XVII International Symposium
"ROAD ACCIDENTS PREVENTION 2026"
Novi Sad, Serbia, 14th and 15th October 2026.

https://doi.org/10.68515/RAP.2026.17.27

TURN SIGNAL USE AS AN ELEMENT OF ACTIVE TRAFFIC SAFETY

Nenad Saulić[a*], Zoran Papić[b], Milja Simeunović[c], Milan Simeunović[d]

[a] Faculty of Technical Sciences, University of Novi Sad, Serbia, e-mail: n.saulic@uns.ac.rs, https://orcid.org/0000-0002-1151-6737

[b] Faculty of Technical Sciences, University of Novi Sad, Serbia, e-mail: z.papic@uns.ac.rs, https://orcid.org/0000-0003-1264-0913

[c] Faculty of Technical Sciences, University of Novi Sad, Serbia, e-mail: mlekovic@uns.ac.rs, https://orcid.org/0000-0001-9650-2635

[d] Faculty of Technical Sciences, University of Novi Sad, Serbia, e-mail: milansim@uns.ac.rs, https://orcid.org/0000-0001-6973-0659

Abstract: Turn signals are one of the basic elements of communication between road users and play a significant role in a vehicle's active safety system. Through their timely and proper use, the driver unequivocally signals their intention to other road users to change direction, change lanes, turn, or enter and leave the traffic stream. In addition to not using turn signals, a significant safety problem also arises when a turn signal remains on after the maneuver is complete. Such signaling can provide other road users with incorrect information about the vehicle's intended movement and influence their decisions, especially at intersections, when merging onto a road with right-of-way, changing lanes, and in other complex traffic situations. The automatic cancellation of the turn signal in most passenger vehicles is linked to the steering wheel's rotation and return motion, which is why it may not automatically cancel during certain maneuvers and at smaller steering angles. The paper analyzes the use of turn signals from an active safety perspective, with particular emphasis on the relationship between automatic turn signal cancellation and steering wheel angle. The results of the authors' previous research showed that in vehicles with a conventional mechanical system, the turn signal automatically cancels after a sufficient steering angle has been reached, when the steering wheel returns to a position of approximately 20–30° relative to the zero position, while a steering wheel angle of approximately 45° is required to activate the mechanism. An analysis of characteristic maneuvers considered situations in which the turn signal may remain active after the maneuver is completed, with a special focus on changing lanes and exiting a roundabout. The analysis results indicate that a turn signal that remains active after the maneuver can provide other road users with incorrect information about the vehicle's future path, thereby contributing to misjudgment of the traffic situation and the occurrence of conflicts.

Keywords: turn signal, active safety, steering wheel, steering angle, automatic cancellation

1. INTRODUCTION

According to the Regulation on the Classification of Motor and Trailer Vehicles, lighting and light-signaling devices on motor and trailer vehicles, i.e., lights, include devices for illuminating the road, devices for marking the vehicle, and devices for giving light signals

* Corresponding author. Tel.:+381605210685, +381214852482; e-mail address: n.saulic@uns.ac.rs

(Rulebook, Official Gazette of the RS No. 24/24). The group of devices for giving light signals includes stop lights, turn signals, and the device for simultaneously activating all turn signals (Rulebook, Official Gazette of the RS No. 24/24).

Turn signals are one of the basic lighting devices on motor vehicles and play a significant role in the active traffic safety system. Their primary function is to convey information to other road users in a timely and unambiguous manner about the driver's intended change of movement pattern or direction. In this way, other road users are enabled to timely detect and correctly assess the driver's intent, adapt their behavior to the new situation, and, if necessary, take appropriate actions to avoid a conflict.

Proper and timely use of turn signals is especially important when merging into traffic, changing lanes, moving into position for a turn, turning, making a U-turn, and passing obstacles or overtaking, exiting traffic, stopping, and other maneuvers that change the vehicle's previous course. Failure to use the turn signal, using it too late, or leaving the turn signal on after the maneuver is complete can provide other road users with incomplete or incorrect information about the driver's intentions. Such situations can lead to a misjudgment of the vehicle's intended path, the creation of conflicts, the need for sudden reactions, and in certain circumstances, even to a traffic accident.

The importance of proper use of turn signals is also recognized by law. A driver must not begin any action with a vehicle in traffic on the road-merging, changing lanes, moving into position for a turn, turning, making a U-turn, passing, backing up, pulling over, stopping, parking, and other actions - before ensuring they can be performed in a safe and proper manner. In addition, the driver is required to clearly and in a timely manner inform other road users of the intention to perform a specific maneuver, by giving the prescribed signal with the turn signals. The required signal must be given for the entire duration of the maneuver, and upon completion of the maneuver, the signal must be discontinued (Law on Road Traffic Safety, Article 32).

From an active safety perspective, it is just as important for the turn signal to be on before and during the intended maneuver, as it is to be turned off immediately after its completion. In most modern vehicles, the turn signal is automatically canceled by a mechanism linked to the steering wheel's return to its straight-ahead position. After the turn is completed and the steering wheel is returned to a position corresponding to straight-line travel, the activated turn signal automatically cancels, under certain conditions. However, depending on the steering wheel angle, the geometry of the executed maneuver, and the characteristics of the mechanism itself, automatic cancellation may not occur, which necessitates driver intervention.

When the turn signal remains on after the maneuver is complete, it sends a message to other road users that is no longer consistent with the vehicle's actual intent and path. A misinterpreted turn signal can influence the decisions of other drivers, cyclists, or pedestrians and contribute to a potentially dangerous situation. Therefore, the way the turn signal is activated and automatically deactivated, in addition to being a technical issue, also has immediate significance for active traffic safety.

In accordance with the above, the subject of this paper is the analysis of the application of turn signals as an element of active traffic safety, with a special focus on the conditions for their automatic cancellation after a maneuver is completed. The relationship between the steering wheel position, or steering angle, and the automatic deactivation of the turn signal will be analyzed, with the aim of determining the characteristic positions at which the deactivation mechanism is activated. The results obtained are expected to indicate possible situations in which the turn signal remains activated despite the maneuver being completed, as well as their potential significance for traffic safety.

2. TURN SIGNAL USE

Previous research indicates that, although turn signals are one of the basic devices for communication between road users, a significant number of drivers do not use them or do not use them correctly and in a timely manner. The problem of not using turn signals is particularly significant from an active safety perspective, as it deprives other road users of information about an intended change of direction or movement of the vehicle. In addition to a complete lack of signaling, potentially dangerous situations can also arise when a turn signal is activated too late or is left on after the maneuver is complete, which can convey incorrect information about the vehicle's future path to other road users.

One of the more extensive field studies on the use of turn signals was conducted by Ponziani (Ponziani, 2012), who analyzed the behavior of approximately 12,000 drivers in real-world traffic conditions. The research results showed that turn signals are not used consistently when performing maneuvers, with the problem being more pronounced for changing lanes than for turning. The paper highlights that the failure to use turn signals is a significant safety concern, as it makes it difficult for other road users to timely recognize the driver's intent and predict the vehicle's future path.

The inconsistency in the use of turn signals is also indicated by a study from Faw (Faw, 2013), which was conducted by observing more than 5,600 vehicles at various intersections. Approximately 76% of the observed drivers used a turn signal, while significant differences were found between individual locations. Depending on the intersection, the percentage of drivers who properly signaled their intention to turn ranged from approximately 54% to 95%. The results also showed that the use of turn signals can be influenced by the direction of the turn, traffic intensity, and intersection characteristics. This indicates that the use of turn signals is not exclusively a result of individual driver habits, but can also depend on the characteristics of the specific traffic situation.

Similar results were obtained in a driver behavior study conducted by Sullivan et al. (Sullivan et al., 2015). An analysis of the behavior of 108 drivers found that turn signals were not used in approximately a quarter of the turns analyzed. Turn signal non-use was recorded for approximately 25% of left turns and 29% of right turns. The results of this study further confirm that timely signaling of a driver's intent is not present in all situations where it is needed, and that the decision to use turn signals can be influenced by the direction of the turn, road characteristics, and the presence of other vehicles.

Besides the frequency of use, the moment at which the driver activates the turn signal is particularly important from a safety perspective. Jokhio et al. (Jokhio et al., 2024) analyzed the use of turn signals during lane changes in real-world driving conditions. The results showed that in approximately 60% of the analyzed cases, the turn signal was activated before the lane change began. However, in approximately 33% of the cases, the signal was activated only after the maneuver had already started, while in about 7% of the cases, it was not used at all. These results indicate that for safety, it is not only important that the turn signal is activated, but also that the signal is given early enough for other road users to recognize the driver's intent and adjust their behavior in a timely manner.

3. TURN SIGNAL OPERATING SYSTEM

In addition to driver behavior and the proper use of turn signals, the technical method of their automatic cancellation after a maneuver is also significant from an active safety perspective. In a large number of vehicles, the automatic cancellation of the turn signal is linked to turning the steering wheel and its subsequent return to the straight-ahead position.

This allows the driver to not have to manually cancel the previously activated turn signal after completing the turn. However, the operation of this system depends on the characteristics of the mechanism, as well as on the magnitude and direction of the steering wheel's rotation during the maneuver.

In conventional mechanical automatic cancellation systems, activating the turn signal moves the flasher lever to the corresponding position, while its return is linked to the movement of the steering mechanism. When the steering wheel is turned in the direction of the maneuver, the system allows the turn signal to remain activated, while upon returning the steering wheel to the neutral position, the mechanism for its deactivation is activated. It follows that for the automatic disengagement, not only the current position of the steering wheel is significant, but also the previously achieved steering angle, as well as the direction of its subsequent movement.

In the technical documentation for the automatic turn signal cancellation system, special attention is paid to the steering angle. In some solutions, the system registers the achievement of a certain steering angle, i.e., the maximum angle reached during the maneuver, after which it tracks the return of the steering wheel to the neutral position. When the return movement of the steering wheel meets the defined criterion, a signal is generated to cancel the turn signal. This principle shows that the automatic cancellation process should be viewed as a combination of at least two parameters—the steering angle achieved and the magnitude of the return movement (Automatic Turn-Signal Cancelling System, US4403211A).

A problem can arise during maneuvers where the steering wheel is turned by a relatively small angle. If the position required to activate the automatic cancellation mechanism is not reached during the maneuver, the turn signal may remain on even after the vehicle has resumed its travel on a new or approximately straight path. This shortcoming of conventional systems is also addressed by the technical solution described in the Vehicle Turn Signal Mechanism (Vehicle Turn Signal Mechanism, US5774049A) document, one of whose objectives is to enable more reliable turn signal cancellation, even in situations with smaller steering wheel turns. This problem can be particularly significant during slight changes of direction and other maneuvers where the steering wheel is not turned enough to activate the standard automatic cancellation mechanism.

The development of electronic control systems has opened up the possibility for the turn signal cancellation process to be based on more than just the mechanical position of the control system elements. More modern technical solutions use data from a steering angle sensor (Steering Column Assembly with Steering Angle Sensor and Turn Signal Cancellation, EP1068991A3/B1), based on which the steering wheel's position can be continuously monitored during a maneuver. In this way, it is possible to register the initial position, the direction of rotation, the angle reached, and the return of the steering wheel to its straight-ahead position.

More recent technical solutions further enhance this principle by introducing variable criteria for the automatic cancellation of the turn signal (Dynamically-Controlled Automatic Turn Signal Cancellation in a Vehicle, patent application US20250170952A1 / EP4559753A1), where the monitoring of the steering wheel angle and its return to the straight-ahead position after reaching a corresponding angle is provided. In this case, the disengagement criterion does not have to be constant, but can also depend on other vehicle movement parameters, including speed. This approach is significant because at different speeds and for different types of maneuvers, the same change in the vehicle's path is not necessarily achieved with the same steering wheel angle.

In a previous study by the authors (Saulić et al., 2024), the relationship between automatic turn signal cancellation, steering wheel angle, and the return movement of the steering wheel was analyzed. In vehicles with a conventional mechanical system, it was determined that the

turn signal, after achieving a sufficient steering angle, automatically cancels when the steering wheel returns to a position approximately 20–30° from its zero position. The average value obtained from measurements was approximately 25°, with no significant differences observed depending on the steering wheel's previous steering angle.

A particularly significant result of the previous research concerned the minimum steering wheel angle that must be achieved to activate the mechanism for the subsequent automatic deactivation of the turn signal. For the vehicles analyzed with a conventional mechanical system, this threshold value ranged from 41° to 48°, or approximately 45°. This result serves as the starting point for the analysis conducted in this paper, as it indicates the possibility that during maneuvers with smaller steering wheel angles, the turn signal may remain active even after the maneuver is complete.

4. DANGEROUS TRAFFIC SITUATIONS CAUSED BY AN UNCANCELLED TURN SIGNAL

A turn signal that remains active after completion of a maneuver can pose a safety hazard because it gives other road users a clear, but incorrect, signal about the driver's intentions and the vehicle's expected path. Based on such a signal, other road users may decide to merge, change their speed or path, or cross the roadway, assuming the vehicle will perform a maneuver that the driver does not actually intend to make.

Table 1. Characteristic dangerous situations caused by an uncancelled turn signal

Traffic situation	Incorrect information provided by the turn signal	Possible reaction of the other road user	Potential conflict / consequence
Approaching the intersection with the right turn signal on, while continuing straight	The vehicle signals a right turn, although it intends to continue straight	The driver from the side street judges that they can safely merge onto the main road	Crossing the path of a vehicle continuing straight; possible side or oblique frontal-side collision
Passing by an entrance or exit of a parking lot with the turn signal on	It creates the impression that the vehicle will turn onto an access road or parking lot before the position of the other vehicle	The driver from the access road/parking lot begins to merge into traffic	Cutting into the path of a vehicle on the main road and the occurrence of a side collision
Continuing to move after exiting the roundabout with the right turn signal on	Other road user can conclude that the vehicle intends to make the next right turn	A driver from the next access road or intersection may begin merging	Conflict with a vehicle that continues straight after leaving the roundabout
Movement on a multi-lane road after completing a lane change	An activated turn signal creates the impression that the driver intends to change lanes	The driver in the adjacent lane may brake, change lanes, or increase lateral distance	Unnecessary evasive maneuvers, conflict with other vehicles, and a possible chain reaction disruption of traffic flow
Passing by a pedestrian crossing or a place where pedestrians cross	A pedestrian can conclude that the vehicle will turn before their position or change its path	The pedestrian begins crossing the street, expecting that a vehicle will not come in his path	Vehicle–pedestrian conflict, with the possibility of sudden braking or a collision with a pedestrian
Passing a cyclist with a turn signal on	A cyclist can conclude that a vehicle intends to turn or change its position on the road	Cyclist changes speed or path based on a misrepresented maneuver	Vehicle–bicyclist conflict or a bicyclist's conflict with other road users

Typical traffic situations in which a turn signal that remains active after completion of the maneuver can contribute to a conflict are shown in Table 1.

An analysis of the situations shown in Table 1 reveals that the fundamental safety problem associated with a turn signal that remains active stems from the discrepancy between the information conveyed by the vehicle and its actual trajectory. Other road users use the turn signal as one of the elements for assessing a vehicle's future movement, so incorrect signaling can directly affect their decisions and behavior.

Particularly unfavorable are situations where another road user, based on an active turn signal, makes a decision that involves cutting into the vehicle's path. Such situations can arise when merging from a side road, driveway, or parking lot, as well as when a pedestrian crosses the roadway. On the other hand, on multi-lane roads, a wrong signal can cause unnecessary braking, a lane change, or another evasive maneuver, thereby transferring the potential for a conflict to other road users.

The risk may be further increased when a new intersection, merge, crosswalk, or other conflict area is located a short distance after a previously completed maneuver. In such circumstances, a turn signal that remains active after the previous maneuver can be interpreted as an indication of an upcoming maneuver. Therefore, the safety significance of a turn signal that remains on after a turn is not only dependent on the fact that the signal stayed on, but also on the characteristics of the traffic situation, the position of other road users, and the possibility that they may use the incorrect information when making a decision about their own movement.

4.1. Analysis of characteristic maneuvers from the perspective of automatic turn signal cancellation

The results of the previously presented research show that for vehicles with a conventional mechanical automatic turn signal cancellation system, simply returning the steering wheel to its straight-ahead position is not sufficient. For the automatic cancellation to occur during the return movement, it is necessary that a certain minimum steering wheel angle be achieved during the previous maneuver, which is about 45°.

A typical example is changing lanes. Unlike turning at an intersection, changing lanes is most often performed with a relatively gentle steering input, followed by a corrective turn in the opposite direction to establish a straight path in the new lane. Depending on the vehicle's speed, the width of the traffic lane, and the length over which the maneuver is performed, it is possible for the maximum steering wheel angle not to reach the value required to activate the automatic cancellation mechanism. In such a case, the turn signal may remain active even after the lane change is completely finished.

A particularly interesting case is roundabouts. The trajectory geometry of a vehicle exiting a roundabout depends on the outer and inner radii, the width of the circular roadway, the exit radius, the vehicle's position, and its speed. At roundabouts with larger radii and tangentially shaped exits, the path change upon leaving the roundabout can be relatively gentle. Therefore, it is possible that the steering wheel rotation during the exit is not sufficient to activate the automatic cancellation mechanism. In that case, the right turn signal may remain active even after leaving the roundabout. In contrast, a conventional left or right turn at an intersection typically involves much larger steering wheel angles. Therefore, the position required to activate the mechanism is more likely to be reached, and the turn signal will automatically cancel upon returning the steering wheel to its original position. However, even in this case, the automatic cancellation should not be considered a substitute for the driver's obligation to check whether the turn signal has been cancelled after completing the maneuver.

From the perspective of conflict prevention, situations where another intersection, merge, parking entrance, or other conflict area is located immediately after a completed maneuver are particularly significant. In such a situation, the turn signal that remains active after the previous maneuver can be interpreted as an indication of the next maneuver. The safety problem, therefore, does not arise solely from the technical fact that the turn signal was not automatically turned off, but from the temporal and spatial connection between the previous maneuver and the subsequent conflict situation.

5. CONCLUSION

Turn signals are one of the basic elements of communication between road users, which is why their correct and timely use plays a significant role in active safety. A safety problem is not only the failure to signal or the untimely activation of a turn signal, but also a situation where the signal remains on after the maneuver is complete. In such circumstances, a clear but incorrect message about the vehicle's intended movement is conveyed to other road users.

An analysis of the operating principle of the automatic cancellation system showed that in classic mechanical systems, the turn signal's cancellation depends on the previous steering angle and the subsequent return of the steering wheel. Results from previous measurements showed that in the analyzed vehicles, the turn signal is automatically cancelled as the steering wheel returns to a position approximately 20°–30° from the zero position, whereas activation of the cancellation mechanism requires a preceding steering wheel angle of 41°–48°, i.e. approximately 45°.

This threshold value is particularly significant for maneuvers performed with relatively small steering wheel turns. Changing traffic lanes, slight changes of direction, and certain ways of exiting a roundabout can be performed without reaching the angle required to activate the automatic cancellation mechanism. Under such circumstances, the turn signal may remain on even after the maneuver is complete and the vehicle continues on a stable path.

The safety implications of such a situation are particularly pronounced when a intersection, merge, parking area, crosswalk, or other conflict zone is located immediately after the maneuver has been completed. Another road user may interpret the activated turn signal as an indication of an upcoming maneuver and, based on that information, make a decision that is not consistent with the vehicle's actual path. In this way, a turn signal that remains active after the maneuver can contribute to a conflict, the need for an evasive maneuver, and, under unfavorable circumstances, a traffic accident.

ACHNOWLEDGMENTS

This research has been supported by the project “Researching trends in the development of sustainable transport and logistics systems“, founded by the Department of Traffic Engineering, Faculty of Technical Sciences in Novi Sad, University of Novi Sad, Republic of Serbia.

6. REFERENCES

[1] Pravilnik o podeli motornih i priključnih vozila i tehničkim uslovima za vozila u saobraćaju na putevima, Službeni glasnik RS br. 24/24 objavljen 22.03.2024. godine.
[2] Zakon o bezbednosti saobraćaja na putevima, Službeni glasnik RS br. 76/23, objavljen 07.09.2023. godine.

[3] Ponziani, R. (2012). Turn Signal Usage Rate Results: A Comprehensive Field Study of 12,000 Observed Turning Vehicles. SAE Technical Paper 2012-01-0261, DOI: 10.4271/2012-01-0261.
[4] Faw, H. W. (2013). To signal or not to signal: That should not be the question. Accident Analysis & Prevention, 59, 374–381, DOI: 10.1016/j.aap.2013.06.036.
[5] Sullivan, J. M., Bao, S., Goudy, R., & Konet, H. (2015). Characteristics of turn signal use at intersections in baseline naturalistic driving. Accident Analysis & Prevention, 74, 1-7., DOI: 10.1016/j.aap.2014.10.005.
[6] Jokhio, S., Olleja, P., Bärgman, J., Yan, F. & Baumann, M. (2024). Exploring turn signal usage patterns in lane changes: A Bayesian hierarchical modelling analysis of realistic driving data. IET Intelligent Transport Systems, DOI: 10.1049/itr2.12457.
[7] Automatic Turn-Signal Cancelling System, US4403211A.
[8] Vehicle Turn Signal Mechanism, US5774049A.
[9] Steering Column Assembly with Steering Angle Sensor and Turn Signal Cancellation, EP1068991A3/B1.
[10] Dynamically-Controlled Automatic Turn Signal Cancellation in a Vehicle, patent application US20250170952A1 / EP4559753A1.
[11] Saulić N., Bogdanović V., Pitka P., Ilin V., Determining the steering wheel position during automatic turn signal cancellation, Savetovanje na temu saobraćajnih nezgoda, Zlatibor, May 16-18, 2024, pp. 428-437.