

# Active suspension and steering system control of emergency rescue vehicle based on sliding mode dual robust coordination control

Donghua Zhao<sup>1,2</sup> , Mingde Gong<sup>1,2</sup> , Dingxuan Zhao<sup>1,2</sup>,  
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## Abstract

The multi-axle emergency rescue vehicle has dangerous driving conditions, high body height, and large weight, and the coupling of each subsystem of the chassis is more complicated. In order to solve the coordination problem between the vehicle suspension system and the steering system, the vehicle can drive more smoothly on uneven road surfaces and improve the riding comfort of passengers. A sliding mode dual robust coupled collaborative control strategy is proposed to address the impact of the multi-axis steering system and active suspension system on driving smoothness and handling stability of emergency rescue vehicles. The active suspension system and multi-axle steering system are synergistically controlled. Firstly, an active suspension sliding mode variable structure controller is designed to improve vehicle ride comfort. Secondly, A new dual robust controller is proposed to realize the handling stability of the vehicle's all-wheel steering system. Thirdly, the coupling cooperative controller of the active suspension system and all-wheel steering system is designed and simulated under different working conditions. The experimental results show that the root-mean-square values of body roll angle, body roll angle acceleration, and yaw angle acceleration with cooperative control are reduced by 26.58%, 30.54%, and 21.92% respectively; moreover, the lateral acceleration and vertical acceleration of the vehicle body are effectively reduced. The use of cooperative control effectively improves the ride comfort and handling stability of the vehicle.

## Keywords

Emergency rescue vehicle, active suspension, multi-axis steering, coupling, coordinated control

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## Introduction

The vehicle's suspension and steering systems are important parts of the vehicle chassis system. Multi-axle emergency rescue vehicle has dangerous driving conditions, high body and heavy load, and the coupling of its chassis subsystems is extremely complicated.<sup>1–3</sup> Numerous scholars have conducted extensive independent control studies on active suspension systems and steering systems,<sup>4–6</sup> but the comprehensive performance of the system is not a simple superposition of the

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