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Statistical Analysis and Impact Forecasting of Connected and Autonomous Vehicles on the Environment: Case Study in the State of Maryland

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Abstract : Over the last decades, the vehicle industry has shown increased interest in integrating autonomous, connected, and electrical technologies in vehicle design with the primary hope of improving mobility and road safety while reducing transportation's environmental impact. Using the State of Maryland (M.D.) in the United States as a pilot study, this research investigates CAVs' fuel consumption and air pollutants (C.O., PM, and NOx) and utilizes meaningful linear regression models to predict CAV's environmental effects. Maryland transportation network was simulated in VISUM software, and data on a set of variables were collected through a comprehensive survey. The number of pollutants and fuel consumption were obtained for the time interval 2010 to 2021 from the macro simulation. Eventually, four linear regression models were proposed to predict the amount of C.O., NOx, PM pollutants, and fuel consumption in the future. The results highlighted that CAVs' pollutants and fuel consumption have a significant correlation with the income, age, and race of the CAV customers. Furthermore, the reliability of four statistical models was compared with the reliability of macro simulation model outputs in the year 2030. The error of three pollutants and fuel consumption was obtained at less than 9% by statistical models in SPSS. This study is expected to assist researchers and policymakers with planning decisions to reduce CAV environmental impacts in M.D.

Keywords : connected and autonomous vehicles, statistical model, environmental effects, pollutants and fuel consumption, VISUM, linear regression models
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