Protecting IP in Autonomous Driving

By Charlene Liu, Ph.D. | August 17, 2021

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Modern autonomous driving technology often entails applications of Artificial Intelligence (AI) to facilitate navigation and safety. For example, autonomous vehicles can often be equipped with multiple sensors around the vehicle, such as LiDAR, radar, cameras, thermometer, accelerometer GPS, Wi-Fi modules, and/or the like, which are configured to capture data reflecting the environment where the vehicle is located. The captured sensor data can then be fed into an AI system that blends the various sensor data to generate a navigation command that autonomously control the movement of the vehicle with little or no human intervention.

One example of AI technology used in autonomous driving includes automotive radar technology. An autonomous vehicle can be equipped with a radar platform, which utilizes analog or digital antennas operating at millimeter wave frequencies (e.g., 77GHz) to obtain radar data for long-range sensing, in particular in difficult weather. This type of radar system can be particularly useful when a vehicle is moving at high speeds and may need sufficient advance notice of any obstruction or changes on road conditions while maintaining the required level of safety. The radar system can often be integrated with an AI system to perform object classification based on input radar data. The AI system can be trained with different types of radar data to identify objects at different ranges, to classify the type of an object (e.g., other vehicles, static objects, pedestrians, traffic light, and/or the like), to fuse multiple sensor data to provide higher resolution of detected objects (e.g., fusing radar data with LiDAR data, and/or the like), and/or the like. The identified object and estimated distance from the vehicle by the AI system can then be used in another AI logic to generate a navigation command accordingly, e.g., to bypass or drive away from the object.

Another example of AI technology used in autonomous driving includes action detection in a live video stream. For instance, an autonomous vehicle is often equipped with a video camera that captures live visual data of the surroundings of the vehicle. An AI system may be engaged to receive the live video stream and to detect an action start of a particular action from the live video stream in real time. Specifically, the AI system may sample the live video stream into a number of video frames, and analyze the visual features of the video frame, based on which the AI system can classify a type of the action and also predict whether a start of an action is happening at a particular video frame. For instance, the AI system may classify a video frame as containing an action of “human walking,” and also containing the start of an action, which translates to detecting the video frame as containing “a pedestrian starting to walk.” The ability of the AI system to detect such start of an action “online,” e.g., in a real-time fashion, assists the vehicle to react to constant changes in the traffic and road conditions and make navigation decisions accordingly to ensure safety.

Given the comprehensiveness and depth of AI technology engaged in autonomous driving systems, protecting intellectual property rights in autonomous driving often entails procuring patents on the underlying AI technology. Several common perspectives can often be assessed to mine innovative concepts from the AI systems in autonomous driving:

1. Application level: the autonomous driving system may engage an AI model to perform a specific function, e.g., to generate a specific prediction output that facilitates autonomous

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control of the vehicle and/or navigation.
2. Data level: in order to generate the specific prediction output at the application level, innovative data preprocessing techniques may be adopted to preprocess raw sensor data (e.g., radar data) into a particular format for input to the AI model. Similarly, training data can be generated via similar innovative data preprocessing techniques for the AI model.
3. Model level: innovative AI models that are designed to learn certain feature representations and to perform the specific function in autonomous driving. The AI model may be trained with an innovative training loss objective.
4. Structure level: the actual structure or architecture of the AI model may be designed with a particular pattern of layers and/or modules. For example, the novel structure of layers and/or modules may achieve parallel processing to improve computational efficiency.

Additional innovative aspects of the AI systems may include post-processing and interpretation of the AI outputs (e.g., the raw output of the AI model may be transformed, normalized, or go through another algorithm to provide meaningful outputs for autonomous driving), learning different downstream tasks specific to autonomous driving on the AI models, and/or the like.

As described above, a large number of AI-related innovations in autonomous driving may occur at the software level. Thus, such software-based AI inventions may naturally face the patent eligibility (or suitability) test in many jurisdictions. However, unlike many other software-type patent applications (e.g., such as a pure business method claim for computing tax returns, etc.) that are usually deemed as too “abstract” to be eligible or suitable, patent offices worldwide generally acknowledge AI-type inventions as a unique advancement in computer technology that has significant technical effect or solves a technical problem. With proper claim language, AI-type patent applications may be considered eligible at jurisdictions that are traditionally strict with software patents, such as EU, U.S., and China. A recommended approach in drafting AI-type patent application is to concretely integrate the usage of a machine learning system into the claims. For example, instead of generically reciting completing a functional step using a machine learning system, the actual involvement of the machine learning system, e.g., what output is generated, what loss function is computed, and how the machine learning system is updated based on the loss function, may be reflected in the claims, which emphasizes that the claimed subject matter cannot be just “abstract” or performed by a human being.

Detectability is another factor to keep in mind while drafting AI-type claims for autonomous driving technology. As most AI systems operate in a “black box” fashion, enforcing an AI patent, in particular, method claims, on an accused product can often prove to be challenging. On one hand, it is worth investigating whether the visible part of the invention may imply at least a part of the invisible part of the invention, e.g., via reverse engineering. For example, the output format, input format, interrelationship between output variables, auxiliary output, and/or other “visible” data components that can possibly be used in reverse engineering may be reflected in the claim language. On the other hand, the claims may be drafted in a “reversible” way to focus on the visible part of the invention. For example, instead of claiming method steps of parallel computations within an AI system, patentee may recite a parallel data output format that is visible at the output of the AI system in the claims.

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