# The Managed Motorway: Studying the Effectiveness of a Dedicated Lane for Connected and Autonomous Vehicles on Motorways

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**Abstract**

It is well known that motorways can suffer from congestion, especially during peak times. Connected and Autonomous Vehicles (CAVs) have the ability to synchronise driving due to communication between vehicles. Studies show that at high penetration rates of CAVs, improved travel rate and reduced road conflicts are seen. However, at lower penetration rates travel rate is worsened when human-driven vehicles (HDVs) and CAVs share the same road space. The number of conflicts also increases at lower CAV penetration rates. It is important that the transition period between HDVs and CAVs does not have a negative impact on travel rate and road safety. This project proposes a solution to this which is to utilise a dedicated lane for CAVs to travel on while they are on the motorway. This project aims to evaluate the effectiveness of a dedicated lane on a section of motorway by simulation. The implementation of this project is developed using *Simulation of Urban MObility (SUMO)*, an open-source traffic simulation software and an API called *Traffic Control Interface* (TraCI) to directly manipulate vehicle's lane changing behaviour.
This project will build upon the work of (Guériau and Dusparic (2020)), using their work of a seven kilometre stretch of the M50 motorway network in Dublin containing two intersections with on-ramps and off-ramps. The dedicated lane on the M50 motorway will be simulated using induction loops (detectors) to identify vehicle types and using the TraCI API to perform the lane-changing behaviours on CAVs, directing them to the dedicated lane. The CAVs will spend as much time on this lane as possible. Another experiment looks at allowing heavy goods vehicles (HGVs) with CAV capabilities onto the dedicated in conjunction with passenger CAVs.
The results obtained show that travel rate and conflicts worsen at low penetration and at high penetration rates. Compared to the baseline, 30% penetration rate showed similar results in travel rate, except in areas where CAVs were weaving back into regular lanes to exit through off-ramps. The number of conflicts was also higher in the dedicated lane simulation than the baseline at these junctions. Further work is needed to allow for smarter merging strategies for CAVs.