Chapter 2
Virtual Prototyping in the Automotive Industry

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ABSTRACT

Virtual prototyping has evolved to the automotive industry and allows for a more speedy and accurate car development process at a fraction of the previous costs. The application of virtual prototyping and utilization of computer aided design, simulations and digital twin has been discussed in this chapter. These approaches reduce development time and costs as well as improve design performance over traditional use of physical models. These tests add value to vehicle performance and safety so there are few tests such as crash, aerodynamics, and virtual assembly are discussed. It also introduces some recent tendencies on virtual prototyping de-

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velopment including Artificial Intelligence, Machine Learning and Virtual Reality. It identifies various challenges in applying these technologies and examines future prospects and implications in introducing them in automobile industry respectively.

INTRODUCTION

Virtual prototyping has become one of the most progressive methodologies in the automotive industry and has significantly impacted the manner in which automotive products are conceived, built and assembled. The pressures of increasing interest in aesthetic and unique designs, higher safety standards, the need for shorter production cycles, and concerns for costs have compelled the industry to go digital. Virtual prototyping which incorporates CAD, simulation aids and digital twin solution is a very effective solution to the above challenges since it allows manufacturers to construct virtual models of vehicles before physical models are developed. This chapter focuses on defining virtual prototyping, its best practises and possible repercussions on the automotive industry, as well as its possibilities for the future(Firu et al., 2021).

The automotive industry like many others has always been innovative because of stiff market competition and also change in consumer preferences. The conventional approaches to prototyping while useful in the past have been becoming less useful in handling the modern vehicles development. Physical prototype is always expensive, take a lot of time and go through many cycles before being optimized hence leading to longer development periods and huge costs. Virtual prototyping resolves these iwoke by allowing engineers to model, analyse and optimize the designs from a virtual platform. With high fidelity models and millennium simulations the actual performance of a particular vehicle can be simulated so that certain prematerial design defects can be corrected at the earliest. This not only helps to cut expenses but also bring the time-to-market to a lower level(Besnea et al., 2019).

The most apparent benefit of virtual prototyping is that the model can reveal the effects of various conditions with a good deal of precision. For instance, crash testing, which is part of automotive safety, can be run on computers through the help of softwares. What these simulations do is to model the impact of collision on the structures of automobiles and this enables engineers to obtain the best designs for safety of passengers. Correspondingly, such characteristics as aerodynamic characteristics, which have an impact on fuel consumption and car stability, can also be examined and improved through the use of even a simulated wind tunnel. Through these tools, manufacturers are able to produce designs that are very close to the target with minimal dependency on physical prototype testing(Henriques & Winkler, 2021).