#### **1. Implementation of Inverse Perspective Mapping Algorithm for the Development of an Automatic Lane Tracking System**

Ipm overview: <https://sci-hub.ru/https://ieeexplore.ieee.org/document/1414393>

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**Introduction/Objectives:** The paper addresses the problem of perspective distortion in images captured by vehicle-mounted cameras, which affects lane tracking systems. The objective is to implement an Inverse Perspective Mapping (IPM) algorithm to correct these distortions, enhancing the accuracy of lane tracking.

**Methodology:**

* **IPM Algorithm:** The IPM technique involves transforming the 2D perspective view of a 3D object to a bird’s eye view, removing distortions due to foreshortening and vanishing points.
* **Geometrical Transformations:** Using a pinhole camera model, the authors derived equations to project each pixel from the 2D perspective view back to its original position in the 3D world space.
* **Implementation Details:** The IPM process included proper camera placement and adjustments of yaw and tilt angles to ensure accurate remapping.

**Results and Findings:**

* **Distortion Correction:** The IPM algorithm successfully removed perspective distortions, providing a clearer representation of the road.
* **Lane Detection Enhancement:** The corrected images facilitated more accurate lane detection and vehicle navigation.
* **Simulation and Real-world Testing:** Tests showed significant improvement in lane tracking accuracy, validating the IPM technique as a viable solution for vision-based driving aids​​.

#### **2. Using DBSCAN and RANSAC on Image Processing for Lane Detection**

Using dbscan and ransac on image also uses lpm: [https://sci-hub.ru/https://ieeexplore.ieee.org/document/8407261](https://sci-hub.ru/https://ieeexplore.ieee.org/document/8407261/)

**Introduction/Objectives:** The paper aims to enhance lane detection in autonomous driving by integrating DBSCAN (Density-Based Spatial Clustering of Applications with Noise) and RANSAC (Random Sample Consensus) algorithms with IPM for robust image processing.

**Methodology:**

* **DBSCAN:** Used for clustering data points in images, effectively identifying lane markings amidst noise.
* **RANSAC:** Applied to fit a model to the clustered data points, refining the lane detection process.
* **Integration with IPM:** The IPM technique was used to preprocess the images, removing perspective distortions before applying DBSCAN and RANSAC.

**Results and Findings:**

* **Robust Lane Detection:** The combined use of DBSCAN and RANSAC significantly improved the robustness of lane detection under various driving conditions.
* **Noise Reduction:** The clustering capabilities of DBSCAN effectively filtered out noise, allowing RANSAC to accurately model the lane lines.
* **Practical Application:** Tests demonstrated the approach's effectiveness in real-time lane detection, contributing to safer autonomous driving systems​​.

#### **3. Safety of Lane Change Analysis for Autonomous Vehicles**

Safety of lane change analysis:

<https://sci-hub.ru/https://ieeexplore.ieee.org/document/9327195>

<https://sci-hub.ru/https://ieeexplore.ieee.org/document/8969220>

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**Introduction/Objectives:** This study focuses on improving the safety and comfort of lane-changing maneuvers in autonomous vehicles. The objective is to develop a model that minimizes the risk associated with lane changes by analyzing the safety distance and using polynomial trajectory planning.

**Methodology:**

* **Lane Change Scene Model:** A simplified high-speed traffic scenario was modeled, focusing on single-lane changes.
* **Gain Function and Safety Distance:** A gain function was used to evaluate lane change intentions, while a minimum safety distance formula assessed the risk of collisions.
* **Polynomial Trajectory Planning:** A fifth-degree polynomial model was used to generate smooth and safe lane-changing trajectories.
* **MATLAB Simulation:** The proposed method was tested and validated using MATLAB simulations.

**Results and Findings:**

* **Improved Safety and Stability:** The method enhanced the safety and stability of lane-changing maneuvers, as demonstrated in simulation results.
* **Optimal Trajectory Selection:** By calculating the loss function, the model selected the optimal lane-changing trajectory, ensuring smooth transitions and minimal risk.
* **Simulation Verification:** The MATLAB simulations confirmed the effectiveness of the proposed approach, showing significant improvements in lane change safety and comfort​​.

Slides outline:

#### **Slide 1: General Abstract**

* **Title:** Overview of Lane Detection and Safety Analysis in Autonomous Vehicles
* **Abstract:**
  + This presentation covers advancements in lane detection and safety analysis for autonomous vehicles. The first paper focuses on implementing an Inverse Perspective Mapping (IPM) algorithm to correct perspective distortions for improved lane tracking. The second paper integrates DBSCAN and RANSAC algorithms with IPM to enhance the robustness of lane detection. The third paper develops a model for safe and comfortable lane-changing maneuvers, using polynomial trajectory planning and MATLAB simulations for validation.