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Survey: An Automatic Parallel Parking using Path Planning Methodologies

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***Abstract*— Throughout the years, the expectations and capabilities of autonomous vehicles have increased, as has the level of automotive intelligence. In the majority of research studies, longitudinal and lateral control topics have been explored to understand and design intelligent systems. For example: Automatic parallel parking, Adaptive cruise control, co-operative adaptive cruise control, semi and fully autonomous cars. Sensors onboard the vehicle and communications networks transmit scene information to other vehicles and infrastructure. To be able to achieve autonomously driving on complex environments and to utilize the information as part of the motion planning and control schemes, different motion planning and control techniques were implemented. Upon implementing these initiatives, the main task is executed to increase the level of safety, comfort, and energy efficiency in the workplace. As part of the present paper, an in-depth review of various parallel parking methodologies based on automatic parallel parking is presented. In this presentation, the main topics that will be covered will be algorithm types, simulations, and field tests, as well as human factors that influence vehicle behavior. Additionally, various parking information services are also offered for parking guidance, facility management, and even for providing an insight into the parking situation. We have also provided a brief description of the techniques used by research teams, a comparison between these techniques, and additional information about the research teams' contributions to motion planning. The paper concludes by discussing a future research direction and application.**

Keywords—Automatic parallel parking (APP), Motion Planning, Adaptive Cruise Control (ACC), Path planning.

I. INTRODUCTION

Among the most challenging and demanding driving tasks for a driver is parking in which the vehicle needs to be backed up in areas with a high chance of colliding with other vehicles [1]. In the act of parking, one of the primary challenges lies in developing a parking maneuver suitable for the vehicle. This maneuver involves simultaneously controlling its lateral & longitudinal motion control and avoiding obstacles in the environment. The design and construction of modern vehicles, as well as safety requirements, adversely affect visibility. According to a recent study, 40 percent of crashes involving loss or damage to property happen during parking or maneuvering [2]. Fortunately, modern vehicles have fully automated parallel and perpendicular parking functions to solve this issue. There will be even more ease of parking jobs by automatically parking the car, employing Automated Parking assist(APA). This means the passenger can drop off the vehicle in a pick-up zone, such as in front of a parking lot, while the vehicle typically does its own parking.

As a result of the exponential increase of the global transport system over the past decade, there have been numerous parking-related problems in the world. This problem became even worse due to staid city planning [3]. Consequently, parking is a time-consuming activity in society, not just because it impacts a business's efficiency, but also because it impacts social interaction and the costs involved in it. Parking facilities do not cooperate with network companies, so Internet companies cannot provide accurate parking facility information. Parking spaces that are normally available do not fit some big cars. To find parking vacancies, all relevant information must be taken into account.

Over the past three decades, several experts have proposed automatic parking systems. Parking trajectory planning is usually the first strategy to be proposed. In order to avoid overloading the vehicle, a detailed reference trajectory must be designed [4], along which the vehicle can move and park. It is traditionally difficult to implement such a strategy because of two major problems. A moving vehicle cannot be controlled automatically. Dynamics constraints of vehicles must be taken into account appropriately in trajectory planning. Constraints describing the curvature of a reference trajectory are often referred to as dynamic constraints. The errors, however, may prevent the control actions from being implemented. On the other hand, in [5], a new method of trajectory planning is presented. Let us assume the origin point is the starting point. In this method of trajectory planning, all steering actions that are possible are evaluated, along with the corresponding trajectory paths as well as the points where the trajectory paths will end. In a reverse manner, the situation is composed of storing the relation between steering actions, trajectories, and ending points with a deep neural network. In other words, once the deep neural network receives endpoints as input, it will output steering actions and trajectory. An updated parking berth (ending point) immediately prompts the vehicle to steer to this parking berth (ending point). However, this new approach consumes a high level of computational resources and computational time.

Secondly, parking guidance control is a strategy. One of the main ideas is to describe a number of different driving regimes in addition to identifying some key switching points in certain rule styles. The vehicle would then follow the preselected sequence of actions to park in the designated berth. However, parking guidance control has yet to be thoroughly tested. "Parking guidance control" that is proposed before does not incorporate any control strategy or control rule, but instead focuses on technology that assists drivers to find parking spaces [6],.

As mentioned earlier we are presenting a brief review on different researchers work and gone through the techniques they implemented from the past two decades are mentioned in this survey paper. Further paper as follows: Section-II is all about the different methodologies for parallel parking. Section-III deals with a brief about the previous researches. Section-IV is a conclusion in which it infers about this research.

II. LITERATURE SURVEY

The first autonomous parallel parking method was proposed by Igor E. Paromtchik et al. in 1996. A fleet of electric computer-driven vehicles powered by a fleet of electric vehicles is the basis for the technological development of a future-oriented urban transportation system in the PRAXITELE project [7]. Parallel parking maneuvers are described with an iterative algorithm. Ultrasonic range data is used in the simulation. A sinusoidal reference function is used to control the steering angle during the parking maneuver as well as the vehicle's longitudinal velocity. During the maneuver, the maneuver is executed in a reactive manner to avoid a collision. The corner motion of the vehicle's frame is evaluated within the constructed local map of the environment while T and steering angle are computed for the motion from the start location. If the simulation indicates a possibility of collision, the start location is changed. It moves to a new starting position in the parking area that is farther from the border of the lane. After that, it repeats the computation process. Parallel parking algorithm summary for iteration 'i' is as follows: 1. Process the range data in order to determine longitudinal and lateral displacements. 2. Search for the value of T by using sinusoidal functions, lateral conditions and the magnitude of steering angle in order to evaluate the motion of the vehicle. 3. An open-loop control function is used to control the vehicle during range processing. 4. Measure the distance between the vehicle and the parking bay's environmental objects. Upon reaching the "parked" location, stop; otherwise, proceed to step 1.

LIGIER's electric autonomous vehicle was incorporated with the developed parking control. See figure 1 below for the experimental results. Plots are made of a vehicle's corners, its midpoint, and its rear axle. Measured the lateral distance with ultrasonography (0.6 m) and the longitudinal distance with 0.9 m by estimating the angular displacement of the vehicle. This resulted in an "increased" length of the parking bay (5.5 m rather than 4.6 m), and the vehicle had reached its necessary parking "depth" after just one movement iteration.

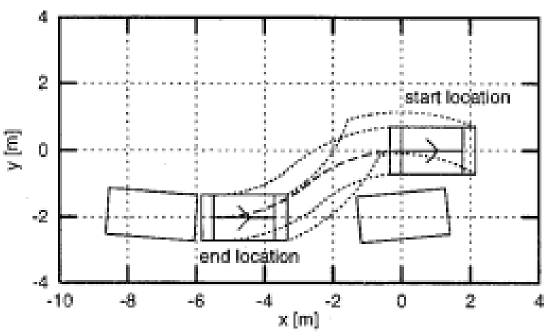


Fig. 1. Parking maneuver [8]

During the study, the steering servo system was tested to see if there was an increase in errors when the wheels were turning without the vehicle moving. There are dynamic errors in the servosystems as well as unmodeled effects like wheels slippage or tires having variable radius) [8].

In 2010, Ankit Gupta et al., proposed an APP system for Ackerman Steering vehicles [9]. In the proposed model, steering planning and simple distance calculations are combined into a two-part trajectory planning algorithm. It is designed to take into account vehicle dynamics and drive torque. In order to plan the path and determine odometry, the algorithm uses geometric calculations. Sensors and encoders are used to determine path and odometry. Information gathered from these sensors is processed by the vehicle's processor. There are four components in this electronic system: 1. Path planning and tracking parameters were obtained by using a few sensors for perception and sensing. It is a distance sensor (Ultrasonic sensor) and a magnetic wheel encoder for tracking. 2. Controller: An algorithm-based system for receiving information from sensors and processing it. 3. Actuators: To control the steering and acceleration functions of the vehicle. 4. User Interface(UI): To display the trajectory and vehicle localization. The developed algorithm is mentioned below.

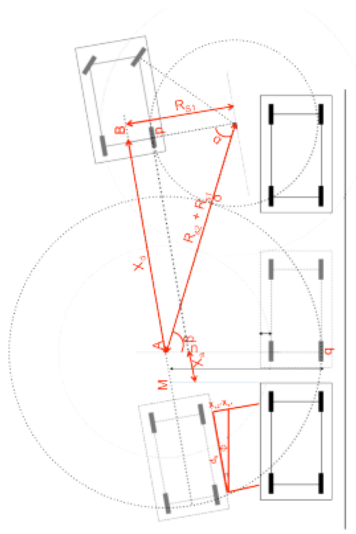


Fig. 2. Parking trajectory and misalignment [9]

Algorithm:
Step1: Manual input from UI
Step2: Obtain values from distance sensor. By multiplying the speed of light (c) by the time taken (t), to calculate the distance (d) between the radar distance sensor and the target surface

$$d = \frac{c * t}{2}$$

Step3: Decision to park left or right side and calculate Φ angle
of misalignment. The distance between the front and rear sensors is represented by ds. Xs2 and Xs1 are the distances measured by the sensors and Φ is the angle of misalignment.

$$\emptyset = tan - 1 \left(\frac{(X_{s2} - X_{s1})}{d_s}\right)$$

Step4: Lock steering angle at 0 and move some distance
Step5: Calculate: a) the distance from point O to till A.
b) Radius of curvature and angle of alignment.

c) Distance from point A to B.

d) Path segment length and finally the length of trajectory. Path segmentation is achieved using area of segment of circle.

$$A = \frac{1}{2} \times (\theta - sin\theta) \times r^2$$

Step6: Move the vehicle forward till reach point A.
Step7: Move the vehicle forward till reach point B.
Step8: Set the angle of inner front wheel to ± 45 degrees angle.

$$\alpha = tan^{-1}(\frac{X_d}{R_{s1}})$$

Where X_d is the distance from point A to B and R_{s1} is the distance from B to C

Step9: Request Reverse gear and move reverse to point O.
Step10: Set alignment angle as per the radius of curvature and

move reverse till it reaches parking space Q.

Step11: If vehicle in Q request parking Gear and Stop.

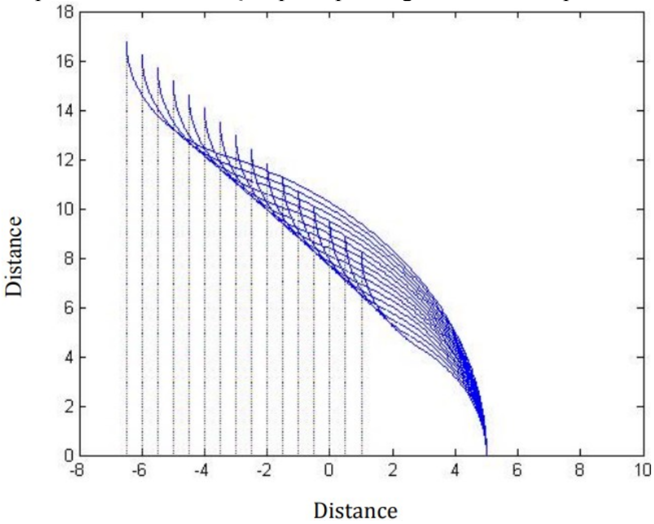


Fig. 3. Boundary conditions of the path planning in simulation [9]

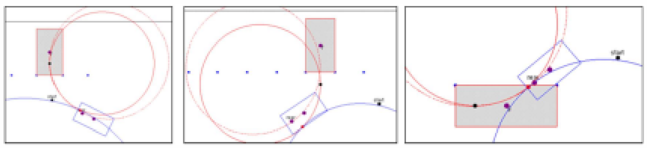
The above algorithm is tested in MATLAB simulation and the fig. 2 shows that if two vehicles are near each other, their trajectory will be shortest. This is not applicable to a practical problem. So, when the vehicle is close to the parked vehicle, it will follow the shortest trajectory [9].

In 2013, Kyoungwook Min et al., Proposed a control system-based APP with limited low speed [10]. This system was designed to determine the value of the vehicle steering control based on two turning radius circles about parallel and perpendicular parking. In parking mode, these two circles are displayed in real time as vehicle stops as vehicle turning radius circles with minimum radius. Ackerman steering was considered in this study [10]. The value of the vehicle steering angle and of the vehicle wheelbase contributed to the turning radius r of the vehicle. By using two minimum turning radius circles, the steering value for parallel and perpendicular parking methods is found in the first step. The steering angle control command value error was later corrected by collecting the log points in front and backward directions and determining three parking methods: forward and backward parallel, and forward and backward perpendicular taking into account the steering angle control command value collected [10]. Upon completing the driving mission, the vehicle parking mission is executed. During parking mode, the start location is the same as the start location during the driving mode. By using two minimal turning radius circles, it is possible to find the new mission location. In order to calculate the steering angle control value, information on the location/direction of the vehicle and the location of the following waypoints need to be taken into account. This control value can then be calculated according to the following formula [10].

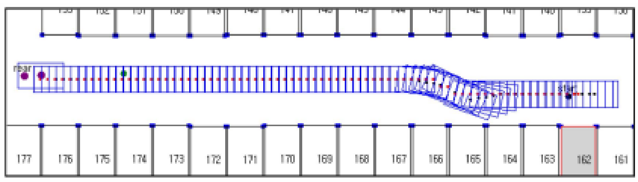
$$\theta_{steering} = \frac{(\theta_3 - \theta_2)}{2} - \theta_1$$

Where θ1 represents angle towards vehicle heading, θ2 represents reference heading angle, and θ3 represents the error of lateral angle vehicle location and look-ahead waypoint.

A forward-moving obstacle was detected using the LMS511 sensor of SICK Corporation in the experiment. Here is the algorithm for performing obstacle perception. Initial data acquisition from LMS (Laser Management System) is performed by VP (Vehicle Positioning) and it is filtered through spatial map data. Then, it extracts the raw data from the object that represents clustering, and then it approximates the spatial location of the clustering. All of the areas in which vehicles are parked are considered as the areas to be filtered. Additionally, you may also filter the forward path of a vehicle using the 3.5 x 15 m rectangle in front of it. Fig. 4 illustrates how forward-moving obstacles are detected [10].



(a) Backward parking (b) Forward parking (c) Parallel parking



(a) Generated Driving path

Fig. 4. Parking Methods [10]

In 2014, Jerome T et al., proposed a fuzzy Neuro control system-based APP for vehicles. In this study, the authors demonstrate how to maneuver an autonomous car-like mobile robot into parallel parking using sensors. Specifically, the project seeks to parallel park a car-like mobile robot following a backward maneuver in a 5-degree polynomial reference path [11]. In this model they used simple kinematics of a vehicle is used. Later using 5-degree polynomial paths as the training data, a subtractive clustering algorithm is employed to determine the fuzzy controller. In turn, the controller is trained by using a neuro-fuzzy inference system with adaptive inference and true-false training [11]. A car-shaped mobile robot (CLMR) is being equipped with eight ultrasonic sensors strategically placed to avoid radial imprecision, which measure the angle of inclination of the car [11]. A specific accelerometer is also being used to measure the angle of the car. In addition to the sensors, the Neuro-Fuzzy Inference System collects the necessary sensor data in order to determine the proper movement direction at every sampling point via the Neuro-

Fuzzy Inference System. Based on the results obtained from actual experiments, In its final position, the CLMR stopped at a distance appropriate between obstacles without colliding with an obstacle as it reversed from the ready position [11].

The equations used for parking curve are 5th degree polynomial condition to generated which is shown in fig.5:

$$y(x_0) = ax^3(x - x_0)^2 + bx^3(x - x_0) + cx^3 + dx^2 + ex + f \quad (1)$$

$$y'(x_0) = 3ax^3(x - x_0)^2 + 2ax(x - x_0) + 3bx^2(xx_0) + bx^3 + 3cx^2 + 2dx + e \quad (2)$$

$$y''(x_0) = 6ax(x - x_0)^2 + 12ax^2(x - x_0) + 6bx(x - x_0) + 2ax^2 + bx^2 + 6cx + 2d \quad (3)$$

The equations 1, 2 and 3 applied to the below table to get the final conditions to get the polynomial curve.

	Initial Condition	Final Condition
Path Curve y(x)	$y(x_0) = y_0$	$y(0) = 0$
Slope of the Path Curve y'	$y'(x_0) = m$	$y'(0) = 0$
Curvature of the Path Curve y''	$y''(x_0) = n$	$y''(0) = 0$

To visualize the parking reference path, the following equations are used during Matlab simulation: x0 = 4, y0 = 3, m=n=0. This equation corresponds to the 5th degree polynomial equation y(x). A polynomial curve of fifth order has continuous curvatures, allowing for parallel parking with a smooth surface

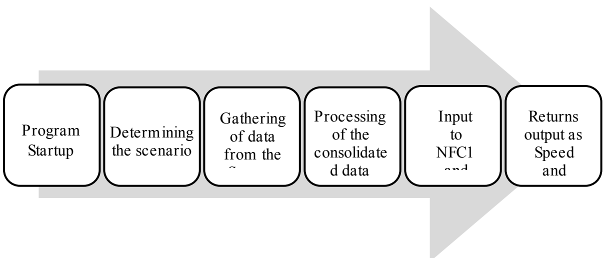


Fig. 5. Fuzzy Neuro system model [11]

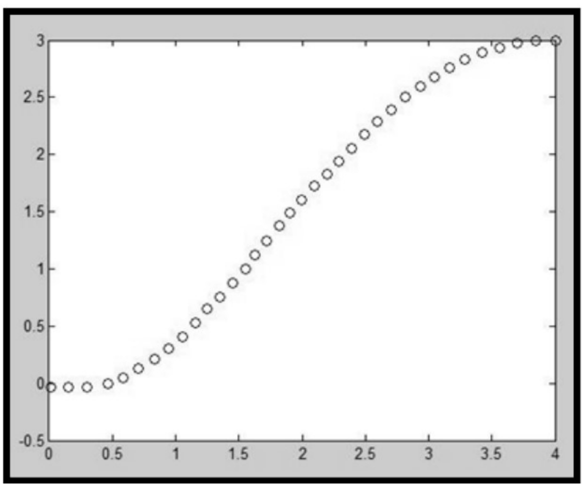


Fig. 6. Maneuvering reference path for the parking system [11]

In 2016, Bai Li et al., proposed a spatial-temporal decomposition method for APP motion optimization to generate reliable initial guesses and to facilitate the NLP-solving process [12]. The proposed initialization strategy was compared with current competitors in a series of comparative simulations, and it has been concluded that the proposed motion planner has the potential to meet the needs of online planning missions. They were able to do this by using the kinematics of a vehicle for defining the optimal control problem. Then by applying the Interior-Point Method (IPM) we can approximate a nonlinear based system using the nonlinear based system for approximations. When there are a number of active constraints involved, IPM is efficient when dealing with large-scale problems. By incorporating logarithmic barrier weights into the optimization objective, IPM computes solutions for a sequence of barrier problems. There are so many scenarios to handle in the proposed plan that it generates a parking motion every time in tens of seconds, which indicates that it is not suitable to handle on-site or online motion planning. By making the motion planner unified, a wide range of scenarios can be handled instead of just a few special cases. Even though the present study employs only objective knowledge, reasonable parking motions can still be generated [12]. The proposed initialization strategy has the advantage of being efficient and advantageously priced in comparison to its prevailing competitors. In terms of the motion planner, it appears that it can be used for on-site as well as online planning missions. The objective knowledge-based system described above, in particular, promotes the development of a decision-making system that fully understands and utilizes vehicles. This definition speaks to the fact that subjective knowledge (these are the experiences of human beings) is not necessarily the terminal of computing [12].

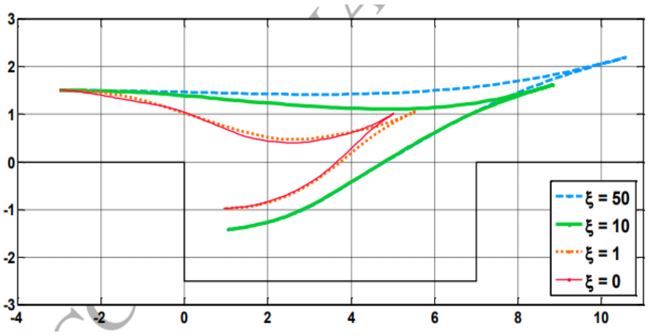


Fig. 7. Comparative Simulations with various weights [12]

Kexin Wang et al. Proposed a simultaneous dynamic optimization approach for APP maneuver planning in 2016 [13]. A straightforward, accurate, and purely objective method of planning time-optimal parallel parking maneuvers is described in this paper. The objective of this paper is to create a unified framework for dynamic optimization, which is composed of various parameters, such as vehicle kinematics, collision-avoidance constraints, and physical restrictions. In this numerical solution to the formulated dynamic optimization problem, interior-point method-based simultaneous dynamic optimization is used. As near-feasible solutions have been widely acknowledged as an effective way to optimize nonlinear programs, we propose a critical region-based initialization strategy to make this process easier. On-site performance is guaranteed using a lookup table-driven strategy, and online maneuver planning is done via a receding-horizon optimization framework [13]. The simulation results show that this proposal is efficient for a series of parallel parking scenarios, even when the slot length is only 10.19% greater than the car length [13]. The IPM Algorithm as follows:

Initialization steps

Step-1: Start
Step-2: Formulate a dynamic optimization problem from the original parking maneuver planning mission.

Discretization steps

Step-3: Normalize the concerned dynamic optimization problem
Step-4: Divide the time domain into a finite number of elements
Step-5: Discretize the differential state variable in each element using Lagrange polynomial equations
Step-6: Discretize the control and algebraic state variables in each element using piecewise Lagrange polynomial equations.
Step-7: Finalize Nonlinear problem-solving process

Optimization steps

Step-8: Pre-solve a sequence of new problems to facilitate the format NLP-solving process.
Step-9: Optimize the discretized variables in the converted NLP problems using IPM.

Finalization steps

Step-10: Output the optimized solution
Step-11: End

Authors conducted simulations in the "A Mathematical Programming Language" (AMPL) environment in order to better understand the behavior of IPM-based simultaneous maneuver planning. Figure 7 illustrates the results [13].

MANEUVER PLANNING CASES 1–10

Case no.	Parking slot size	Special requirement(s)	t_f (sec)	Computation time (sec)
1	SL = 6.0 m	-	7.521	41.868
2	SL = 5.5 m	-	9.242	47.152
3	SL = 5.0 m	-	11.905	59.726
4	SL = 4.5 m	-	33.849	101.411

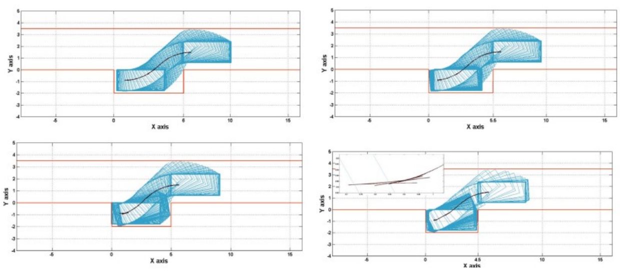


Fig. 8. Optimized motion of 4 cases as above mentioned [13].

In 2017, Benjamas Panomruttanarug proposed an application of iterative learning control in tracking a dubins path in APP [14]. Using traditional path planning, the author describes how to find the shortest parking path while incorporating iterative learning control (ILC). Based on the experiences of others, ILC can help track the designed path. Since 1957, Dubin's method has been used to determine the shortest path without obstacles. A line of continuously connected maneuvers comprises three arcs at most in Dubin's path. Reversing into a side road on the left in this problem is done through the RSL trajectory when R and L are right-handed extremes and left-handed extremes with a minimum radius of turn. In order to adjust the steering angle of the vehicle, the steering wheels have to be controlled in order to determine the Dubin's path in advance [14]. This study presents and experiments with a kinematic model of a rear-wheel-drive vehicle using the dubins method using a go-kart vehicle with a steer-by-wire system. In order to execute the parking procedure, infrared sensors were installed on the left and right sides of the vehicle, and on the back. 310 cm long and 125 cm wide are assumed to be the dimensions of a parking bay for demonstration of the designed parking maneuver. Initially, 5 cm is taken into account as the distance between the parking bay and the point of parking. By using the vehicle parameters, Dubin's algorithm computes the path. A total distance of 320.3346 cm separates (0, 0) from (290, *120). Figure 8 shows the angle of turning and the angle of heading corresponding to the angle of turn [14].

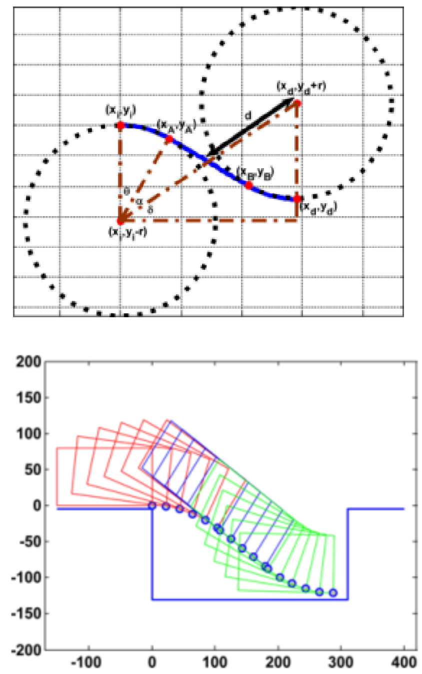


Fig. 9. Reversing by dubins path from (0,0) to (290, -120) and RSL Trajectory [14].

In 2020, Jiyuan Tan et al., proposed a different automatic parking system to solve APP problem [15]. In this model the first step is to find an appropriate reference trajectory defined so that a vehicle can follow it into the berth from the start point to the end point of a particular parking task. A second strategy only entails a series of concrete actions that are required to meet the parking space requirements. In addition, it also requires the main switching points required for the operation of the vehicle in the specific situation. And, it simply provides a guideline that allows the vehicle to follow an optimal sequence of sequential actions as it attempts to park in the parking space. In this novel method, the desired control actions are evaluated directly rather than first identifying the desired trajectory. Furthermore, all three steps in the series of control actions can be explicitly outlined and applied with ease. The authors considered the Chinese driving schools parking standards were designed as three-step parking procedure [15]. The proposed guidance control can be determined by a number of simple equations based on the values of the dynamic parameters of the vehicle. One such rule is the determination of the exact values of the control parameters for the proposed guidance control. An application of hybrid-augmented intelligence named after the three-step guidance control algorithm. It is characterized by the following elements:

Step 1: From the initial state, drive straight to reach the starting position by making a slight angle change between the lateral and longitudinal axis of the vehicle [15].

Step 2: Drive the vehicle backward until the steering angle from the lateral axis to the longitudinal axis of the vehicle reaches the preselected critical angle position, starting from the starting position with a completely right turn (setting the steering angle) with a velocity of v [15].

Step 3: Once the vehicle reaches the final position in the berth (angle from X-axis to longitudinal axis of vehicle is approximately 0) the vehicle will be driven backward with full turns to the left (setting steering angle).

In addition, the three-step guidance control strategy has five variables controlling its performance: X0, Y0, δf, V, and θ. It should be able to accommodate a maximum vertical distance from the berth in relation to its length and width. This can be seen in figure 9 below, which shows the results of the simulation of the planned trajectory [15].

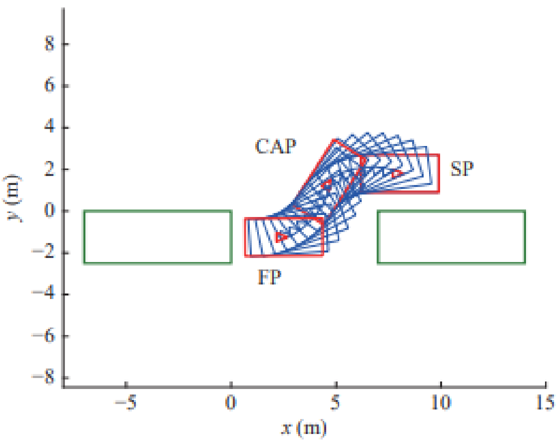


Fig. 10. Simulation result of the APP Trajectory [15]

In 2020, Jyun-Hao Jhang et al., designed a system to overcome autonomous parking problems by combining a sampling-based motion planner and parking-oriented vehicle controller [16]. Using the motion planner, an efficient and collision-free path will be generated for any parking scenario, including parallel parking, perpendicular parking, and other configurations which a human could take. Planning parking paths for various parking scenarios is made feasible with a motion planner that utilizes smooth-feedback Bi-RRT* [16]. Additionally, the new motion planner improves exploration and optimization from the original framework. Besides the two additional samplers that use Gaussian distributions and uniform distributions, we also included a third sampler which facilitates exploration of narrow spaces. Additionally, the proposed motion planner can address the common shortcomings of methods based on RRT, such as inefficiencies in exploration and path quality uncertainty. As the motion planner does not require any template setup, it can be used in a wide range of settings, including daily environments. To deal with movement, both steering control, and speed control are implemented simultaneously. To mitigate the side effects of combining both steering and speed controls, the MPC calculation and the vehicle control are carried out simultaneously in the proposed controller in advance. A practical understanding of vehicle driving should also be considered in order to implement the suggested method in practice. Because the linear state-space model combined with the kinematics of the vehicle allows for a simpler model. In addition to confirming that every technique in the proposed methodology worked as intended, extensive simulations were also performed in order to test its abilities in common and strict parking scenarios [16].

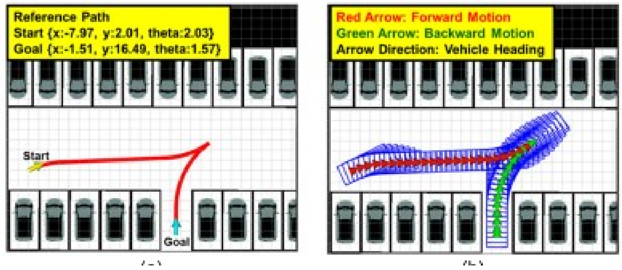


Fig. 11. Reference path planning simulation results [16]

III. Discussion

TABLE I. AUTOMATIC PARALLEL PARKING FRAMEWORK

Year	*Author*	*Proposed system with Algorithm*	*Ref*
1996	Igor E. Paromtchik et al.,	Iterative Algorithm- using ultrasonic sensors	[8]
2010	Ankit Gupta et al.,	Developed algorithm for path planning using sensor data, and vehicle kinematic calculations.	[9]
2013	Kyoungwook Min et al.,	Developed an AVP algorithm using two turning radius tangent circles to adjust steering control value. Used LMS sensor and vehicle position sensors for guidence and obstacle detection.	[10]
2014	Jerome T et al.,	Developed a Fuzzy Neuro control system. using a neuro-fuzzy inference system with adaptive inference and true-false training For path maneuver 5-degree polynomial calculations used.	[11]
2016	Bai Li et al.,	Spatial- temporal decomposition based initialization method using Nonlinear programing by applying Interior point methods for path planning	[12]
2016	Kexin Wang et al.	Developed a framework called interior-point method-based simultaneous dynamic optimization is employed and used receding-horizon optimization framework for path planning.	[13]
2017	Benjamas Panomruttanarug	Developed a iterative learning control for tracking and Dublin path planning algorithm is used for finding shortest path.	[14]
2020	Jiyuan Tan et al.,	Developed a frame work using a 3-Step process for guidence control using kinematic and dynamic calculations.	[15]
2020	Jyun-Hao Jhang et al.,	Developed a framework using Bi-RRT Sampling-based motion planning and MPC controller is used for steering control.	[16]

Automated parallel parking has been considered part of the future of automated driving for three decades. It is mainly due to the fact that there are three simplifications that can be made to the general problem of self-driving cars: (1) the speed is typically low, (2) the environment is clear and known in advance, and (3) there is additional sensor technology on the infrastructure. Therefore, the question of how the infrastructure and vehicles can share the intelligence becomes one of the key design choices. Across the world, researchers have been devising and presenting a wide variety of architectural approaches to solving problems. These models mainly involve simulations, or when a small robot tests the model, it is usually executed in the simulation environment. Few models tested in a real time autonomous vehicles such as LIGIER [8], CHANGE [10], Go-Kart [14] using steer-by-wire. In-order to evaluate the performance of these models there is no common metrics available to compare the model's. But every developed model has its limitations and advantages several rigorous simulation testing happened on each and every model

IV. CONCLUSION

The paper discusses various parking systems and services that provide the provision of intelligent parallel parking or APP services. A parking system that is reliable, efficient, and modern can negate the parking problems that arise as a result of the absence of these features. With today's technology parking concerns can be reduced with the help of different methods such as the use of expert systems, wireless sensors, fuzzy logic, GPS-based solutions, vehicle communication systems, and vision-based solutions. As a result, such a system can be very helpful to various aspects of society, including the economic, social, and safety aspects. Not only that, but it also helps to maintain the environment, preserve fuel, and preserve time as well. In order to be able to develop a better parking system with better precision and low computation, need to determine what type of project is feasible.

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