Relation between Longitudinal and Lateral Action Points

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Abstract

On a motorway, drivers make decisions on their speed. It has been shown that drivers change their acceleration only at specific times and not continuously. Lane changes are also made at discrete moments in time. This paper determines the moments when drivers change their acceleration and moments when they change lanes. Fitting longitudinal and lateral paths separately shows that the action points for lane changing are close to those of acceleration changes. Moreover, fitting them simultaneously shows that a comparable quality of description of the trajectory can be given under the restriction that lane changes are only considered at action points.

Data

- Helicopter mounted camera
- Three lane motorway traffic
- 10 Hz images

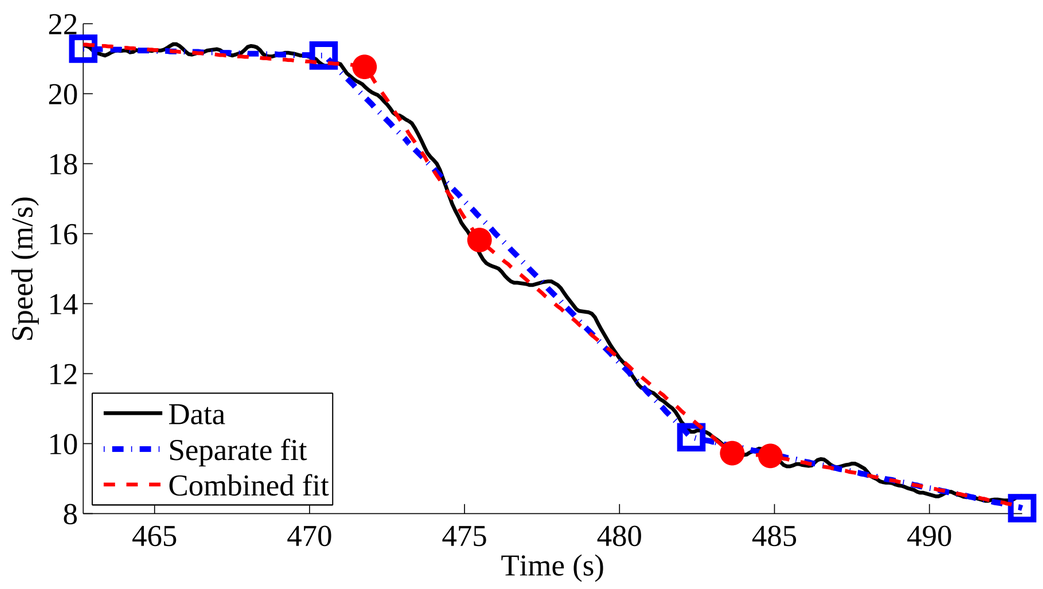
Part 1: separate fits

Longitudinal:

- Fit piecewise linear speed profile over time
- Each extra action point (acceleration change) must improve fit considerably

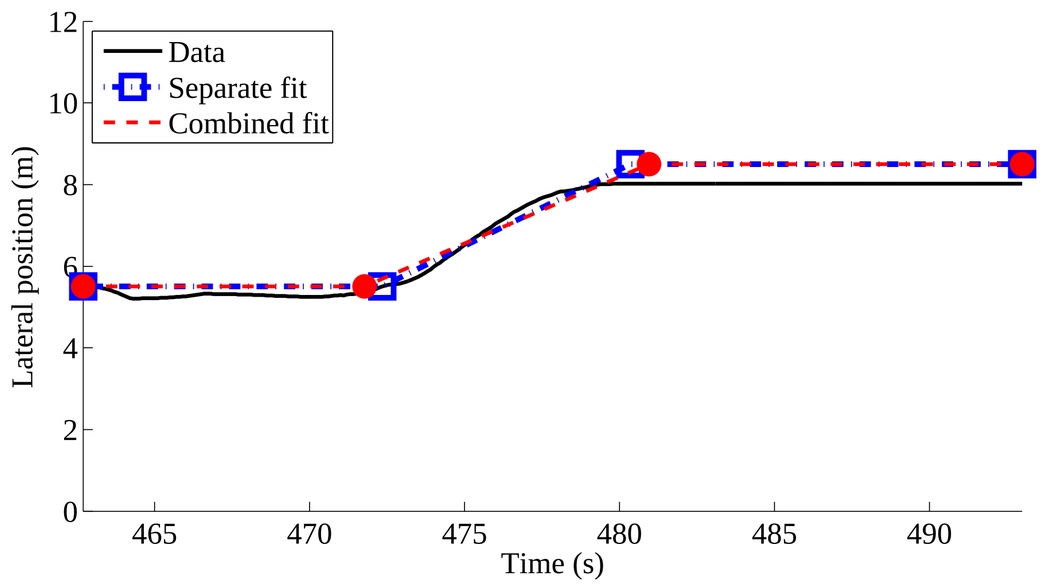
Separately lateral:

- fit lateral position profile over time
- Center of lanes fixed
- Degrees of freedom:



Part 2: combined fits

- Fit piecewise linear speed profile over time
- Same number of acceleration changes
- Lateral: restriction to Start lane change at longitudinal action points
- Quality of fit: error in speed and error in lateral position
- Degrees of freedom:
  - longitudinal action points



Results

Moments drivers change acceleration and the moments they change lanes are similar. An explanation is that the underlying processes are related: a driver only changes lanes if he can accelerate, and he accelerates because he can change lanes.

Outlook

This is an important behavioural finding for microscopic traffic flow models. They usually implement a car-following model separately from a lane change model, whereas this research suggest drivers might make the decision jointly. Considering these actions jointly can fundamentally change the dynamics of traffic flow. The differences become especially relevant when active traffic management measures are being tested in a traffic simulator.

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Project: there is plenty of room in the other lane