

## **Team TJA3**

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## **Requirements**

1. The Traffic Jam Assist (TJA) system must be based on the Adaptive Cruise Control (ACC) system.
  - 1.1. The TJA system, like the ACC system, uses a forward-looking radar to identify a target vehicle and to determine the closing rate to the target vehicle, which ideally should be zero.
    - 1.1.1. If the closing rate is positive, it means that the closing distance between the driver's vehicle and target vehicle is growing, and no action is needed.
    - 1.1.2. If the closing rate is negative, it means that the closing distance between the driver's vehicle and target vehicle is decreasing, and the driver's vehicle needs to slow down and maintain a set distance.
      - 1.1.2.1. The driver must have 3 selections for the set distance: 1 car length distance (default), 2 car length distance, or 3 car length distance.
  - 1.2. The TJA system, like the ACC system, uses a forward-looking camera to allow lane following that keeps the vehicle in the middle of the lane it is in.
  - 1.3. The TJA system's lane following feature, like the ACC system, will steer the vehicle back into its current lane if the driver attempts to change lanes without signaling.
    - 1.3.1. The turn signal will disable the lane following system to allow the driver to successfully merge into another lane.
2. The TJA system will add autonomous operations to adjust to traffic flow by following or stopping behind a target vehicle in the case of slow and stopped traffic on limited access highways.
  - 2.1. If the target vehicle is not moving, the TJA system will stop the driver's vehicle a set distance behind the target vehicle. Specifically, the driver's vehicle must slow down and maintain a reasonable distance that allows the driver to see the rear tires of the target vehicle (default is 1 car length).
  - 2.2. If the target vehicle is moving, the TJA system will start the driver's vehicle and follow the target vehicle at a set distance and control the closing rate. Specifically, the vehicle must follow at a set distance (default is 1 car length) and continuously recalculate the closing rate.
3. The purpose of the TJA system is to reduce driver errors due to fatigue since the driver will no longer have to go between the accelerator and the brakes in traffic. The more often a driver does this, the more often they will make a mistake.

4. The TJA system should only be activated when the GPS tracking device indicates that the vehicle is on a limited access highway and that there is traffic on the highway.
  - 4.1. The GPS tracking device must be able to communicate with the Global Navigation Satellite System (GNSS) network [1, pp. 2] to retrieve information from the GNSS network about the vehicle's current location and traffic on the road.
5. The TJA system will alert the driver of warnings when the closing distance is negative, the vehicle speed is too high, or the vehicle is not lane following.
  - 5.1. The TJA system will display warnings on the dashboard.
  - 5.2. The TJA system will have an auditory warning system consisting of beeps.
6. The TJA system is purely a forward moving system.
  - 6.1. The TJA system will not be active during lane changing.
    - 6.1.1. After lane changing, the TJA system will resume at that set speed if there are no new target vehicles.
    - 6.1.2. After lane changing, the TJA system will recalculate the set speed and closing distance after identifying a new target vehicle.
  - 6.2. If the target vehicle starts reversing, it falls outside the scope of the TJA system and becomes the driver's duty to make the appropriate action.
  - 6.3. If there are inclement weather conditions, it falls outside the scope of the TJA system and becomes the driver's duty to make the appropriate action.
7. If the TJA system needs to disengage, it will inform the driver on the dashboard and deactivate.
  - 7.1. The TJA system will disengage if the radar sensor is faulty or blocked.
  - 7.2. The TJA system will disengage if the system detects a slip condition.
    - 7.2.1. A slip condition is when the wheels are not going the same.
8. The driver will have control over the TJA system.
  - 8.1. If the driver taps the brakes, the ACC system will disable, and as such, the TJA system.
  - 8.2. If the driver accelerates, the TJA system will allow them to, but after they take their foot off the accelerator, the system returns to the set speed.
  - 8.3. The driver must be attentively paying attention to the road.
    - 8.3.1. Tactile feedback on the steering wheel will determine if the driver is attentive.
    - 8.3.2. A driver-facing infrared camera will determine if the driver is attentive.
9. The steering wheel will have buttons to "resume" or "cancel" the TJA system.
  - 9.1. The resume button will bring the vehicle back to its previous set speed.
  - 9.2. The cancel button will turn the system off, including the ability to resume.
10. The TJA system is meant for highways without lots of hills and tunnels and inclement weather conditions, since it affects the radar, camera, and lane keeping.

### **Global Invariants**

1. The vehicle shall not exceed 10 mph if a target vehicle is detected within 15 feet.
2. The vehicle shall maintain a distance of at least 1 car length to the target vehicle.
3. The vehicle shall never surpass 80 mph.
4. The driver shall be able to select a set distance.
5. The TJA system is only a forward moving system.

## References

- [1] “What is GPS tracking and how does it work?”, mixtelematics.com. [Online]. Available: <https://www.mixtelematics.com/us/resources/blog/what-is-gps-tracking-and-how-does-it-work#:~:text=GPS%20Tracking%20System%20Basics,of%20the%20vehicle%20being%20tracked>.. [Accessed Oct. 28, 2022].