

Analysis of dynamic characteristics of vehicle steerability in the context of its diagnostics and evaluation of dynamic properties

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Abstract:

Tests were carried out, which included the determination of the dynamic driving characteristics for the purpose of assessing the dynamic properties and technical condition of the vehicle. The dynamic properties were analyzed for the vehicle in running order and with an additional load. The introduced changes to selected vehicle features caused clear changes in the value of transmittance and the phase shift angle of the measured physical quantities characterizing the lateral dynamics of the vehicle in relation to the excitation in the form of dynamic turning of the steered wheels with a frequency of approx. 0.75 Hz. The preliminary tests used showed a clear influence of changes made to the vehicle on its behavior as observed on the basis of the measured physical quantities. This shows that the method of dynamic steering of steered wheels in the broadest possible frequency range can be used in the process of assessing the properties of a vehicle or its technical condition in the context of turning dynamics and safety in curvilinear motion. **Keywords:** dynamic steering characteristics, frequency characteristics, sinusoidal excitation by turning the wheels

1. Introduction

The basic methods of testing the vehicle's steerability characteristics are the tests described in the normative documents, they are well described in the work [1]. These include, among others: tests of the vehicle response to a step excitation with the linear process of increasing the angle of rotation of the steering wheel (ISO 7401: 2011); tests of vehicle response to steady motion in a circle according to ISO 4138. An extended method of testing the driving characteristics is the test of random or sinusoidal rotation of the steering wheel [2, 3]. The description of determining the dynamic characteristics is described in [5]. The sinusoidal input test method gives a chance to draw conclusions about the dynamic properties of the vehicle, which may be particularly useful during the research of car prototypes. One should also look for new methods of assessing the properties of dynamic prototypes in terms of active safety of vehicles, but also as a method of assessing their technical condition.

2. Results and Discussion

The response of the vehicle to the dynamic impulse to turn by the steered wheels was determined on the basis of the determined: transmittance of the steering angle input by the steered wheels δ_K and the response of the lateral acceleration A_{cy} and the phase shift. The excitation frequency was 0.75 Hz. Fig. 1 shows excerpts of the results of calculations of the transmittance module and the phase angle in the variants of technical condition changes (Base=base version, Belka=Base+additional load, Luz=Base+backlash in the steering gear).

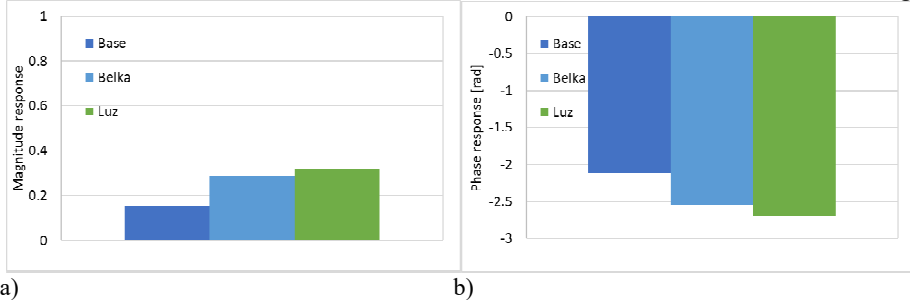


Fig. 1. Results of experimental tests - vehicle response to the dynamic forcing to turn by steered wheels; a) steering angle input transmittance module δ_K and A_{cy} , b) phase shift

The test results showed that even at the steady frequency of steering of the steered wheels, changes in the state of the vehicle cause clearly recognizable changes in the transmittance module and the phase shift of the response to the excitation.

3. Concluding Remarks

Based on the results of experimental tests, changes in the dynamic properties of the vehicle were confirmed based on the increase in transmittance and the phase shift angle. This means that the method is sensitive to the change of the vehicle's features, including e.g. the design feature, which is the mass / moment of inertia, as well as the operational feature resulting e.g. from the technical condition of the vehicle, i.e. the play in the steering linkage. The analyzed method is promising in terms of the assessment of the vehicle's properties and its technical condition, but it requires extension and testing in a wide range of changes in the frequency of forcing a turn with steered wheels, which will be the subject of further works.

References

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