IMPROVING THE LOAD CAPACITY OF TORSION AXLES IN VEHICLE SUSPENSION USING ARTIFICIAL INTELLIGENCE

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The aim of the study is to develop efficient methods to improve the load carrying capacity of torsion axles used in vehicle suspensions by modelling and optimising geometric and material parameters using artificial intelligence (AI) methods.

Torsion axles are used as flexible elements in vehicle suspension systems to ensure energy efficiency and stability. The main problems limiting their lifetime are fatigue failures, local stress concentrations, inappropriate geometric parameters and the effects of varying operating loads. Traditional design and analysis methods are based on analytical and empirical evidence and do not take into account all the factors that influence the durability and strength of a component.

- In this context, a promising area is the use of artificial intelligence methods: neural networks, genetic algorithms, machine learning (ML) and deep learning (DL) models. The use of AI opens up the possibility of creating digital twins of torsos, which allow

- multi-factor optimization of axis shapes and sizes to minimize constraints;
- predict crack locations based on analysis of historical test data;
- predict shaft life based on actual operating parameters;
- analysis of the effect of different operating conditions (speed, temperature, vehicle weight, road conditions) on the behaviour of the structure;
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The use of deep learning algorithms based on numerical modelling data (Finite Element Method – FEM) allows to create training sets from training models that lead to optimal design solutions. The genetic algorithm works effectively for the task of topology optimization of torsion shafts, reducing weight while maintaining or increasing strength.

This paper demonstrates that integrating artificial intelligence technology into the torsion bar design process can shorten the development cycle, increase structural reliability, and improve vehicle performance. The introduction of intelligent methods will allow us to move towards a new generation of adaptive suspension systems that can autonomously respond to changes in load and predict whether maintenance is required.

References (translated):

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