Final Exam_ Principles of Composition (Dec – 5 - 2021)

Prof. Nguyễn Hữu Phúc

Student name: Phạm Tấn Khải

ID: 1851081

Question 1: ***Title for the paper*** :

"The Merge between automated lane-correction and driver's steering assist algorithm with 2 degree of freedom manipulation method"

Question 2:

Abstract

In this paper, we confront difficulties from fusing lane-keeping algorithm and driver's steering in obstacle avoiding, predefined path maneuvers or changing lane trajectory function. Lane-keeping control loop was found not open in the process. Switching method was not implemented into the process. In the process of driver control on the system, the driver himself manage to manipulate the lateral dynamics through the vehicle steering system. When there is no conduct from user steering input, the vehicle center of gravity follows the right position of the lane to keep the vehicle in the desired position with the assist made by the lane correction system. The lane-keeping task is set free or returned without any issue at the beginning also the end of the maneuver. The proposed closed-loop structure execution is illustrated in both of the results of simulation and experiment which are obtained throughout the Italian highways test.

Question 3:

Suggested 5 key words: "Auto lane-correction algorithm, driver steering assist, the manipulation method on 2 degree of freedom, lateral control, vehicle lane altering ".

Question 4:

-Literature review:

- What's known:

In [1], the positive effect of driver assistance systems on drivers' physical and mental workload reduction is shown through the measure of some vital reactions such as the electromyographic and the electrodermal activities. In particular, automated highway systems (AHS), which have been extensively studied at Ohio State University since 1964 [2], are receiving renewed attention due to fast developments in hardware/software technology that stimulate the design of more effective control systems. Since the mid-1980s, a larger effort is being conducted mainly in the California PATH program. Early attempts of the project were devoted to assess previous knowledge in the field of automatic vehicle control providing the analytical basis for new developments [3].

- What's unknown:

In the last several years, large efforts have been directed to the solution of the highway automatic steering control problem for different types of vehicles and using different control strategies and techniques. Most of the contributions rely on buried magnet or electrified wires placed along the path for the detection of the vehicle lateral position, the so-called look down sensing scheme.

- Gaps or limitations of previous studies:

The problem, in the case of passenger cars, was analyzed in this framework by Patwardhan et al. in [4], where they show the fundamental control difficulties of this approach. An interesting alternative approach, that avoids the modification of infrastructures, involves the use of vision sensors placed on the vehicle, the so-called look-ahead sensing scheme. A comparative study of vision-based control strategies was presented by Koseckàˇ et al. in [5]. A great deal of remarkable works about application of advanced linear and nonlinear control techniques to the automatic steering control problem were conducted, still in the PATH program, by Tomizuka and coworkers in the case of four wheeled vehicles in [6], heavy vehicles in [7] and [8], and tractor–semitrailer combinations in [9], while in [10] and [11] the problem of designing a fault-tolerant lane-keeping controller for automated vehicles has been considered. In recent years, the problem of steering control has attracted wide interest also outside the PATH program. Relevant contributions in the field of robust steering and vehicle lateral dynamics control were also provided by Ackermann and coworkers (see, e.g., [12] and [13]). Preliminary experimental results on robust lateral control conducted by Byrne et al. were reported in [14], highlighting several implementation difficulties. Adaptive steering control for lane-keeping of a tractor–semitrailer has been proposed by Wang et al. in [15], while a model-predictive control strategy for lateral control of autonomous vehicles has been considered in [16]. Other contributions based on the look-ahead sensing scheme were provided by Hatipogluˇ et al. in [17], where they used a digital videocamera together with a radar system, by Broggi et al. [18], who used a stereo vision system composed of two videocameras, and by Cerone et al. [19]–[21], where properties of single-input two-output (SITO) systems are exploited. Significant Japanese contributions to the development of vision-based intelligent vehicles, given since the mid 1970s to the early 1990s, are surveyed by Tsugawa[22].

Some of the advanced maneuvers pertaining to vehicle lateral control are lane changing for vehicle-passing purposes and obstacle avoidance. The problem of automated lane-change maneuvers is widely addressed in the literature. In [17], [23], and [24], for example, the authors consider open-loop and closedloop lane-change and design time optimal steering controllers with nonlinear constraints. First, they generate a special openloop lane-change steering signal which minimizes the period of lane-change subject to constraints onthe lateral accelerationand jerk. Then, they discuss how to implement those steering commands in the closed-loop system using a lane-following controller previously published. We point out that autonomous lane change deals with the generation of the appropriate steering signal to have the vehicle accomplish the task without driver assistance.

-Problem(s)/Question(s) raised:
In this paper, we address the problem of combining automatic lane-keeping and driver's steering for either obstacle avoidance or lane-change maneuvers for passing purposes or any other desired maneuvers through a closed-loop control strategy.

-Approach/ method to the research question:
The proposed control strategy is designed assuming that the vehicle is traveling along highway paths. First, in Section II, we present the physical plant and derive a suitable simplified model focusing on the accordance between simplification hypotheses and experimental context. Then, in Section III, we formulate the control problem. Further, in Section IV, we propose a two-degree-of-freedom (2-DOF) closed-loop.

Question 5:

- Problem formulation :

+ Section III: Control problem formulation.

- Method in use:

+ Section IV: Combine Automatic Lane-Keeping and Driver's Steerings.

- Performance results:

+ Section V: Simulation Results and Discussion.

- Performance evaluation/ discussion:

+ Section VI: Experimental Results and Discussion.

Question 6:

Conclusion

Through this paper we have addressing the problem encountered in unifying the two algorithm which control the lane changing maneuver and avoiding obstacles. By fusing two system of automatic lane position control and driver's steering with a close-loop manipulation method, we suggested a model that revolve around the simplification proposition and experimental context. Through out experimental process and simulation results in the test upon Italian highways, we figured out that the system works without a single issue smoothly with high certainty percentages and ready for put in practice. Future work on this system will be focus on the more robust adaptation and more stability in it process.