# PENGEMBANGAN MODEL *DEEP REINFORCEMENT LEARNING* DENGAN SISTEM PERSEPSI TERINTEGRASI UNTUK OPTIMALISASI JALUR LINTASAN PADA SISTEM PARKIR OTONOM

**SKRIPSI**

Diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar
Sarjana Teknik pada Program Studi Mekatronika dan Kecerdasan Buatan


Oleh:

Rizky Hamdani Sakti

NIM 2104761



**PROGRAM STUDI MEKATRONIKA DAN KECERDASAN BUATAN**

KAMPUS UPI DI PURWAKARTA

UNIVERSITAS PENDIDIKAN INDONESIA



2025

# LEMBAR HAK CIPTA

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Rizky Hamdani Sakti

Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Teknik pada Program Studi Mekatronika Kecerdasan Buatan



Universitas Pendidikan Indonesia

Agustus 2025

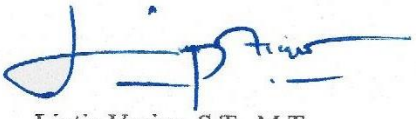
## LEMBAR PENGESAHAN

RIZKY HAMDANI SAKTI

PENGEMBANGAN MODEL *DEEP REINFORCEMENT LEARNING* DENGAN SISTEM PERSEPSI TERINTEGRASI UNTUK OPTIMALISASI JALUR LINTASAN PADA SISTEM PARKIR OTONOM

Disetujui dan disahkan oleh pembimbing:

Pembimbing I



Liptia Venica, S.T., M.T.

NIP. 920210919941203201

Pembimbing II

Dewi Indriati Hadi Putri, S.Pd., M.T.

NIP. 920190219900126201

Mengetahui

Ketua Program Studi Mekatronika dan Kecerdasan Buatan

Dewi Indriati Hadi Putri, S.Pd., M.T.

NIP. 920190219900126201

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Rizky Hamdani Sakti

Liptia Venica, S.T., M.T.

Dewi Indriati Hadi Putri, S.Pd., M.T.

# ABSTRAK

Parkir otonom adalah fungsi krusial dalam pengembangan kendaraan otonom, dengan *Deep Reinforcement Learning* (DRL) menjadi metode kontrol yang menjanjikan. Penelitian ini bertujuan untuk mengembangkan sistem parkir otonom dengan mengintegrasikan sistem persepsi berbasis visi stereo yang akurat dengan model DRL menggunakan algoritma *Twin Delayed Deep Deterministic Policy Gradient* (TD3) untuk optimalisasi jalur lintasan. Penelitian dilakukan dalam lingkungan simulasi CARLA. Dua metode persepsi visi stereo untuk estimasi jarak dievaluasi: berbasis koordinat *bounding box* dan berbasis peta disparitas yang dihasilkan oleh algoritma *Semi-Global Block Matching* (SGBM). Metode persepsi terbaik kemudian diintegrasikan dengan agen DRL, yang dilatih untuk skenario parkir tegak lurus dan paralel. Sistem persepsi berbasis peta disparitas menunjukkan akurasi yang jauh lebih tinggi dibandungkan sistem persepsi berbasis koordinat *bounding box* (RMSE 1.69). Namun, proses *training* model DRL untuk kedua skenario menunjukkan kegagalan. Metrik *training* menunjukkan *cumulative reward* yang terus menurun secara drastis dan *loss* pada *critic network* yang divergen, mengindikasikan kegagalan agen untuk mempelajari *policy* yang efektif. Hasil *testing* salah satu jalur lintasan mengonfirmasi kegagalan ini, di mana kendaraan tidak mampu menyelesaikan manuver parkir. Meskipun sistem persepsi berhasil dikembangkan, integrasinya dengan model DRL TD3 gagal menghasilkan sistem parkir otonom yang fungsional. Kegagalan *learning* DRL menunjukkan adanya masalah fundamental dalam kerangka pelatihan, kemungkinan besar terkait dengan desain *reward function* atau pemilihan *hyperparameter*. Disimpulkan bahwa pendekatan yang diusulkan dalam konfigurasi saat ini tidak efektif.

Kata Kunci: Parkir otonom, *deep reinforcement learning*, TD3, sistem persepsi, *stereo vision*, *computer vision*, YOLO

***THE DEVELOPMENT OF DEEP REINFORCEMENT LEARNING MODEL WITH INTEGRATED PERCEPTION SYSTEM FOR PATH TRAJECTORY OPTIMIZATION IN AUTONOMOUS PARKING SYSTEM***

Rizky Hamdani Sakti

Liptia Venica, S.T., M.T.

Dewi Indriati Hadi Putri, S.Pd., M.T.

## *ABSTRACT*

*Autonomous parking is a crucial function in the development of autonomous vehicles, with Deep Reinforcement Learning (DRL) being a promising control method. This research aims to develop an autonomous parking system by integrating an accurate stereo vision-based perception system with a DRL model using the Twin Delayed Deep Deterministic Policy Gradient (TD3) algorithm for trajectory optimization. The research was conducted in the CARLA simulation environment. Two stereo vision perception methods for distance estimation were evaluated: bounding box coordinate-based and disparity map-based generated by the Semi-Global Block Matching (SGBM) algorithm. The best perception method is then integrated with a DRL agent, which is trained for perpendicular and parallel parking scenarios. The disparity map-based perception system showed significantly higher accuracy then bounding box coordinate-based perception system (RMSE 1,69). However, the DRL model training process for both scenarios showed failure. The training metrics showed a drastically decreasing cumulative reward and a diverging loss in critic network, indicating the agent's failure to learn an effective policy. The results of testing one of the trajectories confirmed this failure, where the vehicle was unable to complete the parking maneuver. Although the perception system was successfully developed, its integration with the TD3 DRL model failed to produce a functional autonomous parking system. The failure of DRL learning indicates a fundamental problem in the training framework, most likely related to the design of the reward function or the selection of hyperparameters. It is concluded that the approach proposed in the current configuration is ineffective.*

*Keyword: Autonomous parking, deep reinforcement learning, TD3, perception system, stereo vision, computer vision, YOLO*

# DAFTAR ISI

# DAFTAR TABEL

# DAFTAR GAMBAR

# DAFTAR LAMPIRAN

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