*Advances and Trends in Engineering Sciences and Technologies III – Al Ali & Platko (Eds)*
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# The analysis and effects of flow acoustic in a commercial automotive exhaust system

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ABSTRACT: One of the most valuable criteria for vehicle quality assessment is based on acoustic emission levels. Unstable exhaust gas at high temperature flowing from internal combustion engine manifold may cause noise and disturbance conflicting with the high standard of acoustic comfort requested by this kind of vehicle. This research was involved in carrying out flow simulation model and analysis on an exhaust system design, and based on virtual data output from CFD tools and AVL-Boost software aiming at identifying the natural frequencies and mode shapes of its structural components, to ensure that external excitation sources do not lead to resonances. The objective of this study was to analyze the dynamic behaviour and to identify the overall characteristics of the exhaust gas, so that components sensitive to induced turbulent vortices may be identified and assessed relative to acceptance criteria for acoustic levels requested by technical specification.

## 1 INTRODUCTION

The exhaust system collects the exhaust gases from the cylinders, removes harmful substances, reduces the level of noise and discharges the purified exhaust gases at a suitable point of the vehicle away from its occupants. The exhaust system can consist of one or two channels depending on the engine. The flow resistance must be selected so that the exhaust backpressure affects engine performance as little as possible. Barhm et al. (2017) used 1D Boost software to describe the effect of using different blend fuels on engine performance and exhaust properties. The result show variation of outlet temperature and flow distribution by using different volume percentage of alcohol-gasoline blends. Barhm et al. (2018(studied the effect of Ethanol-Gasoline blend fuel on engine power output and emissions, the literature's results show great improvement in combustion process and exhaust gas characteristics. Barhm et al. (2017) presented in their technical paper a review of a muffler used in the industry, and this review depicts flow and temperature distribution along the muffler ducts. The techniques for different methods used in the design, calculation and construction of muffler both experimentally, practically and transmission loss characteristics were described. 1D calculations are much faster, and still give a good overview of the system under investigation. By being fast, they are also more suitable to run in optimization loops, which is a desirable feature in the area of exhaust system design, since mufflers are becoming more and more complex (Tonković et al. 2012). There are two basic different principles here: reflection of the sound waves and dissipation of the acoustic energy in the muffler. The mufflers based on the first principle are said to be reactive and are used to mitigate sound consisting of discrete tones, especially in low frequency region. The mufflers based on the second principle are