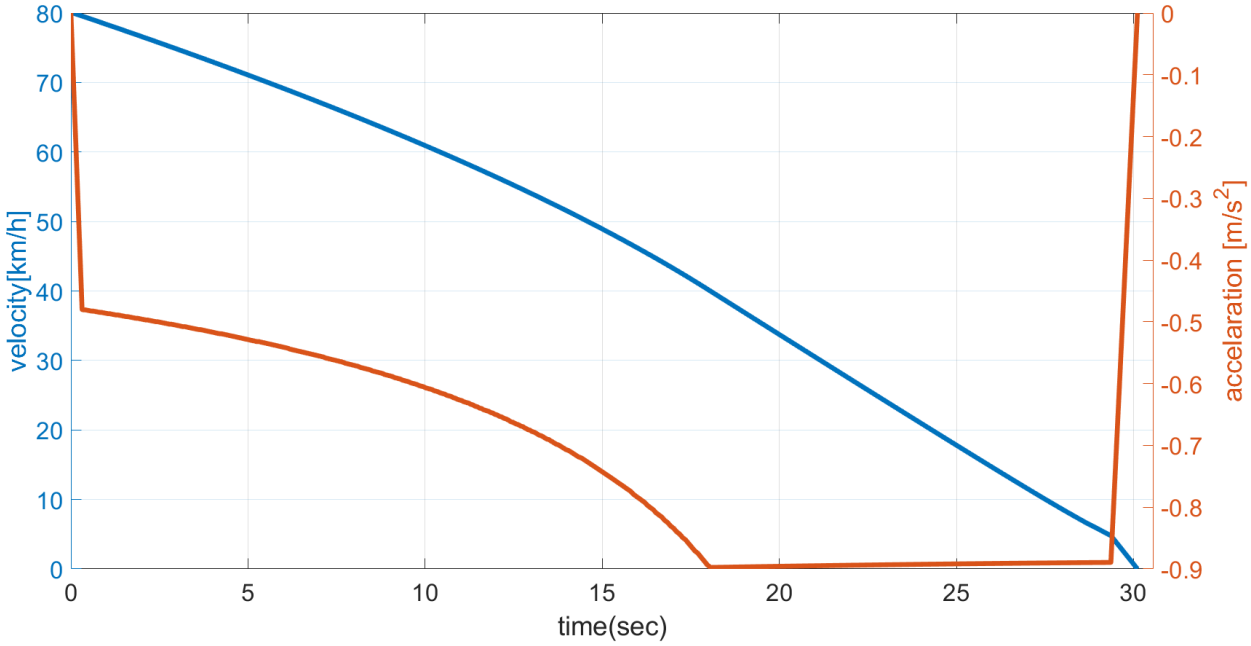
7- Standard duty cycle at AW3 & Gradient 0% –velocity and acceleration as a function of distance e.g.



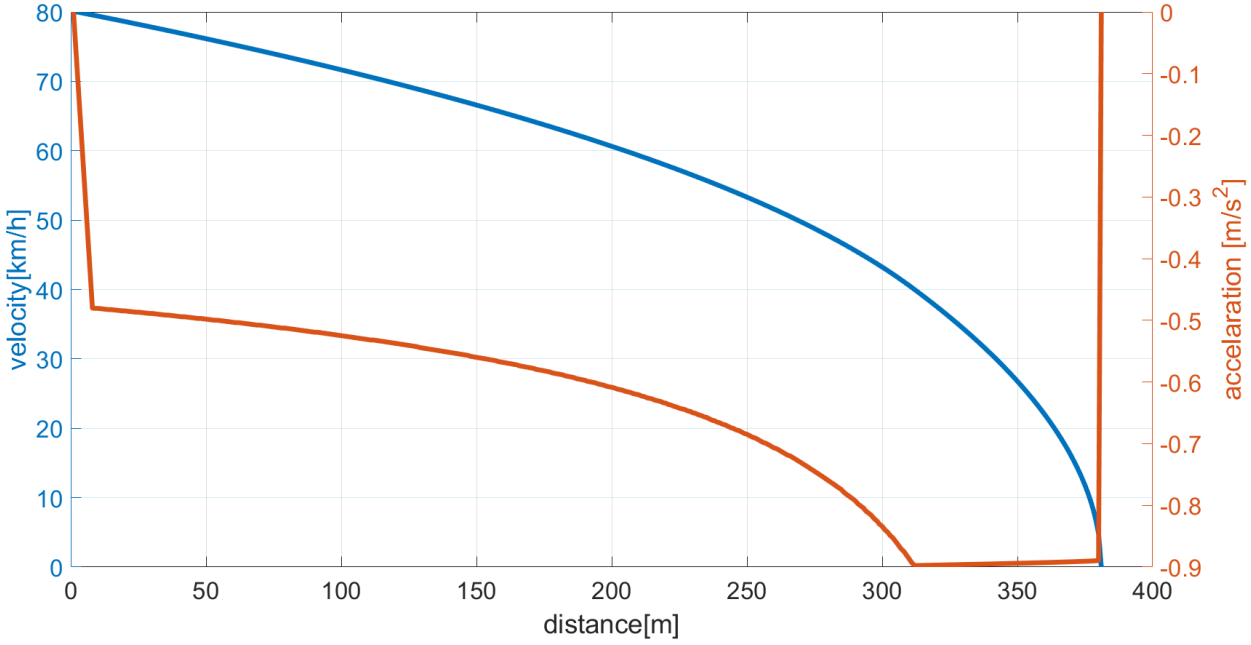
8- Standard duty cycle at AW3 & Gradient 0% –velocity and acceleration as a function of time e.g.



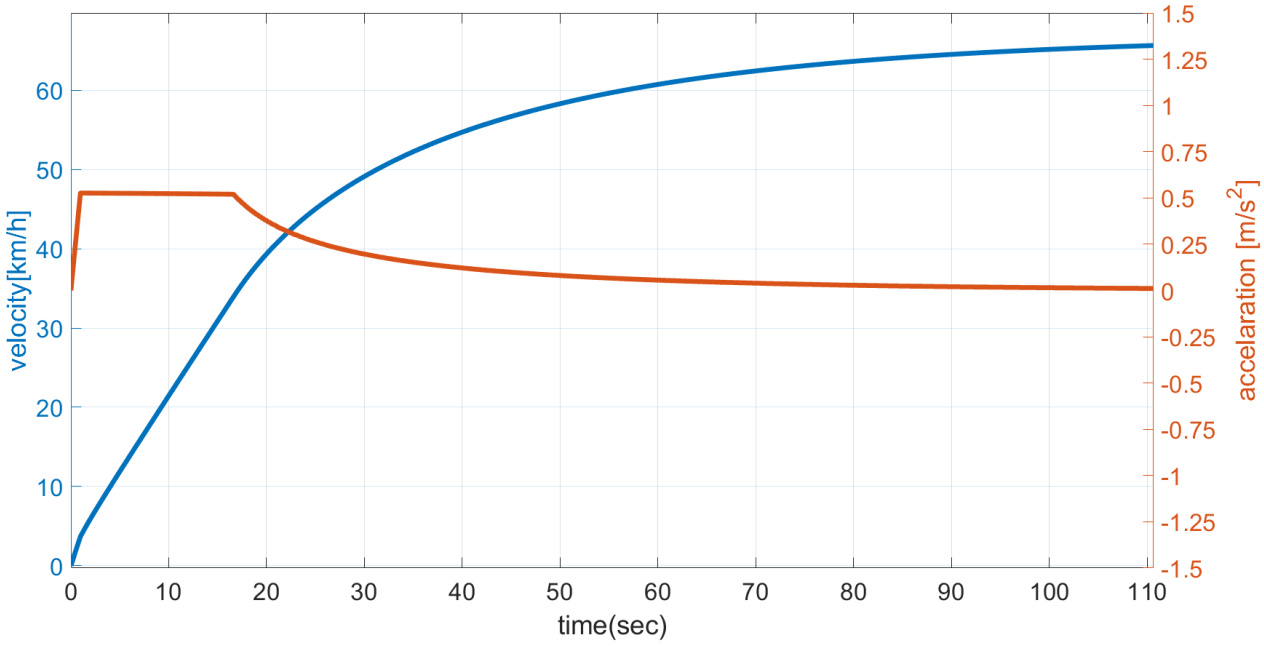
9- Standard duty cycle at AW3 & Gradient 0% –velocity and reduce acceleration as a function of time e.g.



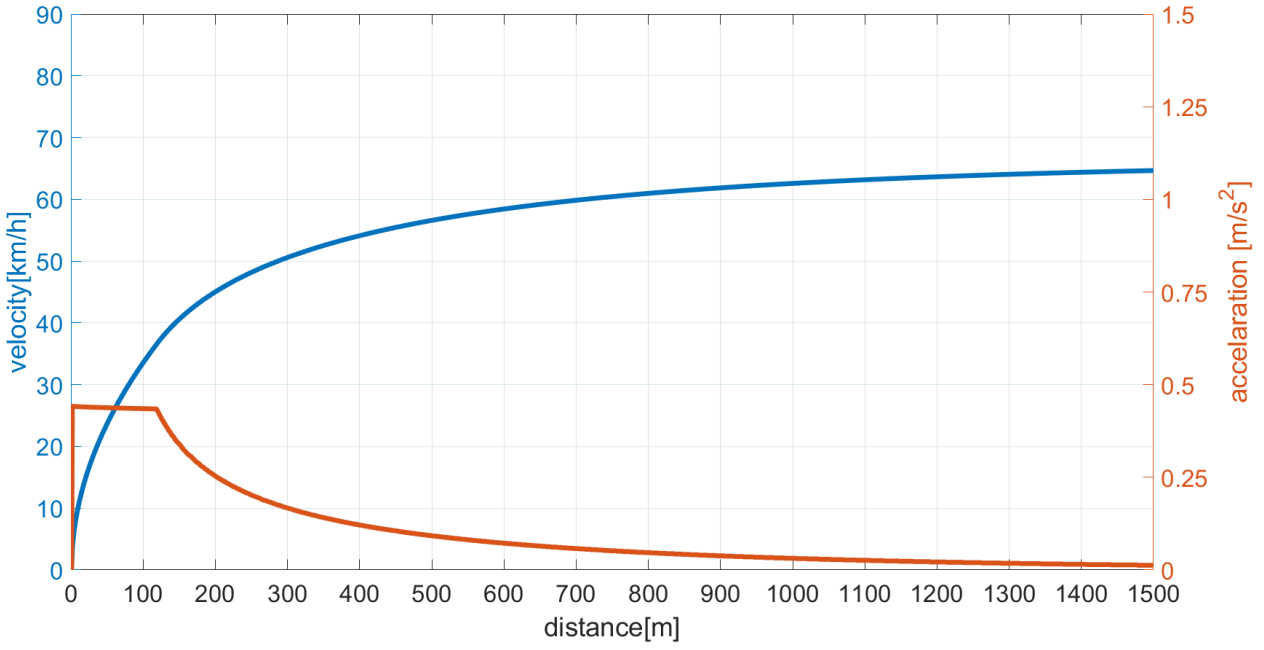
10- Standard duty cycle at AW3 & Gradient 0% –velocity and reduce acceleration as a function of distance e.g.



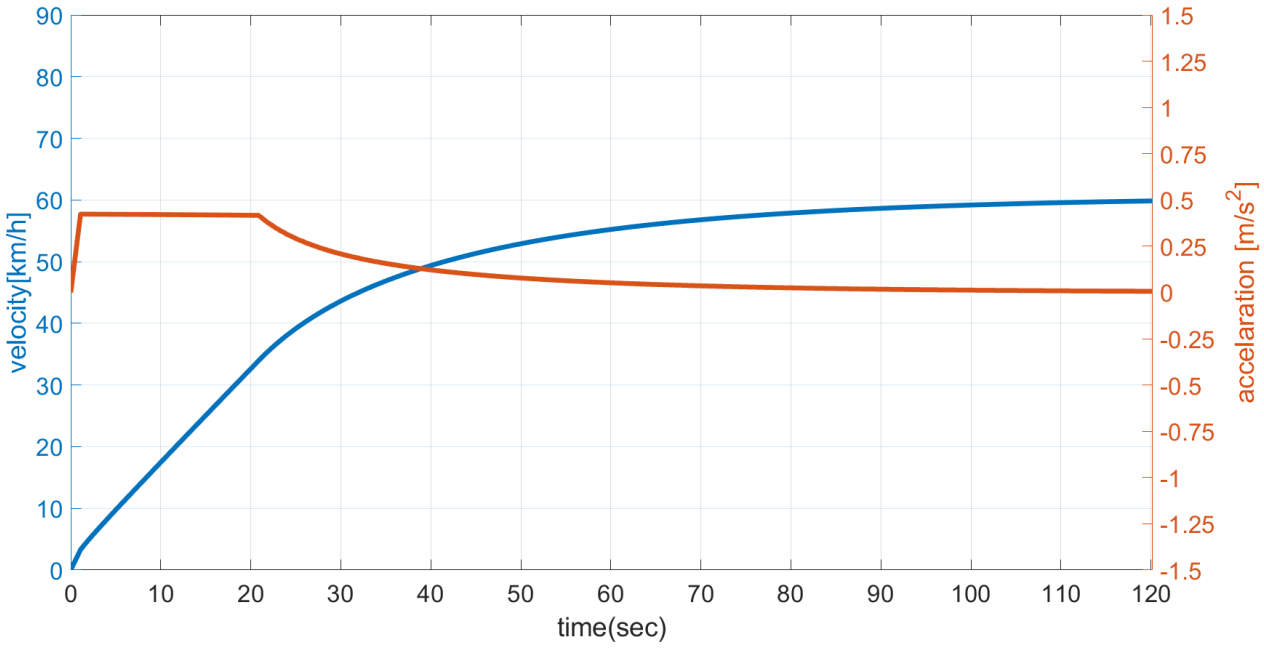
11- Standard duty cycle at AW3 & Gradient 5% –velocity and acceleration as a function of time e.g.



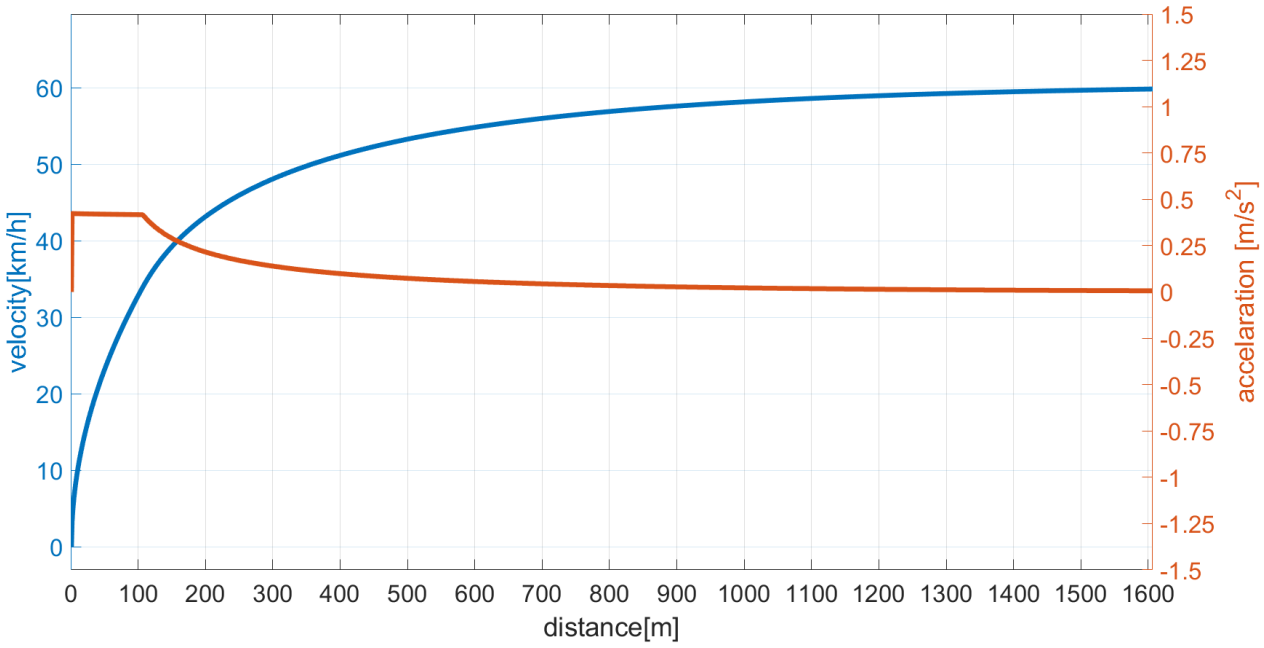
12- Standard duty cycle at AW3 & Gradient 5% –velocity and acceleration as a function of distance e.g.



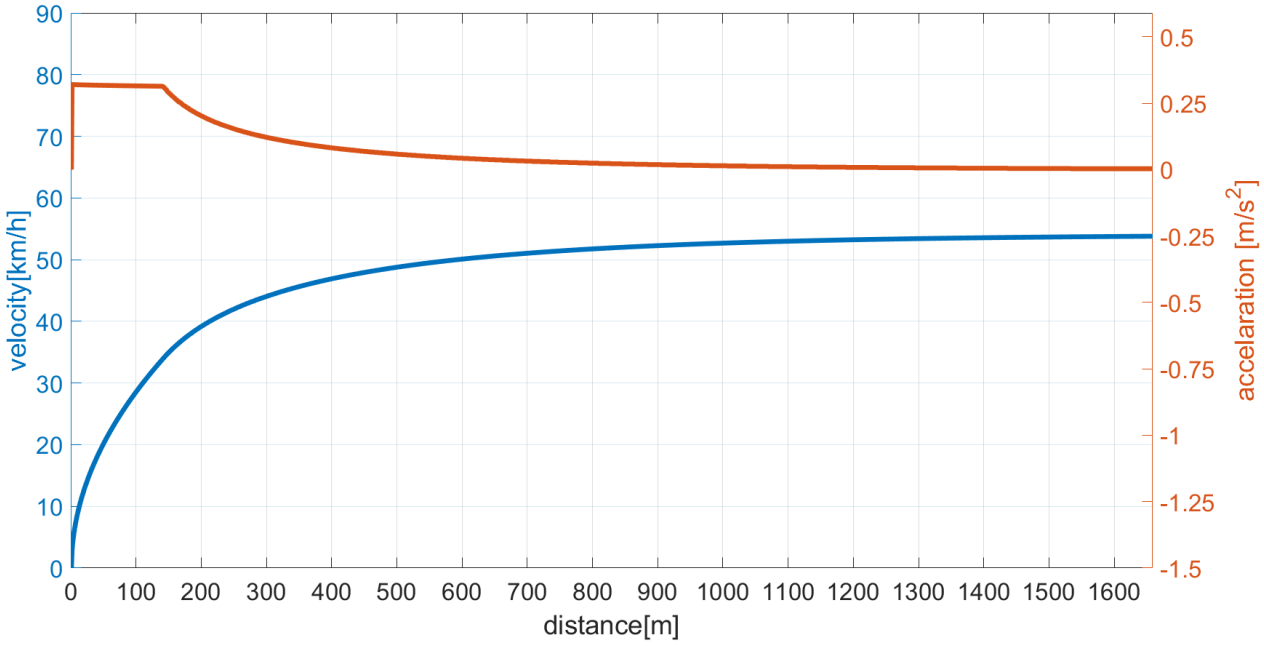
13.Degraded mode (90%) Gradient 5% at Aw3 -velocity, acceleration and mean acceleration as a function of time e.g.



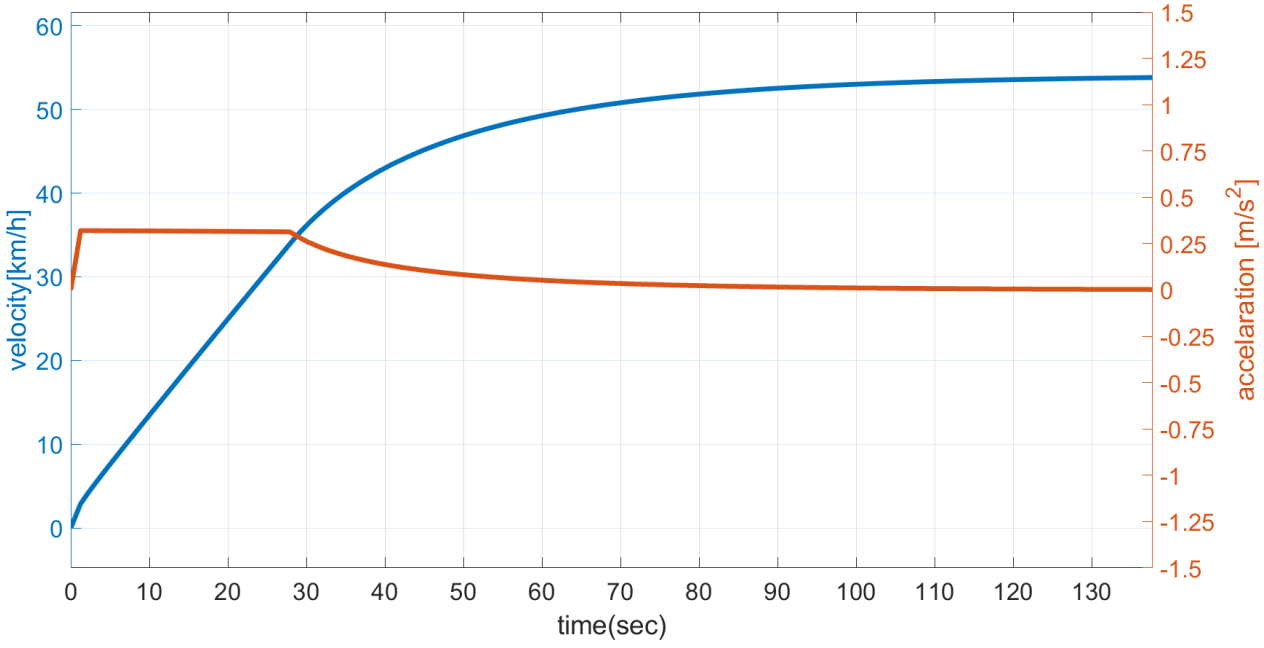
14.Degraded mode (90%) Gradient 5% at Aw3 -velocity, acceleration and mean acceleration as a function of distance e.g.



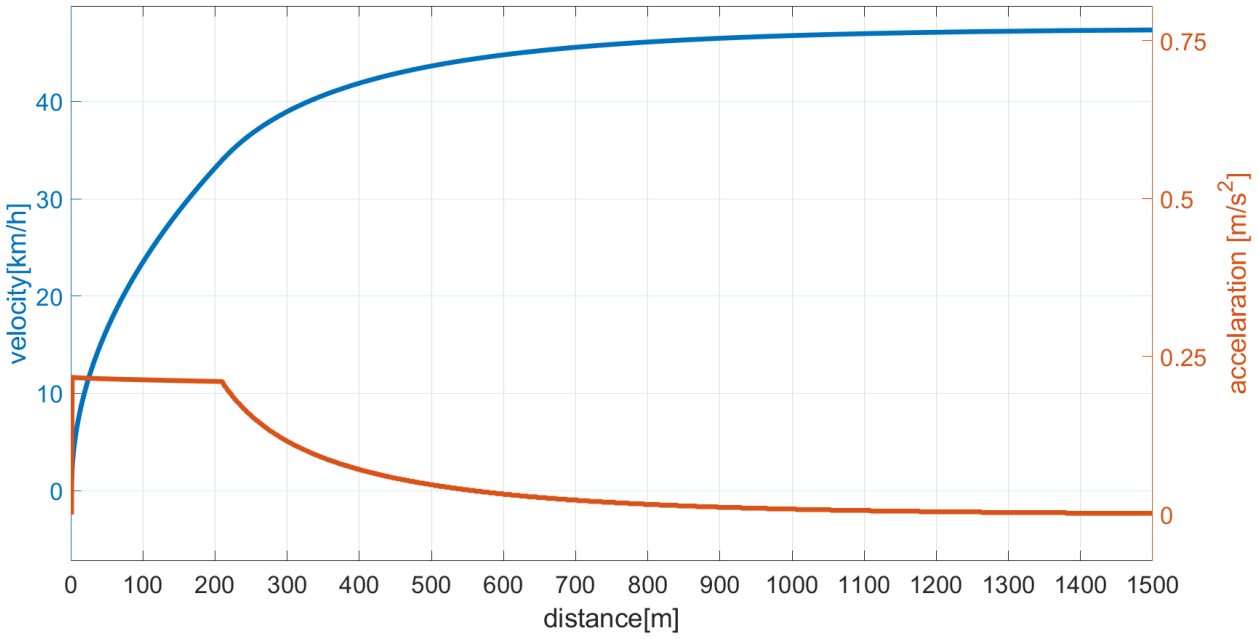
15.Degraded mode (80%) Gradient 5% at Aw3 -velocity, acceleration and mean acceleration as a function of distance e.g.



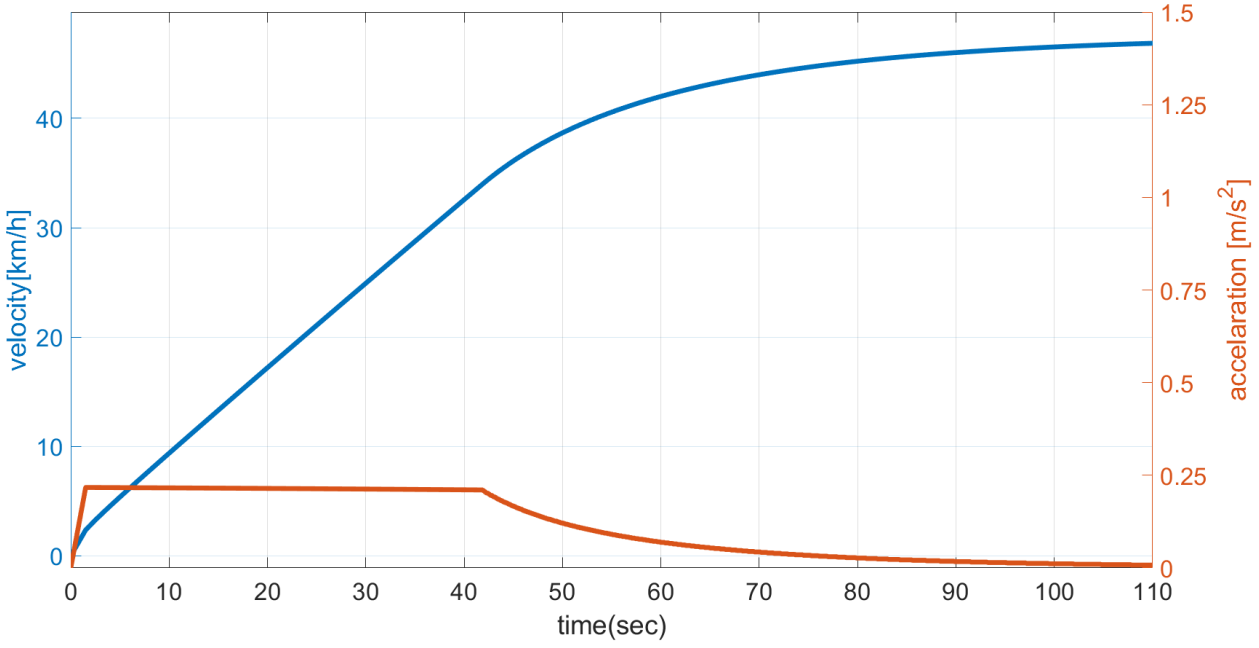
16.Degraded mode (80%) Gradient 5% at Aw3 -velocity, acceleration and mean acceleration as a function of time e.g.



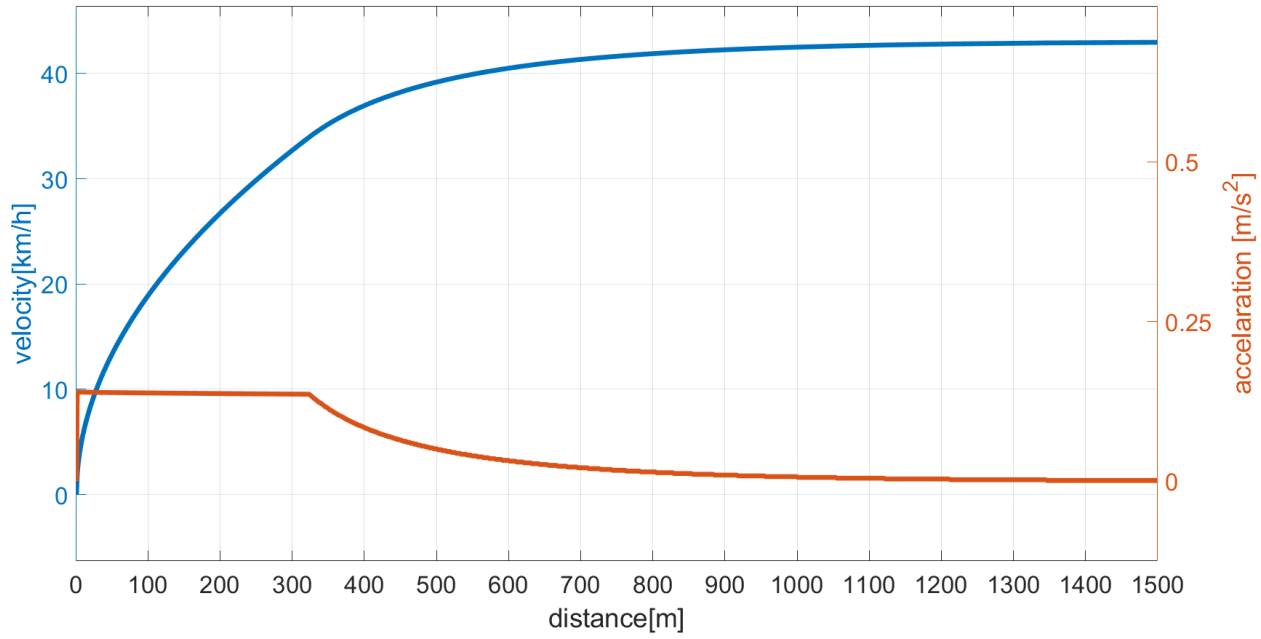
17.Degraded mode (70%) Gradient 5% at Aw3 -velocity, acceleration and mean acceleration as a function of distance e.g.



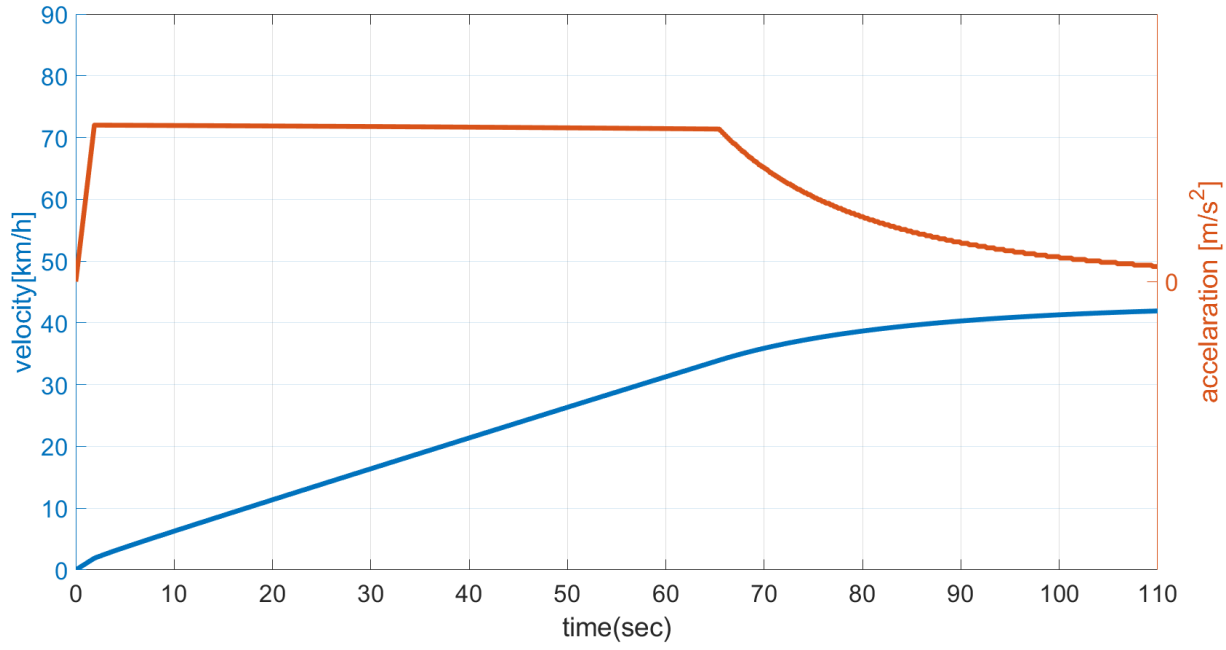
18.Degraded mode (70%) Gradient 5% at Aw3 -velocity, acceleration and mean acceleration as a function of time e.g.



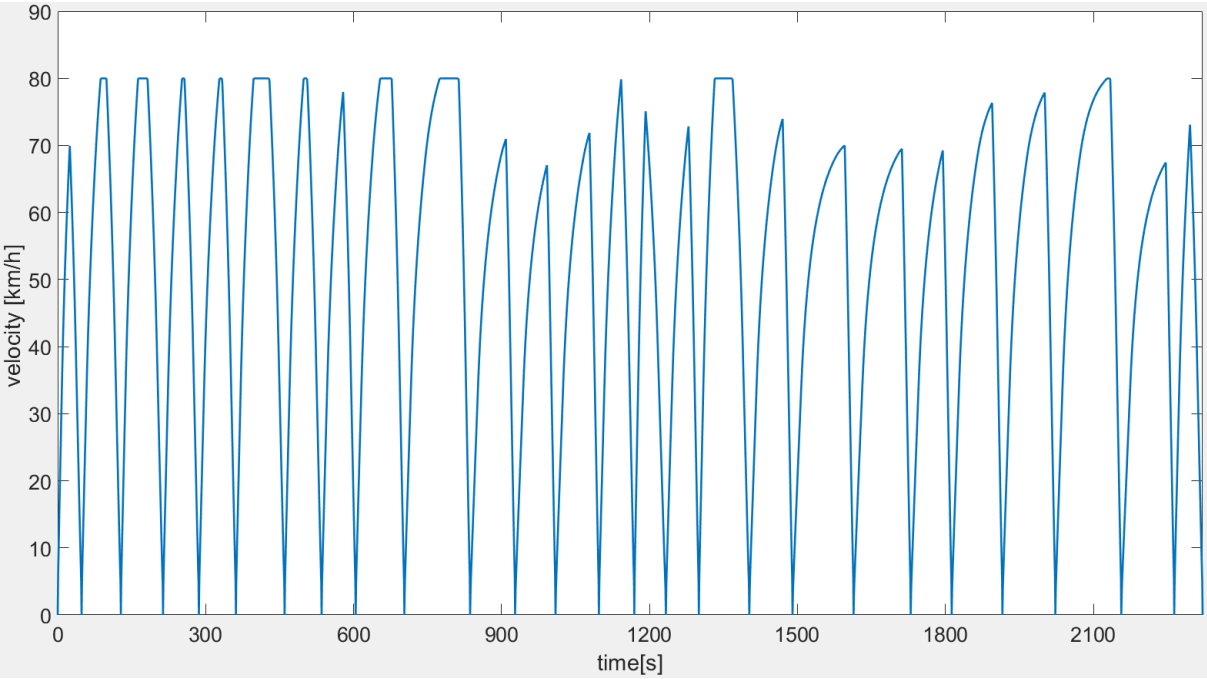
19. Towing mode, Gradient 5% at Aw0 for AW2 -velocity, acceleration and mean acceleration as a function of distance e.g.



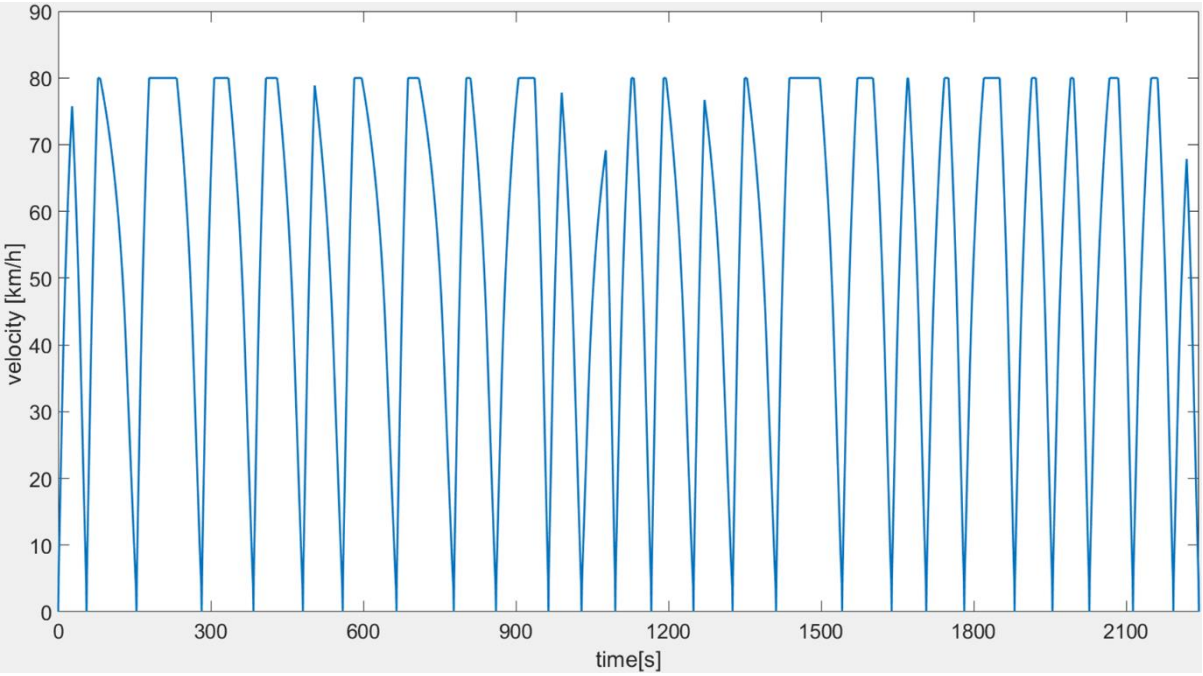
20. Towing mode, Gradient 5% at Aw0 for AW2 -velocity, acceleration and mean acceleration as a function of time e.g.



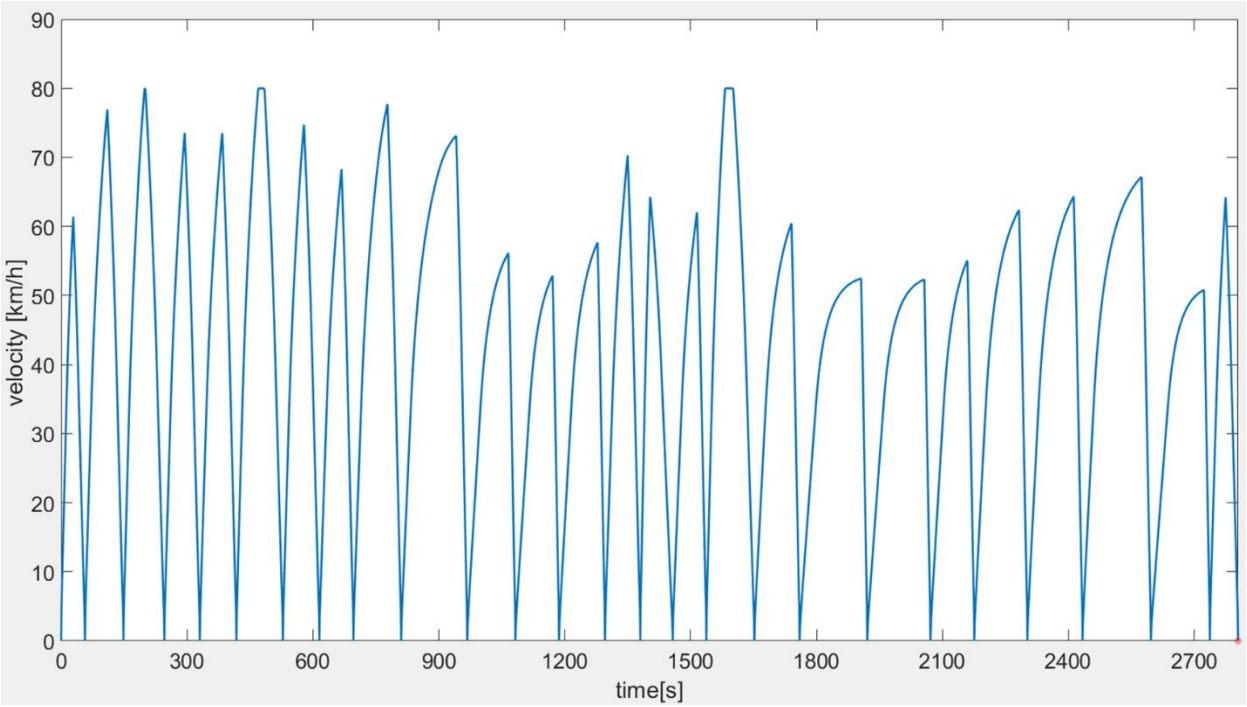
21. Track simulation at aw3 uphill – line 3
Total trip 47 min
Regeneration energy 490 Kwh
Tractive energy 1160 Kwh
Total stops at stations 8.3 min



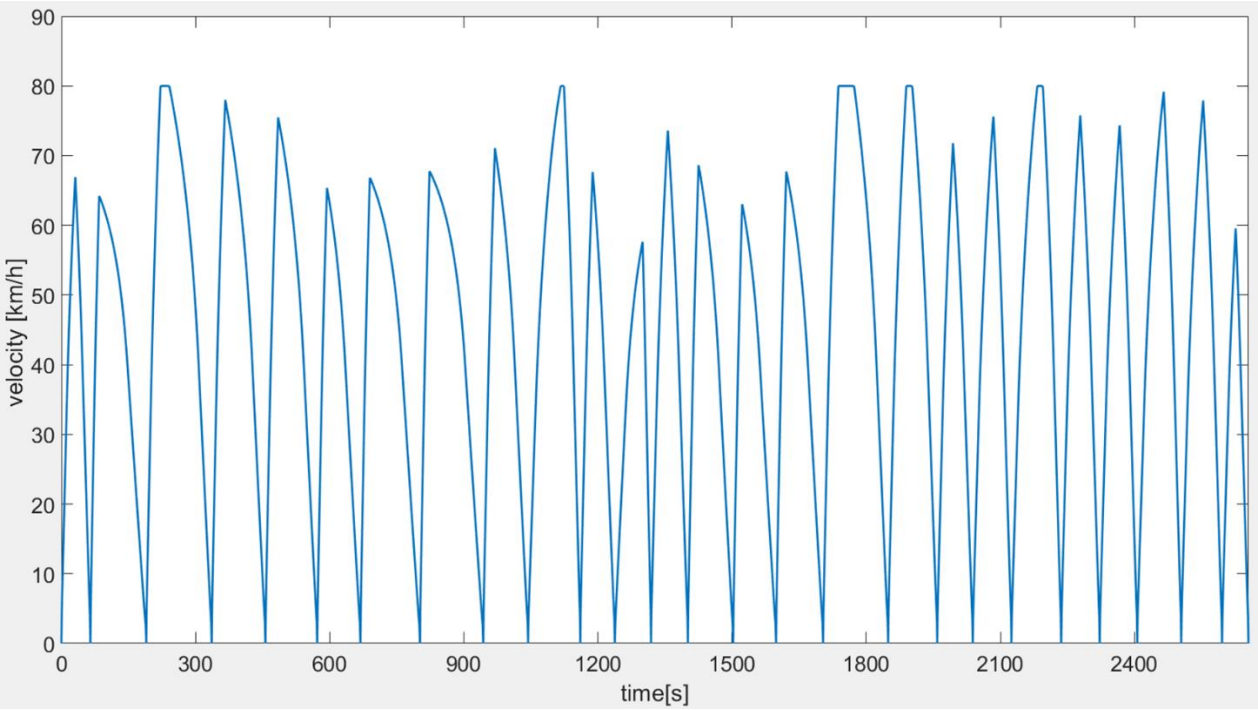
22. Track simulation at aw3 downhill – line 3
Total trip 46 min
Regeneration energy 1020 Kwh
Tractive energy 560 Kwh
Total stops at stations 8.3 min



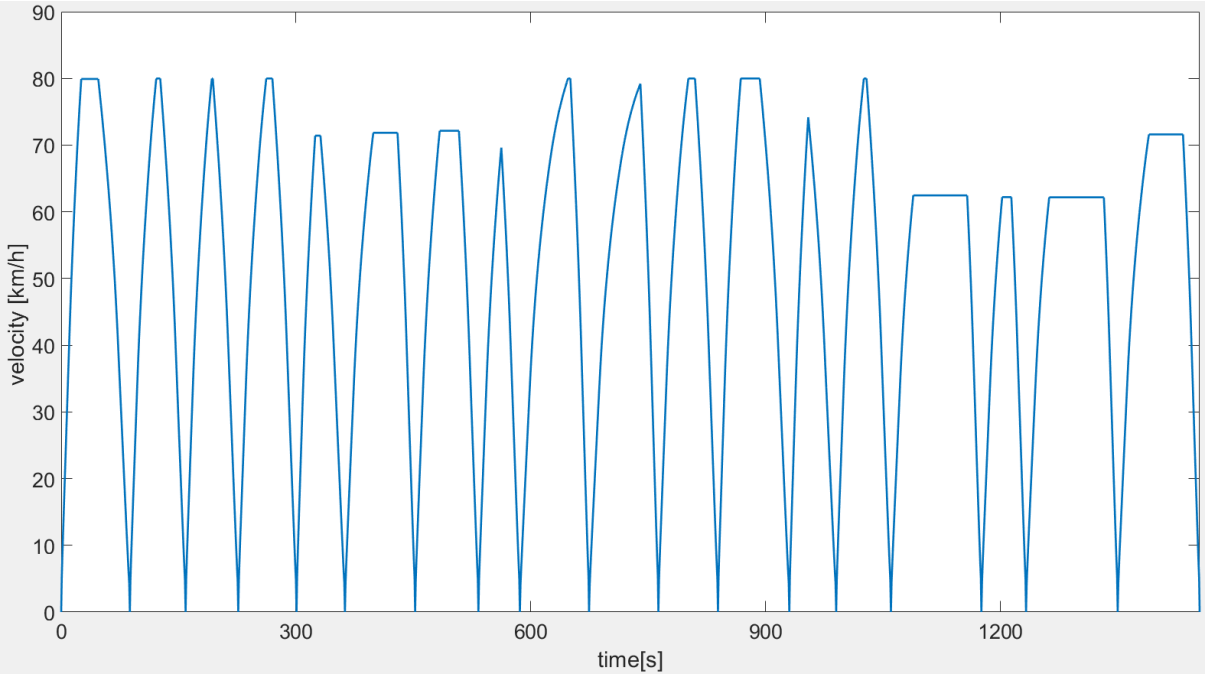
23. Track simulation at aw3 uphill Degraded 70% – line 3
Total trip 55 min
Regeneration energy 370 Kwh
Tractive energy 1030 Kwh
Total stops at stations 8.3 min



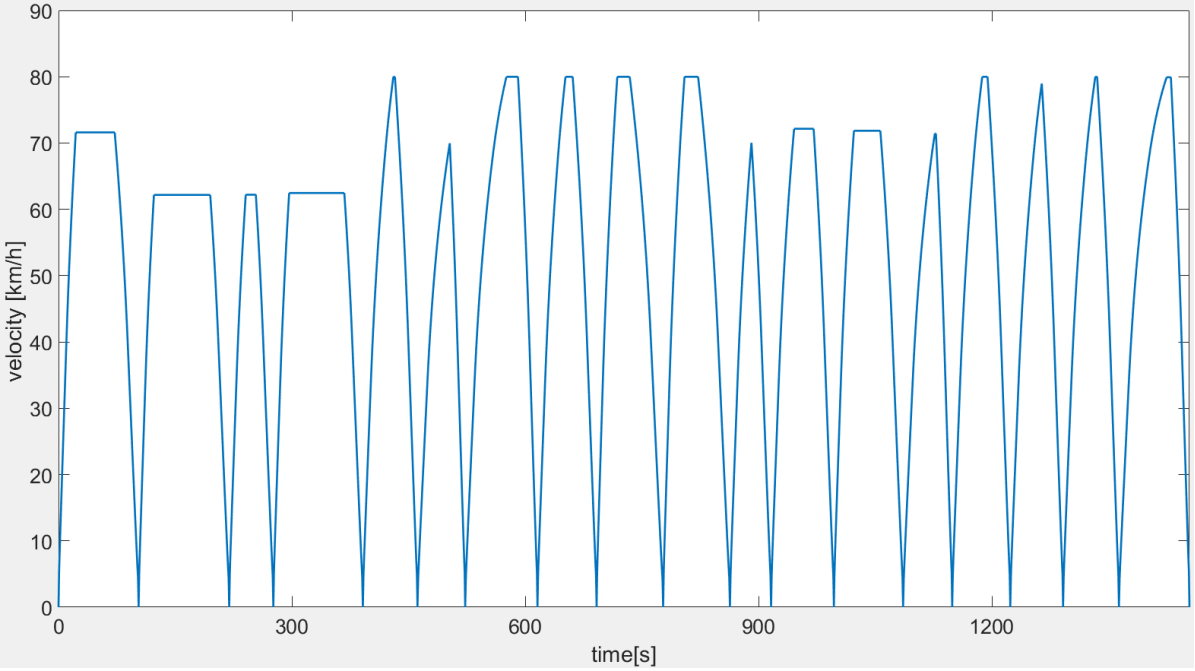
24. Track simulation at aw3 downhill Degraded 70% – line 3
Total trip 53 min
Regeneration energy 930 Kwh
Tractive energy 460 Kwh
Total stops at stations 8.3 min



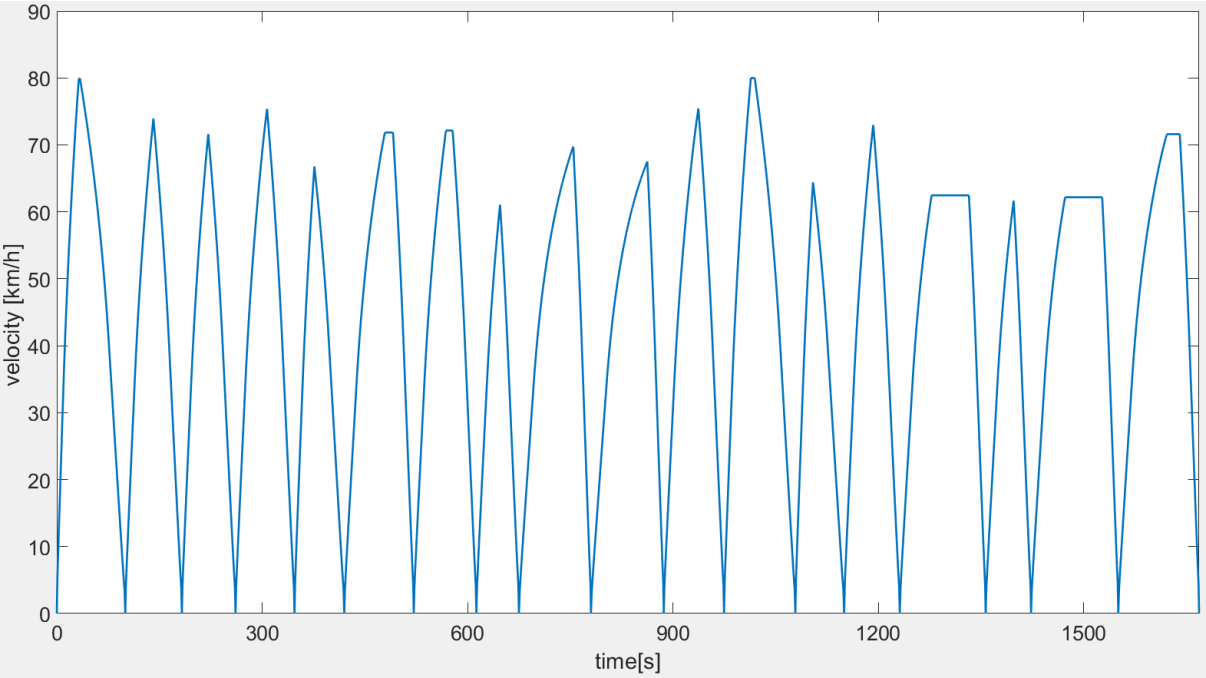
25. Track simulation at aw3 uphill – line 4
Total trip 31 min
Regeneration energy 400 Kwh
Tractive energy 520 Kwh
Total stops at stations 6.3 min



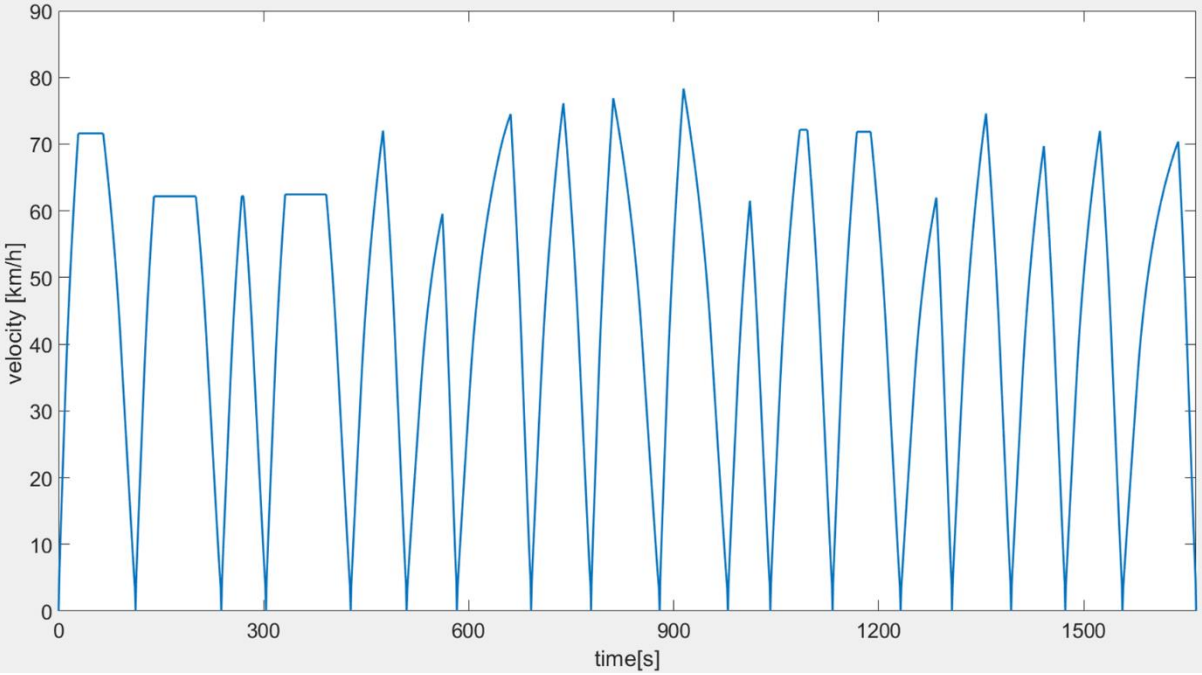
26. Track simulation at aw3 downhill – line 4
Total trip 31 min
Regeneration energy 430 Kwh
Tractive energy 450 Kwh
Total stops at stations 6.3 min



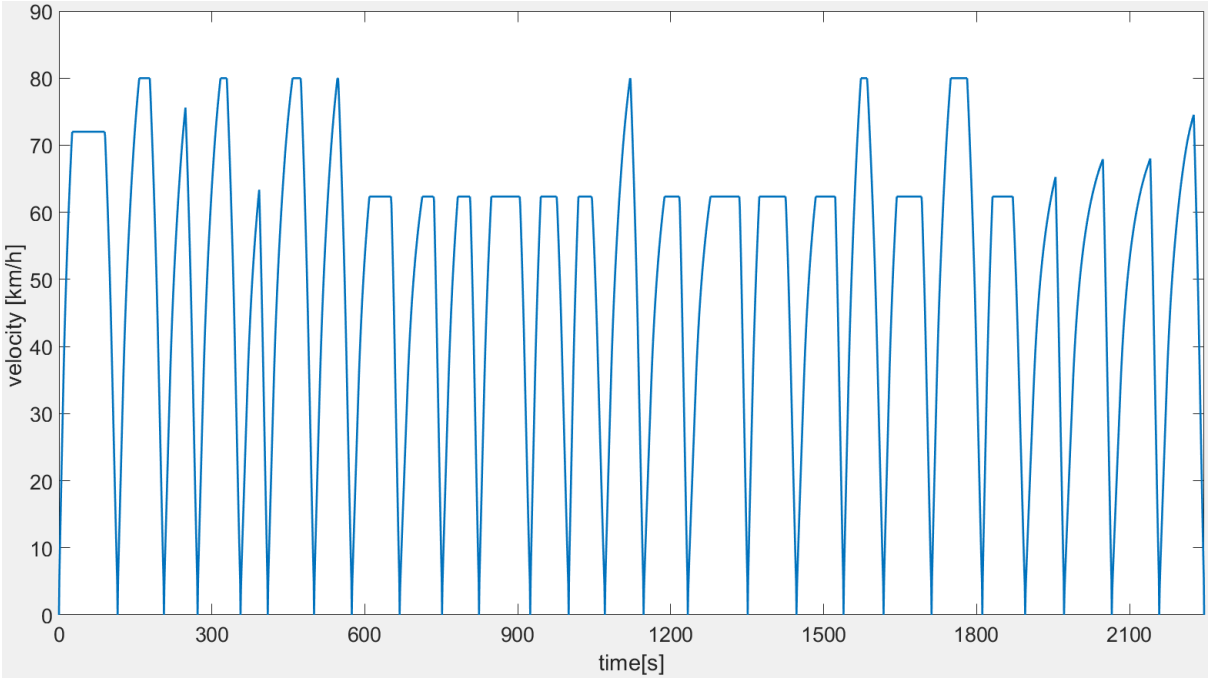
27. Track simulation at aw3 uphill Degraded 70% – line 4
Total trip 34 min
Regeneration energy 350 Kwh
Tractive energy 470 Kwh
Total stops at stations 6.3 min



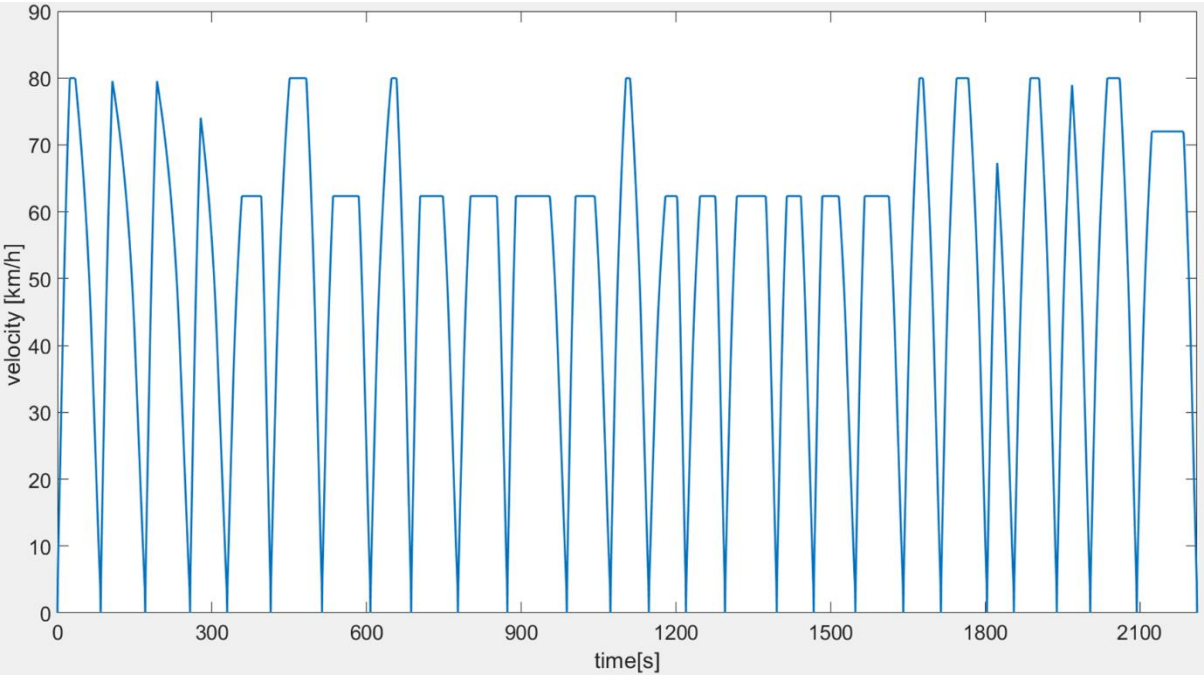
28. Track simulation at aw3 downhill Degraded 70% – line 4
Total trip 34 min
Regeneration energy 380 Kwh
Tractive energy 400 Kwh
Total stops at stations 6.3 min



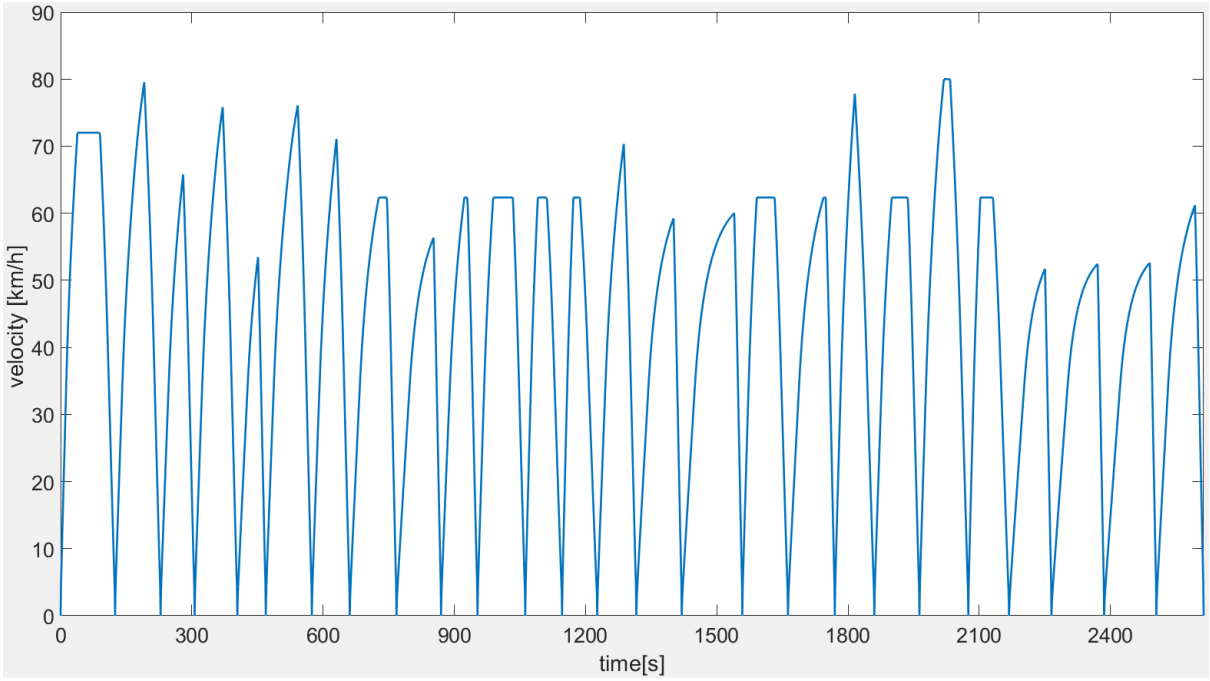
29. Track simulation at aw3 uphill – line 6
Total trip 47 min
Regeneration energy 430 Kwh
Tractive energy 900 Kwh
Total stops at stations 8.6 min



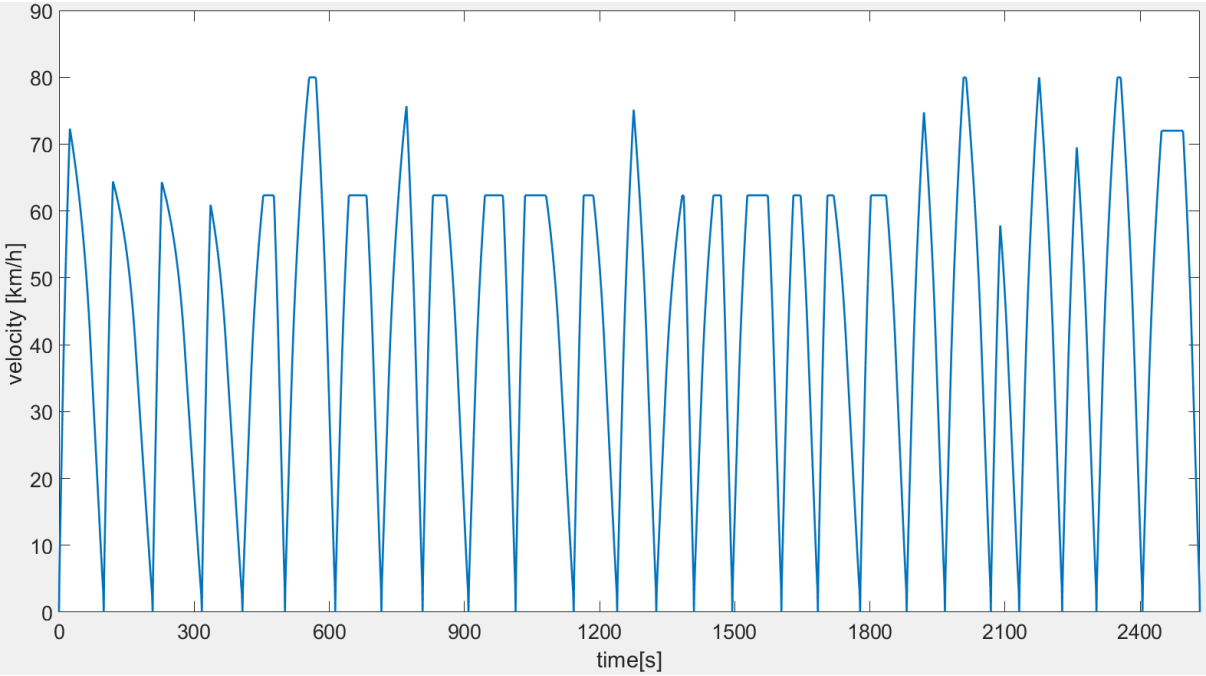
30. Track simulation at aw3 downhill – line 6
Total trip 46 min
Regeneration energy 770 Kwh
Tractive energy 500 Kwh
Total stops at stations 8.6 min



31. Track simulation at aw3 uphill Degraded 70% – line 6
Total trip 52 min
Regeneration energy 370 Kwh
Tractive energy 840 Kwh
Total stops at stations 8.6 min



32. Track simulation at aw3 downhill Degraded 70% – line 6
Total trip 51 min
Regeneration energy 720 Kwh
Tractive energy 440 Kwh
Total stops at stations 8.6 min



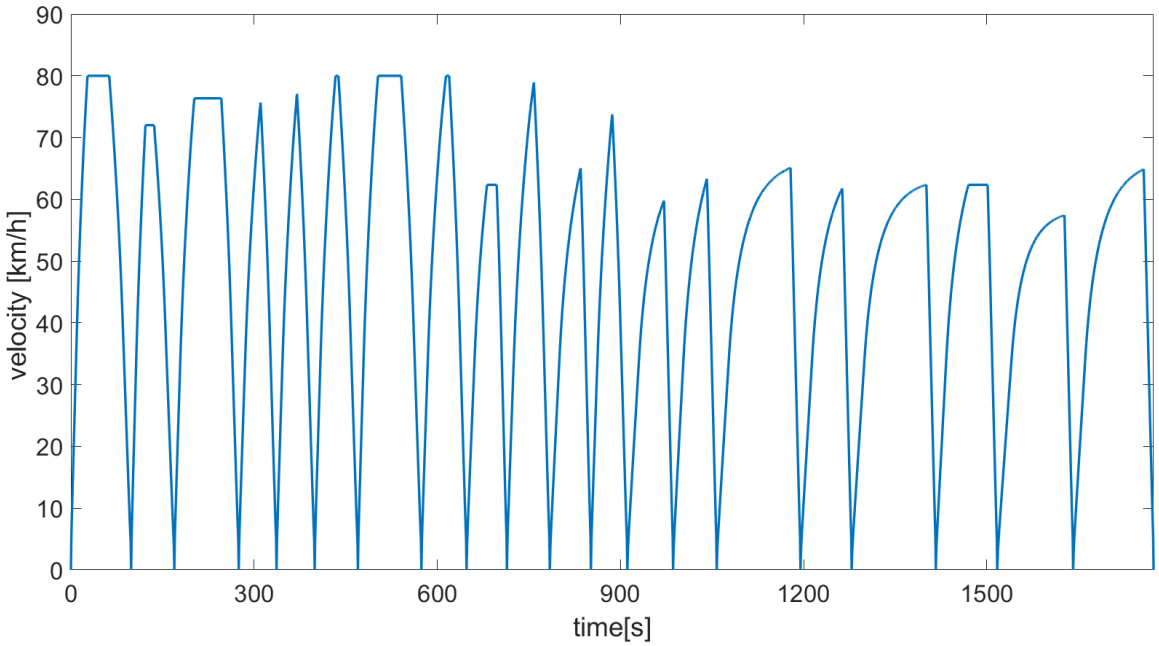
33. Track simulation at aw3 uphill – line 7

Total trip 37 min

Regeneration energy 370 Kwh

Tractive energy 900 Kwh

Total stops at stations 8 min



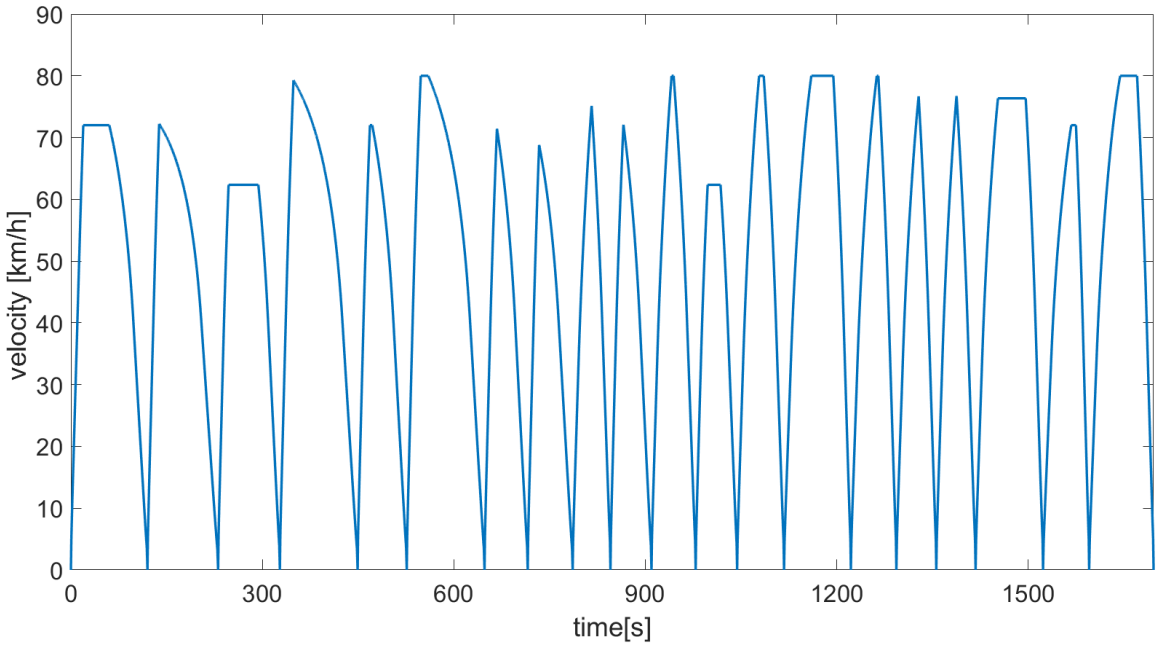
34. Track simulation at aw3 downhill – line 7

Total trip 36 min

Regeneration energy 800 Kwh

Tractive energy 430 Kwh

Total stops at stations 8 min



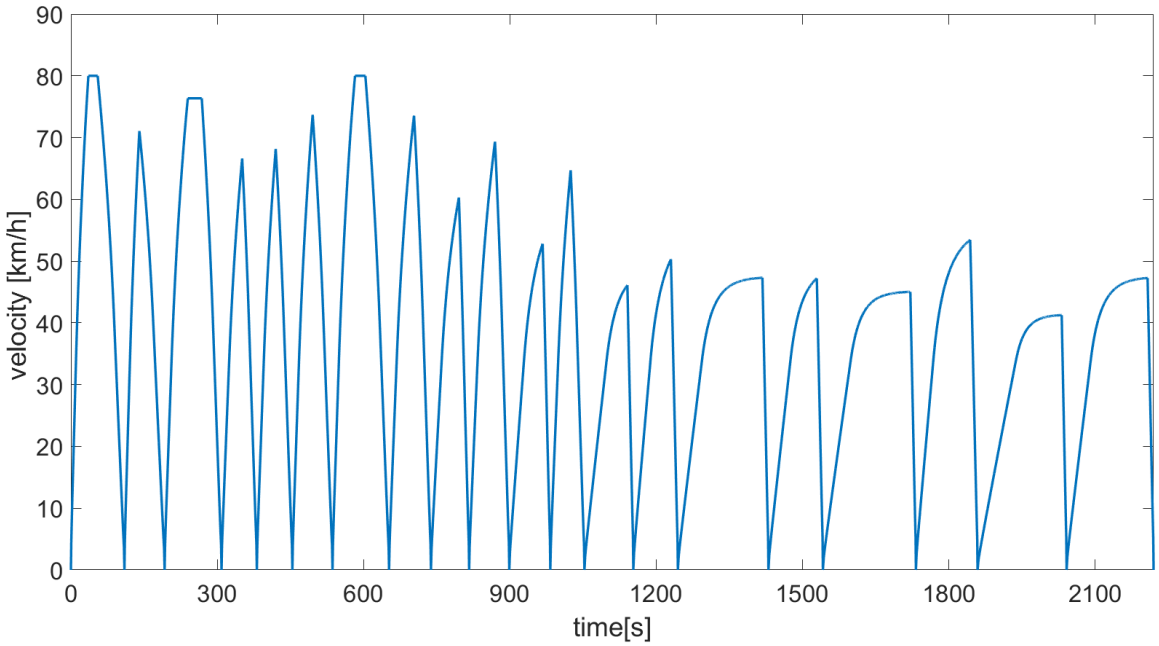
35. Track simulation at aw3 uphill Degraded 70% line 7

Regeneration energy 277 Kwh

Tractive energy 797 Kwh

Total trip 44 min

Total stops at stations 8 min



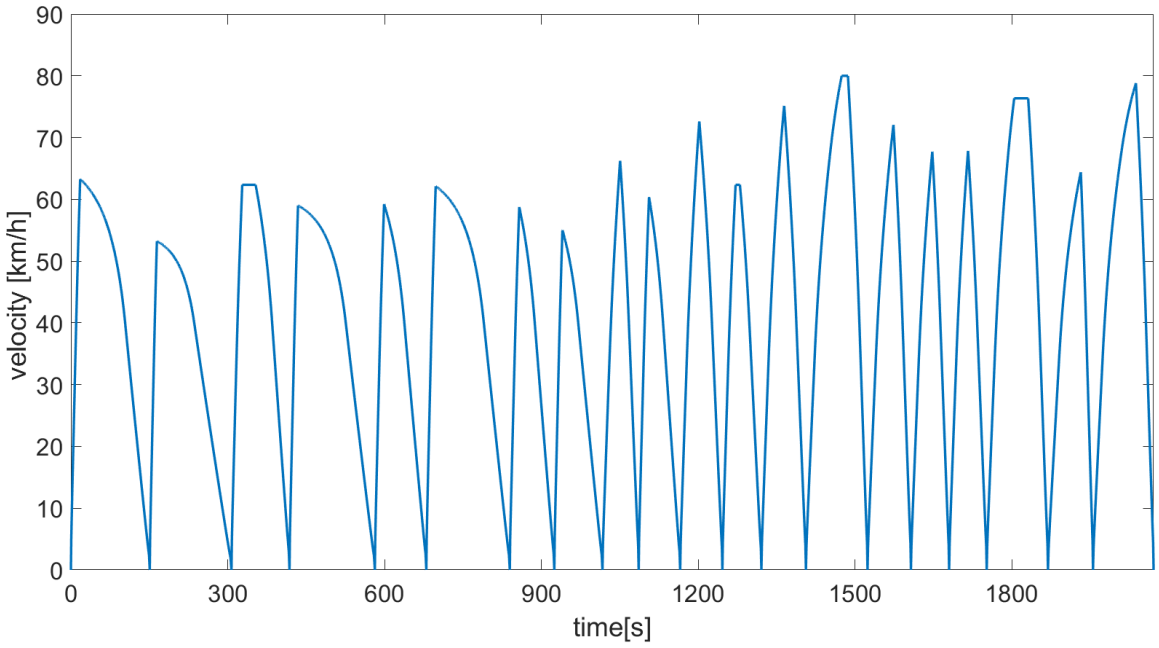
36. Track simulation at aw3 downhill Degraded 70% line 7

Regeneration energy 721 Kwh

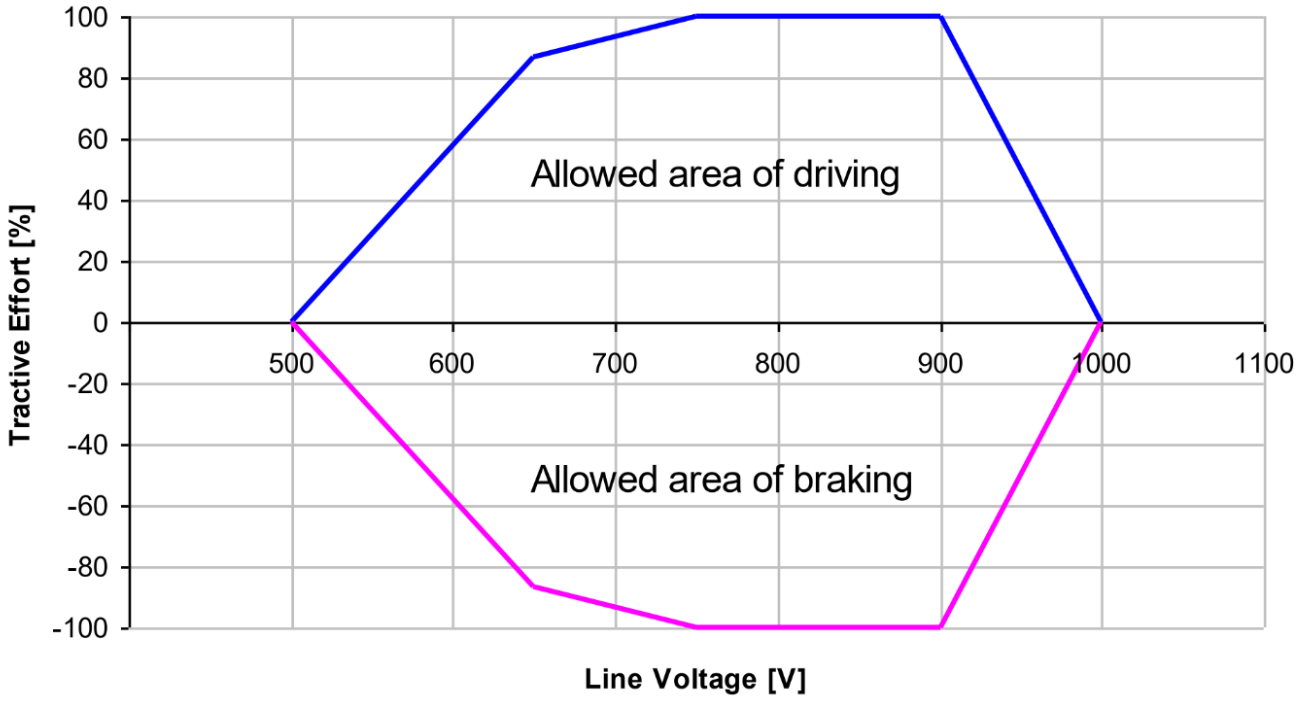
Tractive energy 344 Kwh

Total trip 42 min

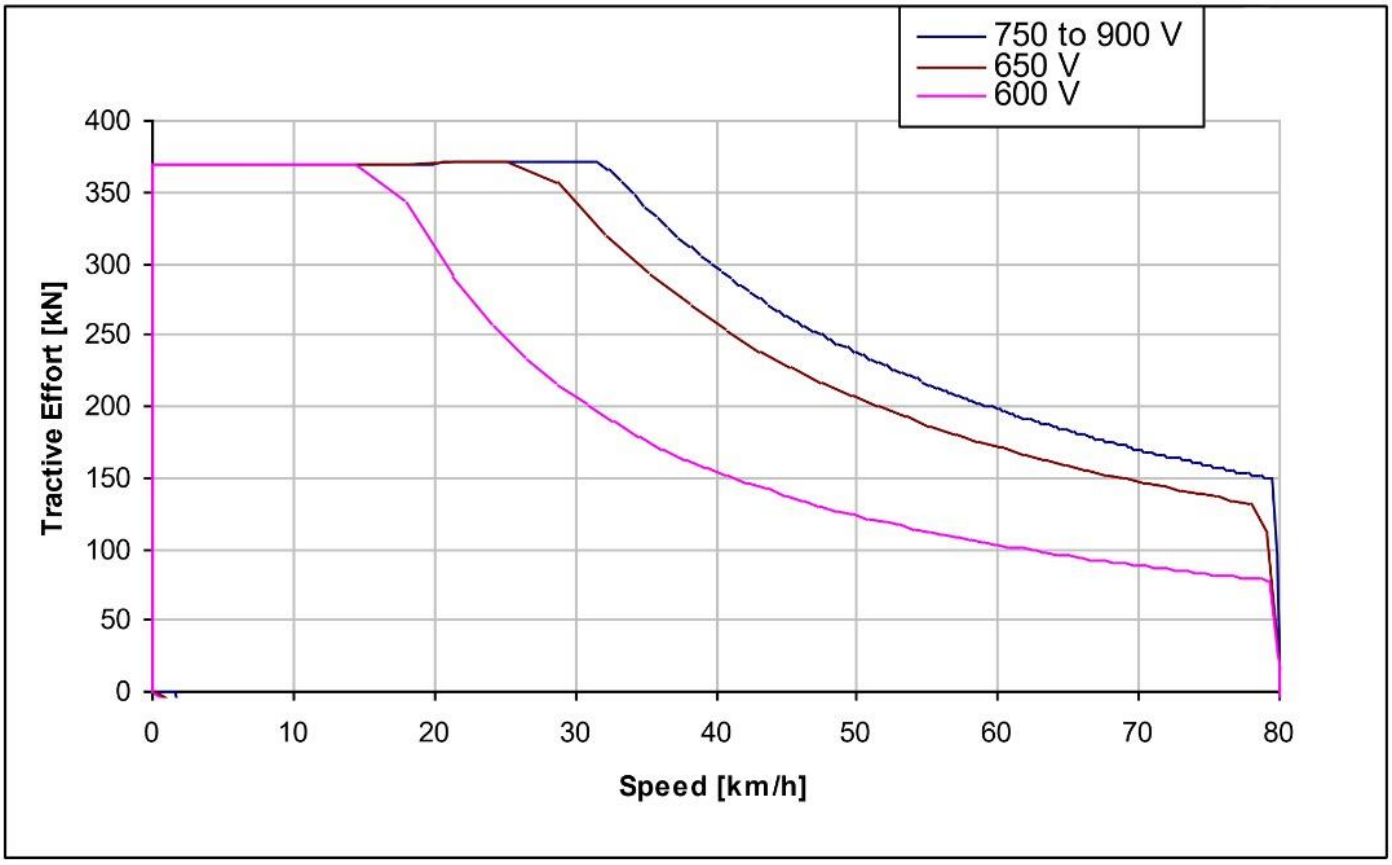
Total stops at stations 8 min



37-Tractive Effort as a Function of Line Voltage (Used Wheels as Worst Case)



38-Tractive Effort as a Function of Speed (Used Wheels as Worst Case)



39. From 10 to 5 km / h reduced in the form of ramps, the amount of electric braking force is reduced and from 5 to 0 km / h only air braking is applied.