Discussion on TLS

The robustness of the platoon could be interpreted using traffic light signals. Several combinations of red light and green light durations are proposed to test the performance of the platoon. The change of the traffic signals could be simulated using the following sinusoidal equation:

The whole complete traffic light cycle is controlled by and indicates the shift of the traffic light cycle and controls the proportion of red light and green light duration in a complete cycle. In this simulation model red light turned on when the function produces a non-negative value while the green light is turned on for a negative value. The optimization results are shown in the following tables.

|  | | | | | |
| --- | --- | --- | --- | --- | --- |
|  | h = 0 | h = 0.25 | h = 0.5 | h = -0.25 | h = -0.5 |
| Red light | 30s | 35s | 40s | 25s | 20s |
| Green light | 30s | 25s | 20s | 35s | 40s |
| Min SOC | 0.7955 | 0.7952 | 0.7942 | 0.7962 | 0.7962 |
| Final SOC | 0.796 | 0.7959 | 0.795 | 0.7964 | 0.7963 |
| Recovered SOC | 0.0005 | 0.0006 | 0.001 | 0.0002 | 0.0001 |
| Max Vel | 9.69 | 11.07 | 13.42 | 16.303 | 14.13 |
| Mean Vel | 7.46 | 7.46 | 7.46 | 7.46 | 7.46 |
| Max ACC | 0.76 | 1.5 | 1.5 | 0.9692 | 1.04 |
| Mean ACC | 0 | 0 | 0 | 0 | 0 |
| Max Jerk | 0.93 | 1 | 1 | 1 | 1 |
| Mean Jerk | 0 | 0 | 0 | 0 | 0 |

|  | | | | | |
| --- | --- | --- | --- | --- | --- |
|  | h = 0 | h = 0.25 | h = 0.5 | h = -0.25 | h = -0.5 |
| Red light | 30s | 35s | 40s | 25s | 20s |
| Green light | 30s | 25s | 20s | 35s | 40s |
| Min SOC | 0.7958 | 0.796 | 0.7947 | 0.7959 | 0.7962 |
| Final SOC | 0.7962 | 0.7961 | 0.7952 | 0.7962 | 0.7963 |
| Recovered SOC | 0.0003 | 0.0005 | 0.0013 | 0.0003 | 0.0001 |
| Max Vel | 10.93 | 11.68 | 13.3 | 10.71 | 14.67 |
| Mean Vel | 7.46 | 7.46 | 7.46 | 7.46 | 7.46 |
| Max ACC | 1.41 | 1.5 | 1.5 | 1.03 | 0.77 |
| Mean ACC | 0 | 0 | 0 | 0 | 0 |
| Max Jerk | 1 | 1 | 1 | 1 | 1 |
| Mean Jerk | 0 | 0 | 0 | 0 |  |

It can be seen from the results that mean speeds are maintained at the same value regardless of the change of the traffic light signal arrangements. The maximum velocity in the optimization model ranges from 9.7 to 16.3 but energy consumption results are approximately the same at around 79% of SOC when completing the proposed drive cycle.