Applying Pre-preemption of Traffic Signals at Intersections near Railroad Grade Crossing to a Micro-Simulation Model

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The Network

• Prior studies used detectors that are expensive to install. This study is based on monitoring upstream intersections.

• The minimum green times for all approaches were set to 5 seconds.
• 6 trains passed the intersection in an hour.

Background

• The goal of current signal preemption for intersections near highway-railroad grade crossings (IHRGCs) is to eliminate train-vehicle conflicts.
• The “track clearance phase” turns green as soon as the train was detected, while other phases became red immediately.
• With such an absolute priority, new safety issues occur due to the abbreviations of minimum green times.
• The approaching trains can be detected by monitoring the preemption at upstream intersections on the train path.
• Central signal control software can initiate phasing/timing prior to the regular preemption of traffic signal operations.
• Apply a pre-preemption strategy called Improved Transitional Preemption Strategy (ITPS) from other studies to a virtual network in VISSIM.

ITPS Algorithm

Begin algorithm when a train is detected earlier than the regular train detection

Remaining Time ≤ Yellow + All Red time for current phase

Is the current phase the “track clearance phase”?

Is the remaining time enough for next one, two, or even three phases?

End algorithm and start the track clearance phase

End algorithm and keep the phase

Go to the next phase

Update information

Performance after applying Pre-preemption Measures

Average delay time per vehicle [s] 24.50
Average speed [mph] 20.95
Total travel time [h] 22.99
Number of Stops 931.20

Performance before applying Pre-preemption Measures

Average delay time per vehicle [s] 21.5096
Average speed [mph] 21.9116
Total travel time [h] 21.9872
Number of Stops 920

Green Time Distribution

Before Applying Pre-preemption

After Applying Pre-preemption

Conclusion

• Pre-preemption Strategy ITPS can be represented in VISSIM by using VisVAP.
• Pre-preemption successfully avoids abbreviations of minimum green time for the vehicular signal phases.
• However, ITPS increase the delay and travel time for the whole network.