[W] - Rd:1e

Composer / Researcher

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Annum

2009 - 2010

Duration

5 min 12 sec

Composition

[W] -Rd:1e

Behaviour of complex microscopic systems:
Examining mobility of uni-directional vehicular motion
in a two lane system.
[Obstruction in left lane]

Computer generated music

For

3.1 Speaker system diffusion

Index

Composition of [W] – Rd:1e:

[W] – Rd:1e is a computer generated music composition where the calculated results were used to determine a realistic flow of organic sound travelling between the left to the right speaker. Matlab allowed these conditions of various: velocities , vehicle lengths and time duration relationships to be associated with audio frequency parameters, who were fed to a Pitch-to-Midi converter, the pitches were then read and turned into a sequence(s) of pitches and rhythms the computer could understand. The velocities and vehicle lengths were analysed with Fast Fourier Transform software. This gave the harmonic spectra which were used to determine the timbres of the electronic tones [the composition has these electronic timbres playing the exact rhythms to the vehicle mobility through the lanes].The end result shows a micro timbral transformation of primal but homophonous sound.

Vehicular motion:
Two lane mobility in unidirectional system
[Obstruction in left lane - motion from left to right lane]

Study: Traffic flow *[sight specific]* over two lane unidirectional system.
Location: Wilgerood road – Kloofendal, Roodepoort, Gauteng, South Africa.
Date: 18 - 20 /February/2010.
Cameras: Two cameras were installed in opposite directions 600 meters apart, one situated facing the on coming traffic, the other situated facing the out going traffic.
Conducted: On an even stretch of road.
Weather: Sunny, with clear view.

Motion in the left lane is obstructed [*Speed government in reaction to leading traffic and the management of lane-change manoeuvres to pass slow-moving vehicles or move away from the obstruc*tion] was captured as data.

The resultant manoeuvres can be highly dynamic. It is of out-most importance that the computation must be as safe and reliable as possible. Government of the *maximum travel speed* begins in the distance to and the speed of the closest obstacle along the lane. These are provided as the Lead Vehicle Distance and Lead Vehicle Speed Subjects, respectively, and their values are guarded against transient tracking loss as in the computation of Precedence and Clearance, retaining the smallest value of the Lead Vehicle Distance for a configurable time before allowing it to grow again,also maintaining a safe distance behind a slow-moving vehicle and queueing in stop-and-go traffic.
Vehicle length with a minimum of one vehicle-length in travel lanes and tapering down to 2m on approach to an intersection. In the steady-state the commanded velocity is computed using a simple feedback-control law: vcmd = K gap(gap actual − gap desired) where gap desired is computed according to the rule listed above, gap actual is the Lead Vehicle Distance and K gap is a configurable gain. As a simple proportional controller, this exhibits a steady-state lag in the tracking of gap desired. Moreover, the simplicity of the control law, when combined with the abstracted Lead Vehicle Distance, afforded smooth, repeatable performance in the face of noisy obstacle data. Note that this control law will drive the commanded speed to zero on approach to a stopped car or roadblock. If the obstacle subsequently starts moving along the road, the commanded speed will increase again, resulting in a stable queuing behaviour. If the obstacle does not start moving, a passing manoeuvre may be warranted. When a passing lane is available in the same direction of travel, it will be selected once the current speed limit has been slowed to a configurable fraction.

When the Intended Lane differs from the Current Lane, the Feasibility is determined as the ability to maintain proper spacing with surrounding vehicles while ensuring the system reaches the Intended Lane within constraints such as the length of the remaining road and the distance to the Current Goal.

The two-lane unidirectional case is depicted in Fig. 1.0 – 1.4 [of selected scenarios].

- The distance to the current goal.
- The remaining distance in the current lane.
- The distance to the closest blockage in the current lane.
- The projected future position of the closest vehicle, in the current lane.

Assuming that the merge is kinematically feasible, each Moving Obstacle in the merge-to lane is evaluated both for whether it can be overtaken for a front-merge within the merge-by distance and for whether it is possible to slow down and wait for a back-merge opportunity. The gap between the obstacles is, and will remain, large enough to allow proper spacing. The target slot is selected from the set of feasible slots according to the context of the manoeuvre. Both the Current and Intended Lanes are in the same direction, thus the foremost feasible slot is selected in order to make the best time. If proper spacing has been met, one last check is made to make sure the rear vehicle's velocity can be matched after the merge without violating proper spacing.

Varied lengths of each vehicle are colour coded.

Day 1 -18/02/2010: 10h140,15

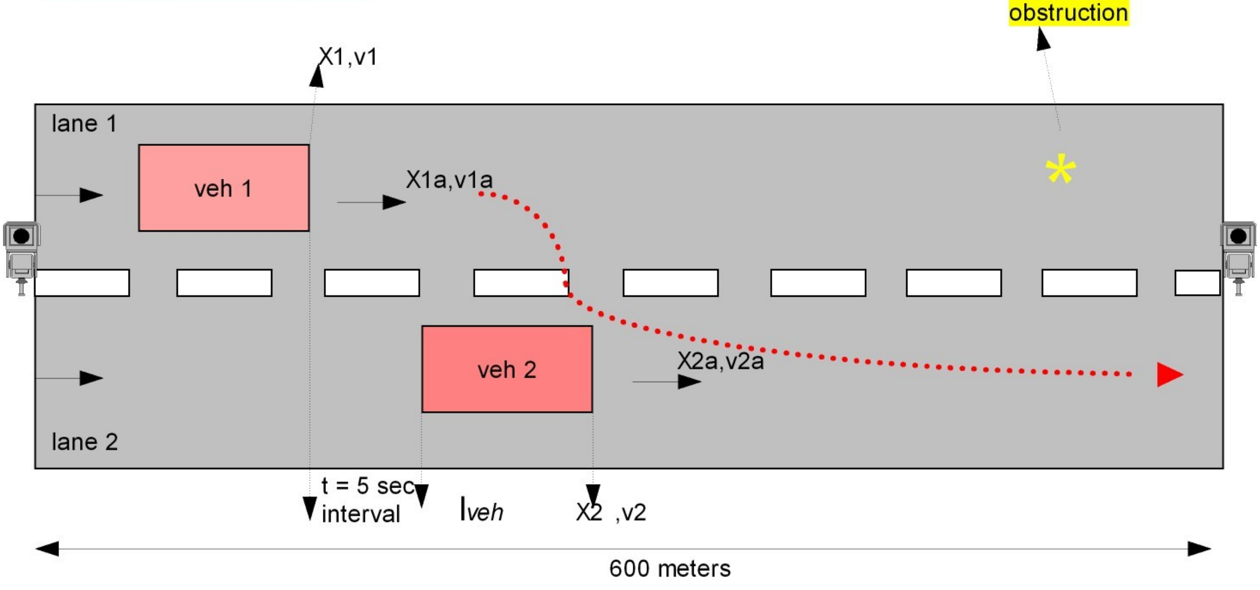


Fig 1.0: lane driving scenario showing a front merge opportunity [lane2]

Day 1 -18/02/2010: 10h42,26

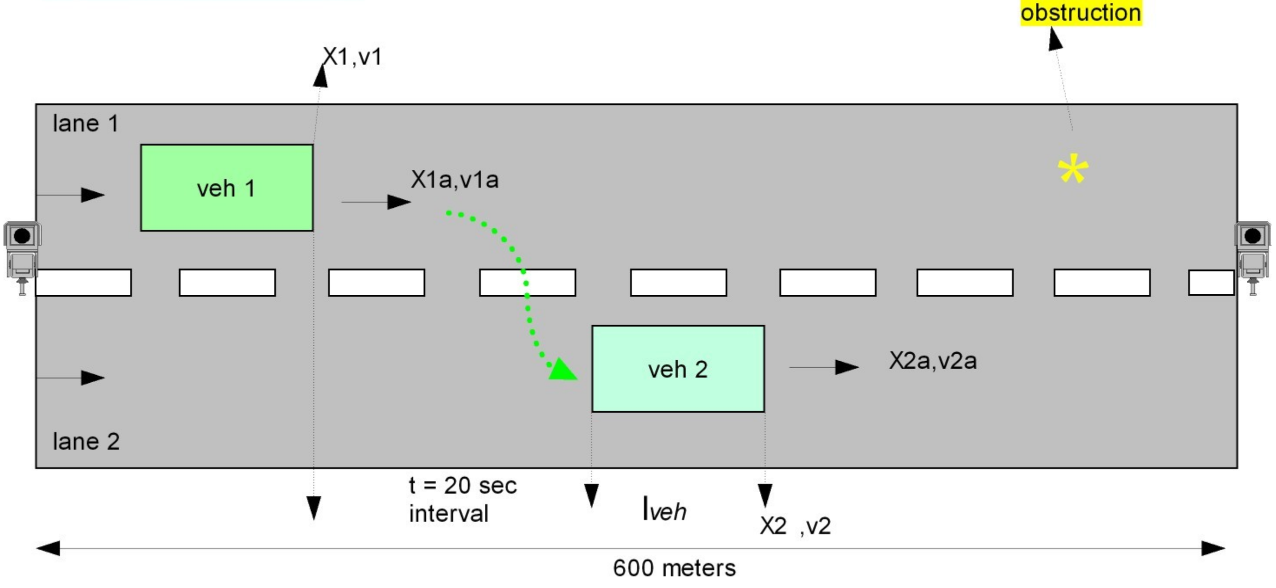


Fig 1.1: lane driving scenario showing a back-merge opportunity [lane2]

Day 1 -18/02/2010: 10h22,06

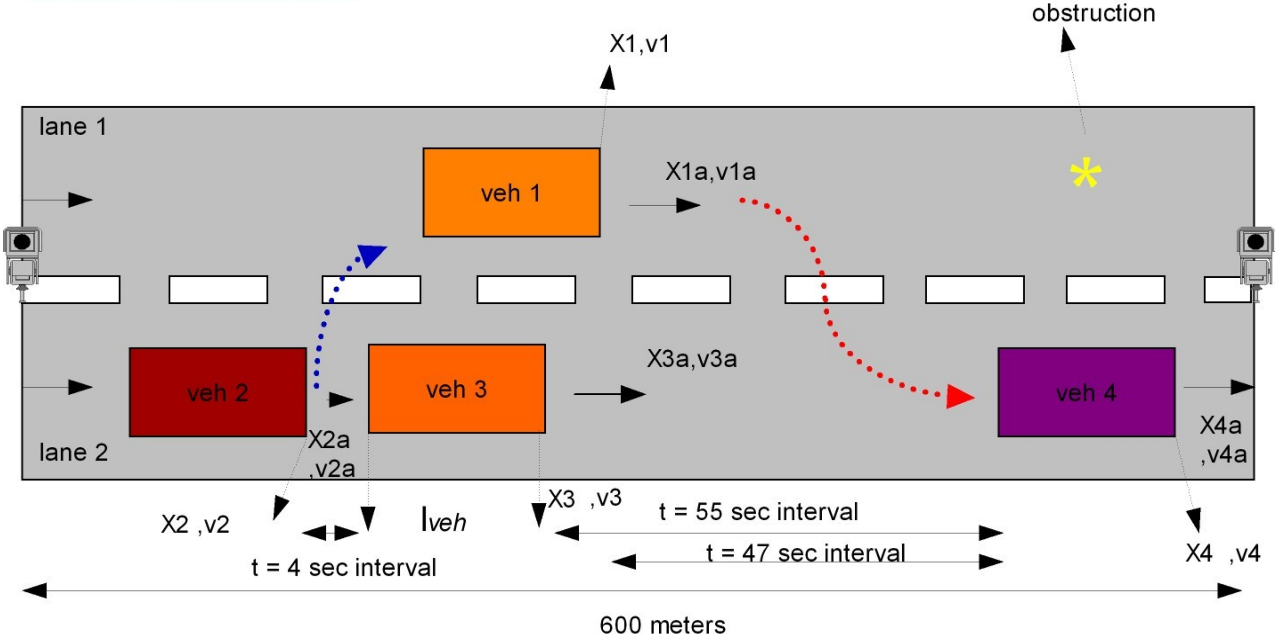


Fig 1.2: lane driving scenario showing a back-merge [lane1] and a front-merge [lane2] opportunity

Day 3 -20/02/2010: 10h33,56

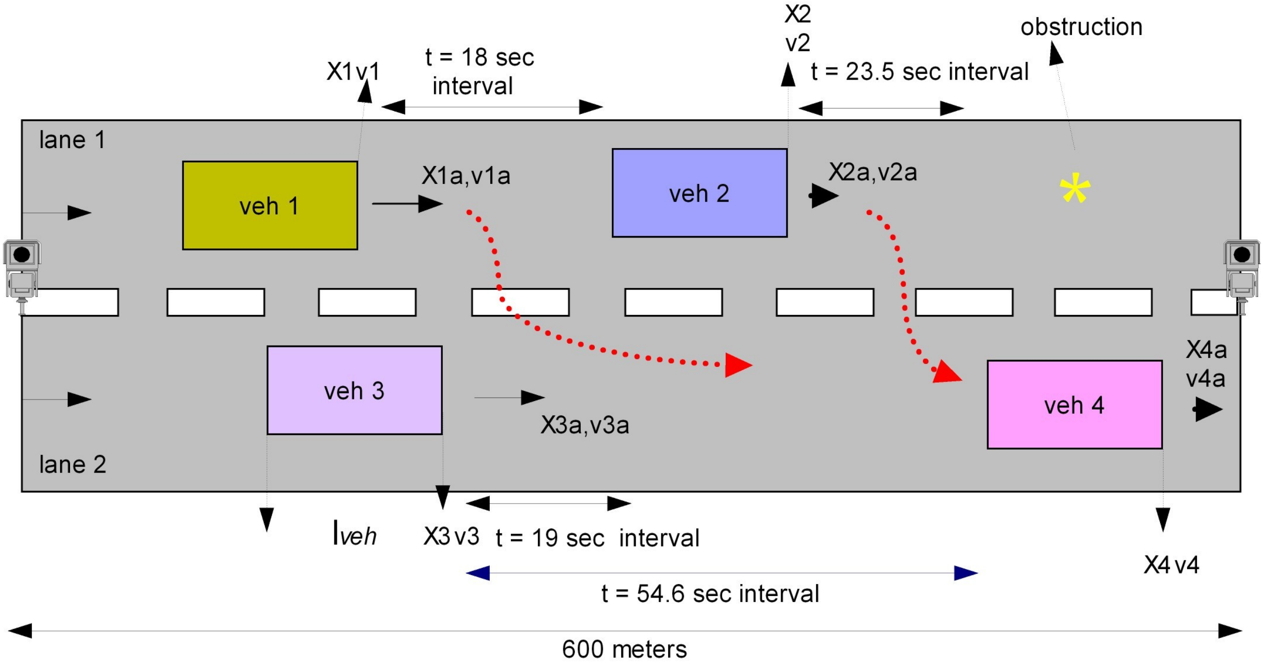


Fig 1.3: lane driving scenario showing two front-merge opportunities [lane2]

Day 2 -19/02/2010: 09h56,42

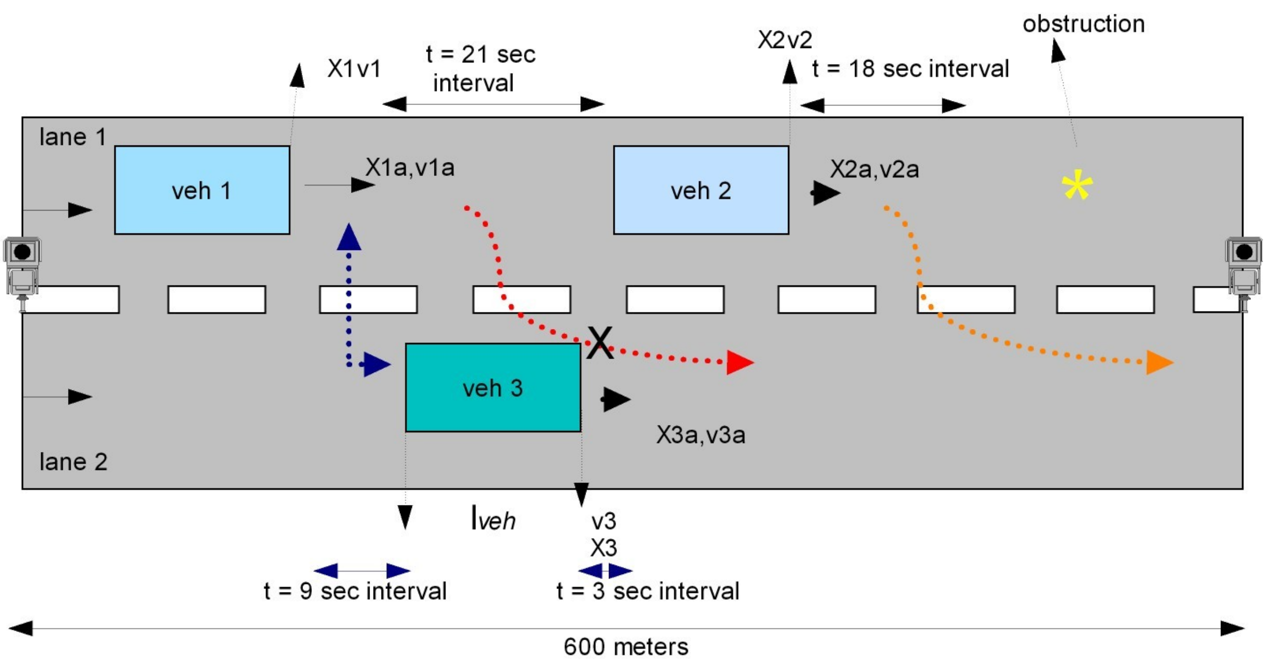


Fig 1.4: lane driving scenario showing a failed front-merge manoeuvre [lane2] and two successful front and back - merge opportunities [lane2]

Graphic representation – of speed adjustment

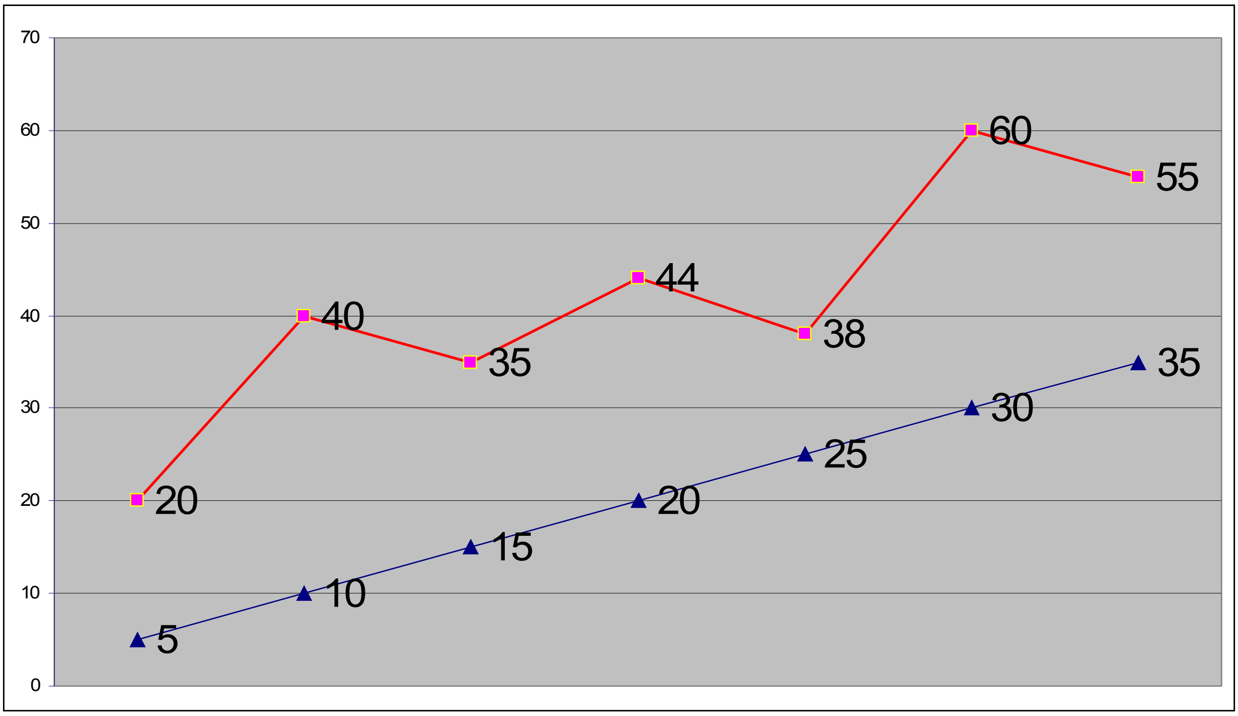


Fig 2.0 : example of left lane vehicle speed adjustment due to obstruction and lane changing [velocity/time km/sec] ***Day 2*** **:** 19/02/2010 10h13,45

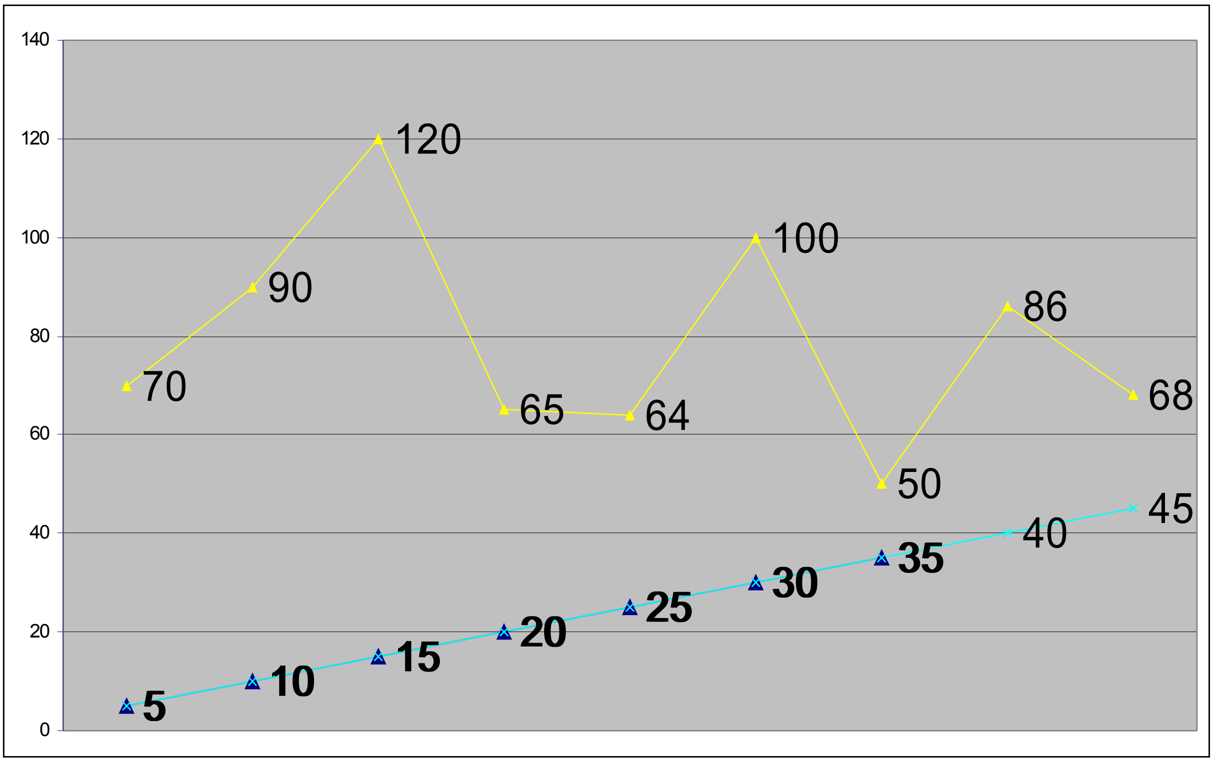
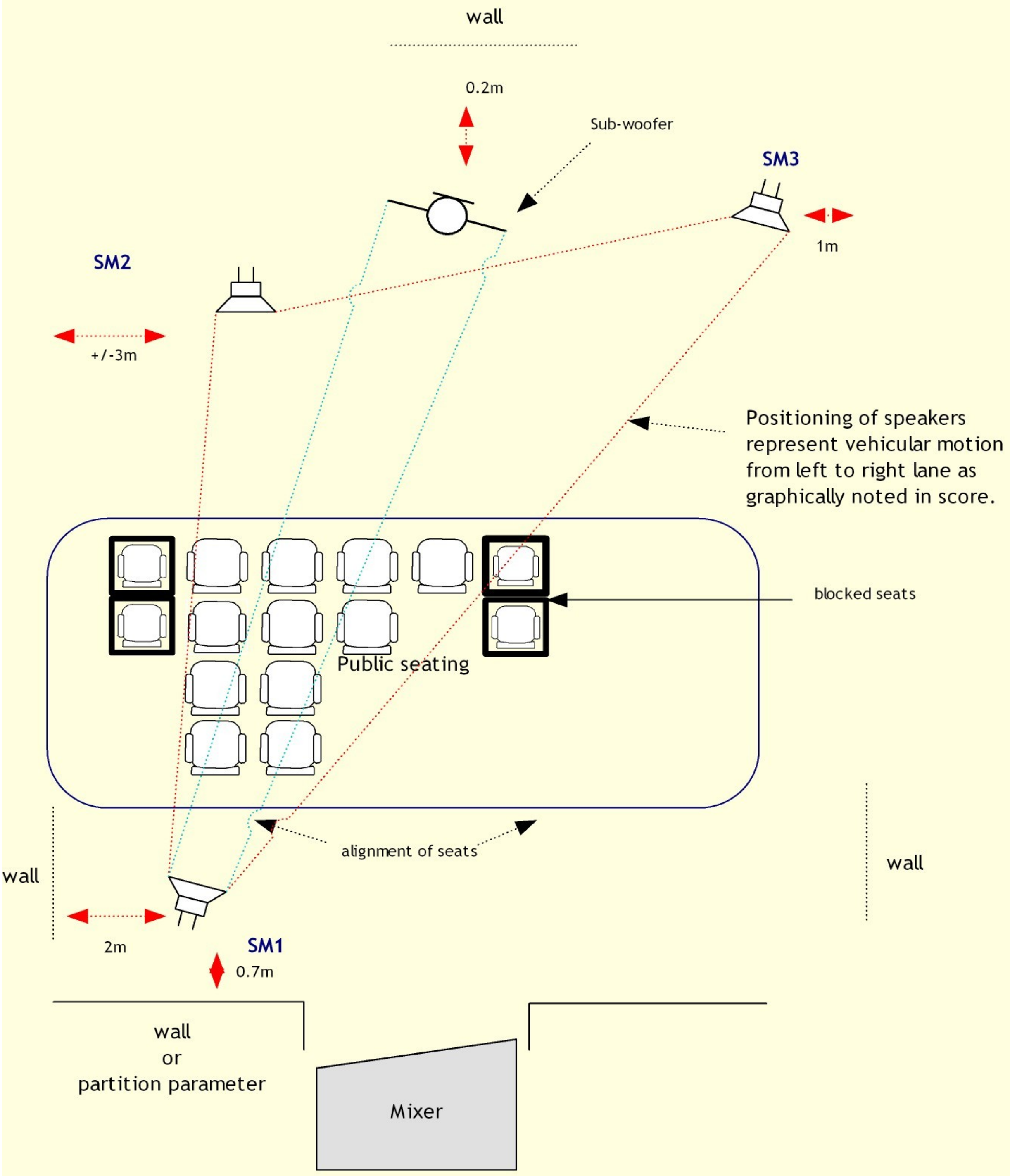


Fig 2.1 : example of right lane vehicle speed adjustment to incoming traffic from left lane [velocity/time km/sec] ***Day 2*** **:** 19/02/2010 10h14,35

Technical information:

1 - Sound diffusion and projection for [W]- Rd:1e



2 - Lights to be switched off during performance

References:

1] Jun Miura, Motokuni Ito, and Yoshiaki Shira. A three-level control architecture for autonomous vehicle driving in a dynamic and uncertain traffic environment. In ITS, pages 706–711, Boston, MA, 1997.
2] Rahul Sukthankar, Shumeet Baluja, and John Hancock. Multiple adaptive agents for tactical driving, 2002.