

ABSTRAK

METODE *FUZZY LOGIC* UNTUK SIMULATOR *ANTILOCK BRAKING SYSTEM* (ABS) PADA *DUMP TRUK*

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Keselamatan berkendara pada *dump truck* di industri konstruksi dan pertambangan menjadi prioritas utama. Sistem pengereman konvensional yang tidak memadai sering kali menyebabkan roda terkunci (*wheel lock-up*) dan hilangnya kendali saat pengereman mendadak. Penelitian ini bertujuan merancang dan mengimplementasikan simulator *Antilock Braking System* (ABS) menggunakan metode *Fuzzy Logic* untuk meningkatkan keamanan serta efektivitas pengereman. Metodologi penelitian meliputi perancangan sistem *fuzzy* dengan masukan berupa *slip* roda, kecepatan kendaraan, dan jarak objek, yang menghasilkan keluaran tekanan rem. Sistem logika dikembangkan menggunakan *Python* dan diintegrasikan dengan simulator pada platform *Unity* melalui komunikasi TCP/IP untuk pertukaran data *real-time*.

Dalam penelitian ini pengujian dilakukan dalam berbagai skenario, termasuk perbandingan performa dengan dan tanpa ABS, variasi kecepatan awal (15-40 km/jam), dan variasi beban muatan (0 kg hingga 11.000 kg). Hasil penelitian menunjukkan sistem ABS berbasis *Fuzzy Logic* berhasil mencegah roda terkunci secara efektif di semua kondisi, menjaga stabilitas dan kendali truk. Terbukti, tanpa ABS roda terkunci total saat kendaraan masih melaju 24.038 km/jam, sedangkan dengan ABS kecepatan roda termodulasi hingga berhenti sepenuhnya. Analisis performa menunjukkan hubungan linier antara peningkatan kecepatan dan beban dengan waktu pengereman. Pada skenario spesifik, sistem ABS mampu mengurangi jarak henti menjadi 5.388 meter (dibanding 5.873 meter non-ABS) dan waktu berhenti menjadi 3.253 detik (dibanding 5.561 detik). Simulasi ini membuktikan implementasi *Fuzzy Logic* pada ABS tidak hanya meningkatkan keselamatan dengan mempertahankan kendali, tetapi juga terukur mampu mengurangi jarak dan waktu pengereman.

Kata Kunci: *Antilock Braking System* (ABS), *Dump Truck*, *Fuzzy Logic*, Keselamatan Berkendara, Simulator.

ABSTRACT

FUZZY LOGIC METHOD FOR AN ANTILOCK BRAKING SYSTEM (ABS) SIMULATOR ON A DUMP TRUCK

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Driving safety for dump trucks in the construction and mining industries is a top priority. Inadequate conventional braking systems often lead to wheel lock-up and loss of control during sudden braking. This research aims to design and implement an Antilock Braking System (ABS) simulator using the Fuzzy Logic method to enhance safety and braking effectiveness. The research methodology includes designing a fuzzy system with inputs of wheel slip, vehicle speed, and object distance, which produces an output of brake pressure. The logic system was developed using Python and integrated with a simulator on the Unity platform via TCP/IP communication for real-time data exchange.

In this study, testing was conducted under various scenarios, including a performance comparison with and without ABS, variations in initial speed (15-40 km/h), and variations in payload (0 kg to 11,000 kg). The results show that the Fuzzy Logic-based ABS successfully prevented wheel lock-up effectively in all conditions, maintaining the truck's stability and control. It was proven that without ABS, the wheels locked completely while the vehicle was still moving at 24.038 km/h, whereas with ABS, the wheel speed was modulated until the vehicle came to a complete stop. Performance analysis revealed a linear relationship between increases in speed and load with braking time. In a specific scenario, the ABS was able to reduce the stopping distance to 5.388 meters (compared to 5.873 meters without ABS) and the stopping time to 3.253 seconds (compared to 5.561 seconds). This simulation demonstrates that the implementation of Fuzzy Logic in ABS not only improves safety by maintaining control but also measurably reduces stopping distance and time.

Keywords: *Antilock Braking System (ABS), Dump Truck, Fuzzy Logic, Driving Safety, Simulator.*