Modeling highway traffic flow using distributed time-delay

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In today's highways, billions of dollars are lost due to traffic congestion. To reduce congestion, traffic flow control is being used on many highways. To design effective control algorithms, however, a good model of traffic flow is needed. It has been proven that the so-called fluid-flow model represents the actual flow effectively for this purpose. This model uses the distributed variables which indicate the traffic density and mean speed at any time at any location of the highway. As a result, traffic fl ow is described by a partial differential equation, which is not very convenient for controller design. Therefore, this model is usually discretized in space (sometimes also in time to obtain a discrete-time model) to replace partial differential equations by ordinary differential equations. However, the discretization in space requires introduction of time-delays, since traffic moves from one point to the next in a certain time. These time-delays are usually taken as point-wise in the present literature. However, since different vehicles typically travel at different speeds, it may be more realistic to use distributed time-delays. In this talk, we introduce a highway traffic flow model which uses distributed time-delays. We then present a congestion controller design example based on this model. The example also utilizes the overlapping decompositions approach, which was recently introduced in [1].

[1] Iftar A., Extension principle and controller design for systems with distributed time-delay, *Kybernetika* **53**(4):630–652, 2017.

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