The impact of heavy vehicle platoons on bridge traffic loads

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Abstract

Traffic experts expect that interconnected autonomous vehicles will be implemented on roads in the near future to reduce emissions and to increase safety on roads [1], [2]. Since the navigation of vehicles in platoons is highly time synchronized, current inter-vehicle distances will decrease. Simulations have been conducted to measure the effect of platoons on bridge traffic loads in this study. Information regarding vehicle characteristics in current traffic is gathered using weigh-in-motion (WIM) technology so that synthetic traffic may be generated. Platoons are created through a "swapping" algorithm; the result is a traffic stream with platoons, and an otherwise equivalent basic traffic stream. A library of bridge influence lines is then subjected to each traffic stream to observe the effects of platoons on maximum load effects. The goal is to provide policy-makers and bridge authorities with the knowledge to make wise decisions during this transportation revolution.

Keywords: bridges; weigh-in-motion; traffic; axle; platoons; self-driving; ultimate limit state.

1 Introduction

Heavy vehicle platoons are a key objective of autonomous vehicle technology which will significantly alter the logistics of how goods are transported on road networks. A platoon can be defined as a convoy of software-coupled heavy vehicles navigating as one entity with a significantly smaller inter-vehicle distance than is typical of regular traffic (see Figure 1). The advantages of heavy vehicle platoons centre around decreased fuel consumption due to a reduction in drag due to air resistance. The emergence of self-driving passenger vehicles has captured the attention of the public, but it is the deployment of this technology in heavy vehicles which has greater economic upside potential, as well as greater implications for the design and maintenance of road network infrastructure.

Despite being demonstrated in controlled environments, several challenges must be addressed before platoons are implemented on public roads. A challenge of great importance is managing the effect of platoons on bridges in a transportation network. The research herein attempts to answer the question of the impact of heavy vehicle platoons on bridges, as compared to current traffic. The aim is to shown what effect platoons have on maximum bridge loads, which key variables are involved, and to find sensible limits that may be placed on platoons to ensure the safeguarding of bridge infrastructure.

These questions will be addressed using Swiss motorway traffic as a baseline. Switzerland has several weigh-in-motion (WIM) stations that have been in operation for the last 20 years providing heavy vehicle data. Current traffic patterns will be artificially modified to simulate the formation of platoons, and the load effects from the base traffic will be compared to the load effects of the traffic with platoons. Basic synthetic traffic generation is completed according to the methods laid out in [3].

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