# Summary of the Doctoral Dissertation

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**titled: "Analysis of Motorcycle Vibrations in Relation to Rider Comfort and Safety"**

prepared under the supervision of

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This doctoral dissertation focuses on the issue of vibrations affecting a motorcyclist during riding and the possibilities of their measurement, analysis, and reduction. The main objective of the research is to understand the phenomenon of vibrations in motorcycles, their impact on rider comfort and safety, and to develop practical design solutions for suspension and steering systems.

The initial part of the publication presents the context of the undertaken topic, defining theoretical and practical objectives, justifying the choice of the subject, and discussing the research methodology. This allows the reader to understand both the scientific and practical motivations behind the work.

Next, the dissertation portrays the motorcycle as a complex technical object, with a particular focus on its suspension—both front and rear—and discusses modern solutions used in shock absorbers. This design background provides a better understanding of how individual motorcycle components influence the source and level of vibrations.

The subsequent section delves into the problem of vibrations in transport, highlighting motorcycles as a source of vibrations and how these vibrations can affect user comfort and safety. In this context, it discusses the results of previous research, identifying existing gaps in knowledge and measurement methodology, and indicating current methods for preventing vibrations.

The work also includes a detailed review of methods for measuring and analyzing vibration exposure, encompassing both technical solutions (vibration recording devices) and analytical procedures for assessing their health effects and determining permissible exposure levels.

Further sections present research conducted in real-world conditions, including the recording of signals in the time and frequency domains. The obtained results were then used to verify and reproduce the recorded vibrations in laboratory conditions on a specially designed

test stand. Thanks to an iterative approach, it was possible to adjust the parameters of the test stand to faithfully simulate the motorcycle's behavior when riding on various types of surfaces.

A subsequent part of the work is dedicated to modifications of the suspension and steering system aimed at minimizing vibration effects. The presented solutions are original ideas, showcasing various design variants and evaluating their effectiveness in the context of the obtained measurement results.

The publication also discusses motorcycle modeling in a CAD environment (SolidWorks) and conducting simulations using LS-DYNA software. Using a specific Yamaha XV 125 model as an example, the entire process of creating a virtual counterpart of the vehicle, defining material properties, and performing numerical analyses is presented. The simulation results were compared with data collected during real-world and laboratory tests, which allowed for the verification of the effectiveness of the proposed solutions.

The final section of the work presents a discussion of the results, comparing observations from both measurements and simulations. The implications of the introduced modifications for rider comfort and safety are also discussed, along with directions for further research.

The entire work is summarized with concluding remarks that indicate the extent to which the set goals have been achieved and how the obtained results can be practically utilized. Numerous references to scientific literature, lists of tables, and figures complement the publication and allow for verification and a deeper understanding of the obtained results.