

Formation and Spatial Evolution of Traffic Oscillations

A seminar by

*Soyoung Ahn
Intelligent Transportation Systems Laboratory
Portland State University*

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Abstract

Data from two portions of congested freeway have unveiled the mechanisms that cause traffic oscillations (i.e., stop-and-go driving conditions) to form and grow in amplitude over space. Oscillations formed due to driver lane-changing maneuvers. Vehicles that inserted themselves into relatively small spacings in adjacent (target) lanes triggered these formations by inducing temporary decelerations among vehicles immediately upstream. Once they formed, this same lane-changing mechanism triggered oscillation growth.

We found no evidence that oscillations formed or grew due solely to driver interactions in single streams of traffic, independent of adjacent streams. Still, car-following behavior might also trigger these formations and growths. (Oscillations have been observed on single-lane roads and this implies that car following plays a role.) Yet on (multi-lane) freeways, whatever the influence of this latter behavior might be on oscillations, it is secondary to that of lane changing. The finding is notable in light of the many attempts to explain oscillations as strictly a car-following phenomenon.

Of further note, oscillations often diminished in amplitude when they propagated past merge areas that had become fully engulfed in queues. The oscillations' growth caused by lane-changing was countered by the inflows from queued on-ramps. This effect is explained with a theory that applies both to the merging and the diverging maneuvers that occur near ramps. The theory was validated using observations from two freeway merges.