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OPTIMIZING AUTOMOTIVE TRANSMISSION WITH THE HELP OF ARTIFICIAL INTELLIGENCE

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Annotation: The article ''Artificial Intelligence Optimization Automobile Drive Axle Assembly" examines the optimization of automobile drivetrain and planetary transmission components**.**

Key words: Transmission, gearbox, mechanism, engine, etc.

Introduction: problem statement

A car gearbox (transmission) is a mechanism designed to efficiently transmit engine torque to the wheels. Traditional automatic or manual transmissions operate based on predefined algorithms.

However, such systems have problems such as: High fuel consumption, Delays in gear shifting, Inability to adapt to driving conditions,

Ignoring driver style.

Using artificial intelligence (AI) technologies, it is possible to turn the gearbox control into a flexible and self-learning system.

2. The goal is to optimize the car gearbox control system using artificial intelligence, resulting in: reducing fuel consumption, smoothing transmission operation, increasing engine and transmission resource, and improving driving comfort 3. Artificial intelligence approaches The following AI methods can be widely used in transmission control: 3.1. Machine learning.

Determining the optimal gear stage using regression and classification models. Sensor data (speed, torque, engine speed, pedal pressure, road gradient, etc.) is used for training.

3.2. Artificial Neural Networks (ANN) A neural network can select the most appropriate gear in real time based on the dynamics of the vehicle.

The model learns and adapts to the driving style.

3.3. Reinforcement Learning (RL) The vehicle "learns through experience".

A "reward" or "penalty" is assigned for each gear change (e.g. fuel efficiency, acceleration quality).

The system continuously improves its strategy.

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3.4. Fuzzy Logic

Provides smooth transitions in transmission control.

Operates based on logical rules such as “low speed high torque comfort”.

Relevance of the topic

The automotive industry is currently rapidly developing in the direction of fuel economy, environmental friendliness and the development of intelligent control systems.

The gearbox (transmission) directly affects the overall efficiency of the car, as it transmits engine torque to the wheels and determines the engine's operating range.

Traditional transmissions (AT, CVT, DCT) operate on a rigid algorithm. This has the following limitations: Inability to adapt to road conditions. Failure to take into account the driver's style High fuel consumption and emissions Artificial Intelligence (AI) makes this process flexible, self-adapting Artificial Neural Networks (ANN) ANN is a mathematical model that simulates the work of biological neurons. The neural network determines the gear in real time based on incoming signals. Advantages: Fast adaptability. Working with uncertain and noisy data Possibility of real-time operation Application example: Using a Deep Neural Network, the optimal gear is determined based on vehicle acceleration, engine torque, and load conditions. 3.3. Reinforcement Learning (RL) In this method, the system learns through “experience”. A reward or penalty is assigned for each gear change. The reward function is usually based on the following criteria: Reducing fuel consumption Maintaining engine torque stability Smoothing the acceleration allows the system to be transformed into a learning system. 2. The principle of operation of the gearbox The gearbox (manual or automatic) transmits engine torque to the wheels by varying degrees. Main components: Engine output shaft . Transmission pairs Clutch torque converter, Output shaft Control system . The goal of optimization: At each time, the gear should be selected so that the engine is in the most efficient operating range (in terms of RPM and torque).

3. The role of artificial intelligence technologies

3.1. Machine Learning (ML) ML models learn gear selection based on historical data.

For example: Input: speed, RPM, pedal position, road gradient

Output: optimal gear stage The “driving data set” (Driving Dataset) is used for training. , Algorithms: Decision Tree Random Forest rule-based model Support Vector Machine identifies smooth boundaries Neural Network studies complex, nonlinear relationships

One of the main development directions of the modern automotive industry is the creation of intelligent control systems, increasing fuel economy and achieving environmental friendliness. The efficiency, comfort and operational performance of a car largely depend on the operation of the gearbox.

The transmission serves to transmit the torque generated by the engine to the wheels in the required ratio. If the gear shift time is not selected correctly, the engine will consume excessive power, fuel consumption will increase, and the smoothness of the movement will be impaired.

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Traditional transmission control operates mechanically or electronically based on predetermined algorithms. Such systems cannot adapt to all driving conditions. Therefore, transforming the gearbox into an intelligent control system using artificial intelligence (AI) technologies will increase the overall efficiency of the vehicle.

Summary

Optimization of automotive gearboxes using artificial intelligence: increases energy efficiency, reduces operating costs, makes vehicle control flexible, and reduces environmental impact. As a result, future “smart cars” will be more efficient, environmentally friendly, and comfortable. Optimization of automotive gearboxes based on artificial intelligence is one of the most promising areas in automotive engineering today. In the future, gearboxes based on AI will play an important role in intelligent transportation systems, autonomous vehicles, and electric vehicles. These technologies will expand the technical capabilities of the vehicle, ensuring energy efficiency and environmental safety.

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