

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TESLA, INC.,
Petitioner

v.

INTELLECTUAL VENTURES II LLC,
Patent Owner.

IPR2025-00342
U.S. Patent No. 7,336,805

**PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. § 312 AND 37 C.F.R. § 42.104**

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PETITIONER’S EXHIBIT LIST

Ex.1001	U.S. Pat. No. 7,336,805 to Gehring et al. (“the ’805 patent”)
Ex.1002	Prosecution History of U.S. Pat. No. 7,336,805 (U.S. Application No. 11/154,772) (“the ’772 application”)
Ex.1003	Declaration of Dr. Jeffrey Rodriguez under 37 C.F.R. § 1.68
Ex.1004	<i>Curriculum Vitae</i> of Dr. Jeffrey Rodriguez
Ex.1005	“Visual Perception of Obstacles and Vehicles for Platooning,” Broggi et al. (“Broggi”)
Ex.1006	“Object Recognition Using Alignment,” Daniel Huttenlocher (“Huttenlocher”)
Ex.1007	U.S. Patent No. 5,434,927 to Brady et al. (“Brady”)
Ex.1008	“Automatic Vehicle Guidance: The Experience of the ARGO Autonomous Vehicle,” Broggi, Bertozzi, et al. (“Bertozzi”)
Ex.1009	Microsoft Computer Dictionary, 3rd ed., 1997, excerpts
Ex.1010	IV’s Complaint, <i>Intellectual Ventures II, LLC v. Tesla, Inc.</i> , No. 6:24-cv-188-ADA (WDTX)
Ex.1011	Proposed Scheduling Order, <i>Intellectual Ventures II, LLC v. Tesla, Inc.</i> , No. 6:24-cv-188-ADA (WDTX)
Ex.1012	Statistics on District Court Timing
Ex.1013	Interim Procedure for Discretionary Denials in AIA Parallel District Court Litigation, June 21, 2022
Ex.1014	IV’s Preliminary Infringement Contentions, <i>Intellectual Ventures II, LLC v. Tesla, Inc.</i> , No. 6:24-cv-188-ADA (WDTX)
Ex.1015	Declaration of Sylvia Hall-Ellis, Ph.D.

I. INTRODUCTION

U.S. Patent 7,336,805 (“the ’805 patent,” Ex.1001) is directed to “a method for assisting vehicle guidance on the basis of image data[.]” Ex.1001, 1:6-9.

However, as shown in this Petition, claims 1-2 and 6-11 (the “Challenged Claims”) recite well-known aspects of vehicle guidance and image recognition. Pursuant to 35 U.S.C. §§311, 314(a), and 37 C.F.R. §42.100, Tesla, Inc. (“Petitioner”) respectfully requests that the Board institute review and find the Challenged Claims unpatentable.

II. GROUNDS FOR STANDING

Petitioner certifies that the ’805 patent is eligible for IPR and that Petitioner is not estopped from requesting IPR.

III. NOTE

Petitioner cites to exhibits’ original page numbers, unless noted otherwise.

Emphasis in quoted material has been added. Claim terms are presented in *italics*.

IV. THE '805 PATENT

The '805 patent describes a method for docking assistance using image analysis. Ex.1001, Abstract. A vehicle is equipped with a camera (image sensor 22 on vehicle 20 in Figure 2) to obtain image data. Ex.1001, 2:56-57.

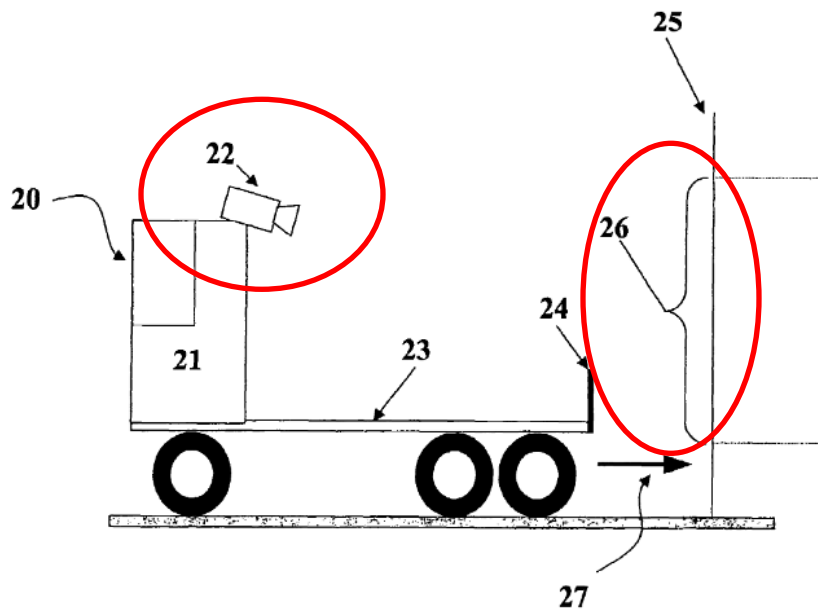


Figure 2

Ex.1001, Fig. 2 (annotated)

The obtained images are analyzed to locate objects, e.g., cargo door 26 in Figure 2. Ex.1001, Abstract, 7:13-29. The obtained image data is broken down into edge segments, and interrelationships between the edge segments are stored in a tree structure. Ex.1001, 3:37-39; 4:43-45. The edge segments are then analyzed to check for the presence of a geometric object similar to a shape (e.g., geometric form) associated with a potential destination of the vehicle (e.g., rectangle for the

cargo door of the dock). Ex.1001, 3:40-43. The detected geometric objects are then “analyzed for plausibility” using a known matching algorithm. Ex.1001, 2:41-43; 3:3-8; 3:47-50. Plausible objects then undergo an additional “acceptance analysis.” Ex.1001, 3:41-54. Accepted object(s) are then used in calculating a trajectory to assist in vehicle guidance to the dock. Ex.1001, 3:61-66.

V. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art in June 2004 (“POSITA”) would have had a bachelor’s degree in electrical engineering, computer engineering, computer science, or a related subject, and four years of work experience in image processing, automated vehicle control/navigation, or a related field. Less experience may be necessary with additional education (e.g., a master’s degree), and likewise, less education may be necessary with additional work experience (e.g., 5-7 years). Ex.1003, ¶14.

VI. CLAIM CONSTRUCTION

For purposes of this proceeding and the grounds presented herein, no claim term requires express construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017). Ex.1003, ¶34.

VII. RELIEF REQUESTED

Petitioner asks that the Board institute an IPR trial and find the Challenged Claims unpatentable in view of the analysis below.

VIII. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

A. Challenged claims

Petitioner challenges claims 1-2 and 6-11.

B. Statutory grounds for challenges

Grounds	Claims	Pre-AIA Basis (§103)
#1	1-2, 9-10	Broggi, Huttenlocher, and Brady
#2	6-8, 11	Broggi, Huttenlocher, Brady, and Bertozzi

Broggi (Ex.1005): “Visual Perception of Obstacles and Vehicles for Platooning” (“Broggi”). Broggi was publicly available by at least September 1, 2000. *See* §IX (citing Ex.1015). Broggi is prior art under pre-AIA §§102(a)-(b).

Huttenlocher (Ex.1006): “Object Recognition Using Alignment” (“Huttenlocher”). Huttenlocher was publicly available by at least September 26, 1989. *See* §IX (citing Ex.1015). Huttenlocher is prior art under pre-AIA §§102(a)-(b).

Brady (Ex.1007): U.S. Patent 5,434,927 (“Brady”) issued July 18, 1995. Brady is prior art under pre-AIA §§102(a)-(b), (e).

Bertozzi¹ (Ex.1008): “Automatic Vehicle Guidance: The Experience of the ARGO Autonomous Vehicle” (“Bertozzi”). Bertozzi was publicly available by at least September 27, 1999. *See* §IX (citing Ex.1015). Bertozzi is prior art under pre-AIA §§102(a)-(b).

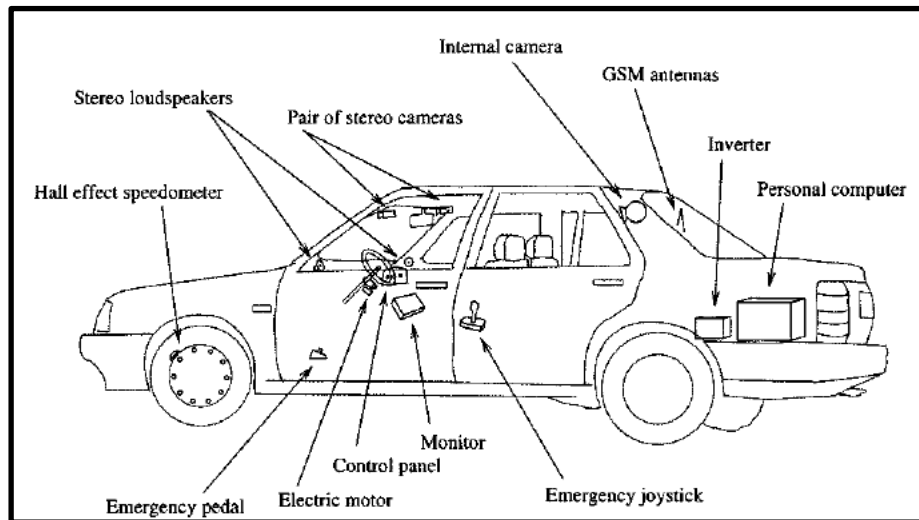
Petitioner’s §103 obviousness grounds rely on the combined teachings of the references, not physical incorporation of elements. *See In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012).

C. Ground 1: Claims 1-2 and 9-10 are obvious over Broggi-Huttenlocher-Brady.

1. Broggi

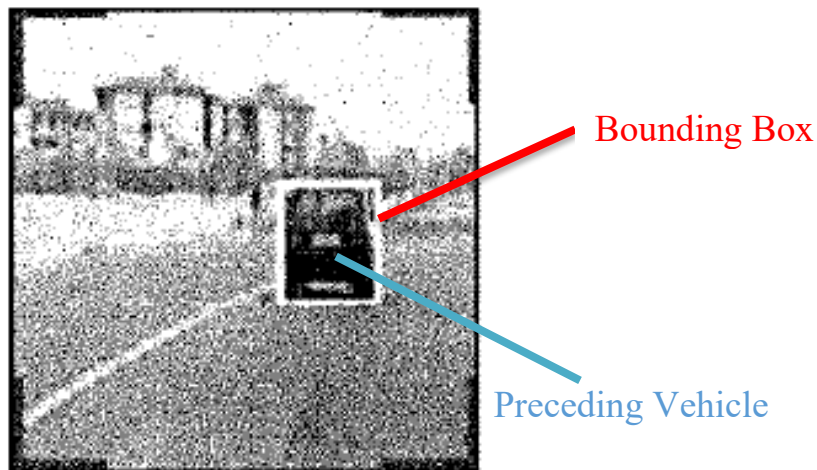
Broggi describes an “autonomous vehicle equipped with vision systems and automatic steering capability” that performs lane following and platooning, “the automatic following of a preceding vehicle.” Ex.1005, 164-165. Broggi provides an example of its motor vehicle and corresponding equipment, including cameras, speakers, and a monitor, in Figure 1:

¹ While the lead author of Ex.1008 is the same as Ex.1005 (Alberto Broggi), Petitioner refers to Ex.1008 by the second-named author (Massimo Bertozzi) to distinguish from Ex.1005.



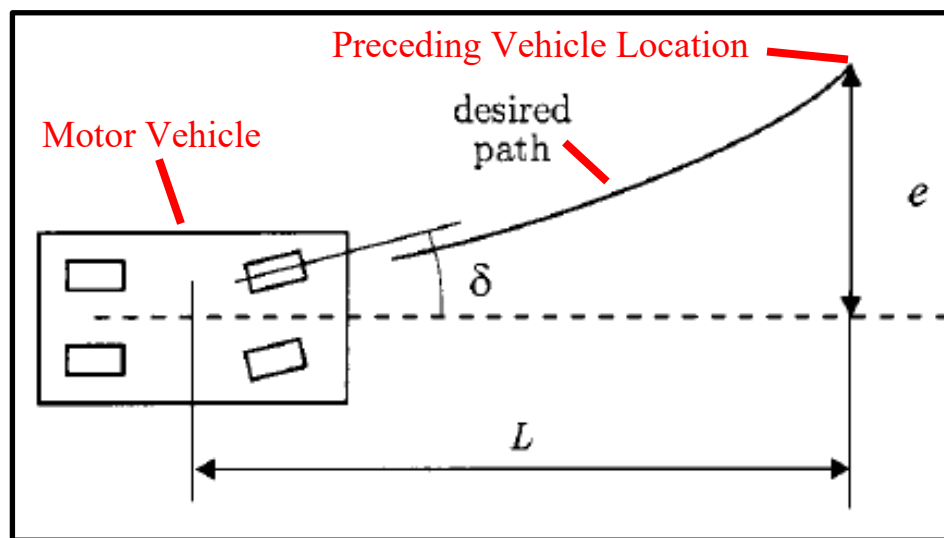
Ex.1005, Fig. 1.

Broggi's motor vehicle uses obtained images to localize and track objects Ex.1005, 164. For example, during platooning, Broggi analyzes "a specific region of the image" to detect a preceding vehicle. Ex.1005, 170. A "traditional pattern matching technique" is used to detect a bounding box of the preceding vehicles by (1) determining "two corners representing the bottom of the bounding box around the vehicle," and (2) detecting "the top part of the bounding box, which is looked for in a specific region whose location is again determined by perspective and size constraints." Ex.1005, 170-171.



Ex.1005, Fig. 16 (annotated)

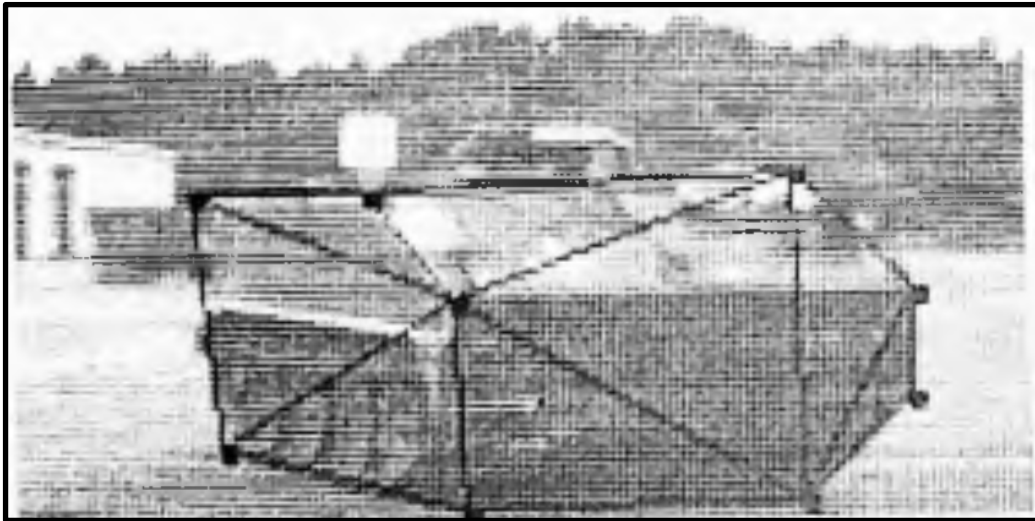
A desired path for the vehicle is then calculated based on the determined location of the preceding vehicle, as reflected in Figure 21:



Ex.1005, Fig. 21 (annotated)

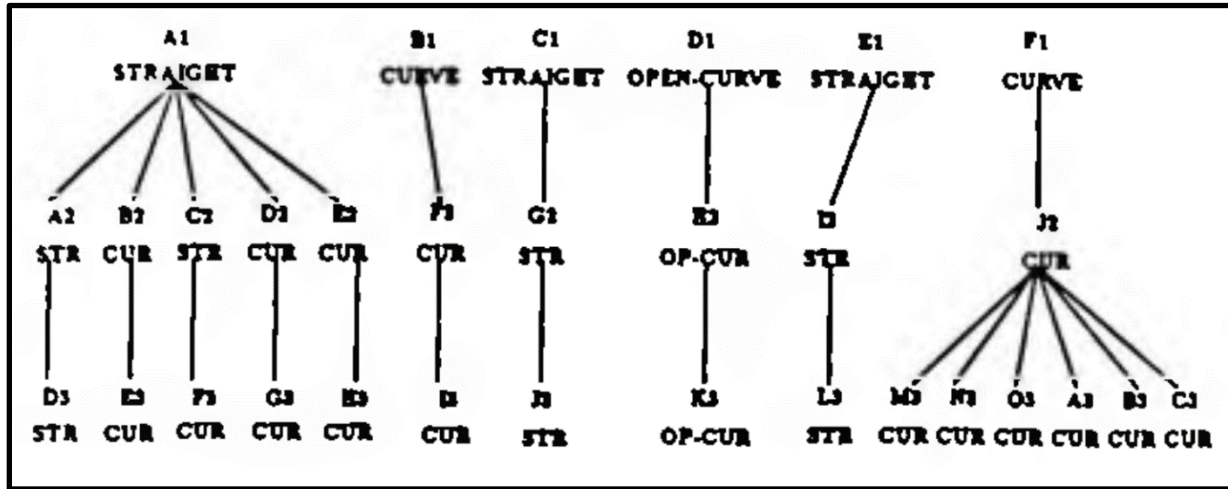
2. Huttenlocher

Huttenlocher describes a pattern matching technique for identifying an object—e.g., a preceding vehicle (reflected in Figure 11)—in an image that “uses edge-based shape features for matching.” Ex.1006, 373.



Ex.1006, Fig. 11 (in part)

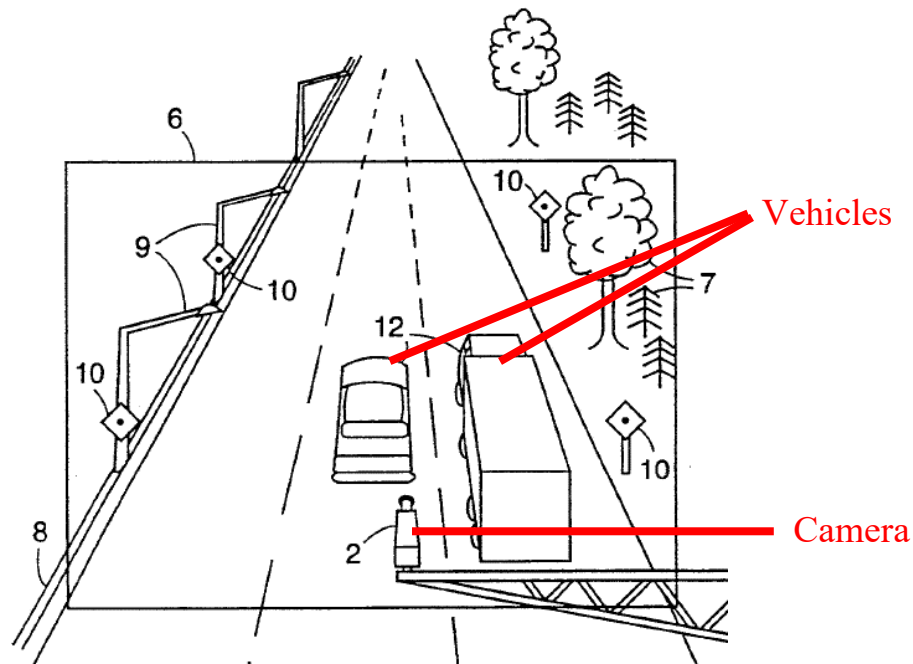
After using an edge detector on an image, the edges are segmented and edge segments are stored in a hierarchical tree structure. Ex.1006, 373. The hierarchical segmentations “form a (multi-rooted) tree, where each region at a coarse scale corresponds to one or more regions at each finer scale,” shown in Figure 4. Ex.1006, 373.



Ex.1006, Fig. 4

3. Brady

Brady describes a method for identifying and tracking vehicles in a roadway scene in real-time, as reflected in Figure 1. Ex.1007, 3:59-62.



Ex.1007, Fig. 1 (in part, annotated)

Brady stores identified vehicles and corresponding positional data in an object list to aid in tracking. Ex.1007, 11:21-25. For example, Brady keeps “a vehicle log 102 of all vehicles currently within the scene, including vehicles’ associated track histories, inertial history 104 of the scene...and potential future track positions....” Ex.1007, 11:21-25.

4. Reasons to Combine Broggi-Huttenlocher-Brady

a) Analogous Art

Broggi, Huttenlocher, and Brady are analogous art to the '805 patent. Broggi pertains to the same field of endeavor as the '805 patent: image processing and the detection of objects (e.g., vehicles) in images, including image processing in the

context of vehicle guidance. Ex.1001, 1:6-9; Ex.1005, 164 (Broggi presents “methods for sensing obstacles and vehicles”), 165, 166 (system functionalities include “automatic following of the preceding vehicle, that requires the localization and tracking of a target vehicle”), 170-172 (describing vehicle detection). Broggi is reasonably pertinent to a particular problem addressed by the ’805 patent, namely, path calculation to a destination based on image analysis. Ex.1001, 3:13-22, 30-33; Ex.1005, 173-175, Fig. 21. Accordingly, Broggi is analogous art to the ’805 patent. Ex.1003, ¶56.

Huttenlocher is analogous art in the same field of endeavor as the ’805 patent: image processing and the detection of objects (e.g., vehicles) in images. Ex.1006, 375, Figs. 2, 11 (image detection of a “personnel carrier”). Huttenlocher is reasonably pertinent to particular problems addressed by the ’805 patent, namely, object detection through image analysis and associated data processing/storage. Ex.1001, 2:32-41; Ex.1006, 373 (“image is processed by an edge detector,” “[a] hierarchy of curve segmentations can be obtained,” “the hierarchy forms a tree of segments”), 374 (“[p]oints for use by the alignment algorithm are obtained from the features” based on the types of segments stored in the multi-scale segmentation tree). Accordingly, Huttenlocher is analogous art to the ’805 patent. Ex.1003, ¶57.

Brady is analogous art in the same field of endeavor as the '805 patent: image processing and the detection of objects (e.g., vehicles) in images, including image processing to identify and “track objects within the roadway scene, such as a vehicle[.]” Ex.1007, abstract. Brady is reasonably pertinent to a particular problem addressed by the '805 patent, namely, vehicle detection through image analysis and storing related information. Ex.1001, 2:48-52; Ex.1007, 11:21-25 (“keeping a vehicle log 102 of all vehicles currently within the scene, including vehicles’ associated track histories, inertial history 104 of the scene...and potential future track positions”). Accordingly, Brady is analogous art to the '805 patent. Ex.1003, ¶58.

b) Broggi-Huttenlocher

A POSITA would have been motivated to implement Huttenlocher’s pattern matching technique utilized for object recognition as part of Broggi’s vehicle detection methods because doing so would have been the combination of prior art elements (Broggi’s vehicle detection using a “traditional pattern matching technique” and Huttenlocher’s known pattern matching technique) according to known methods to yield predictable results (using Huttenlocher’s known pattern matching technique as Broggi’s “traditional pattern matching technique” for vehicle detection). *KSR Int’l v. Teleflex Inc.*, 550 U.S. 398, 416 (2007); Ex.1003, ¶59.

Further, a POSITA would have been motivated to make the combination because Broggi contains an explicit teaching, suggestion, or motivation (calling for use of a “traditional pattern matching technique”) that would have led a POSITA to modify Broggi to implement Huttenlocher’s known pattern matching technique. Ex.1003, ¶60.

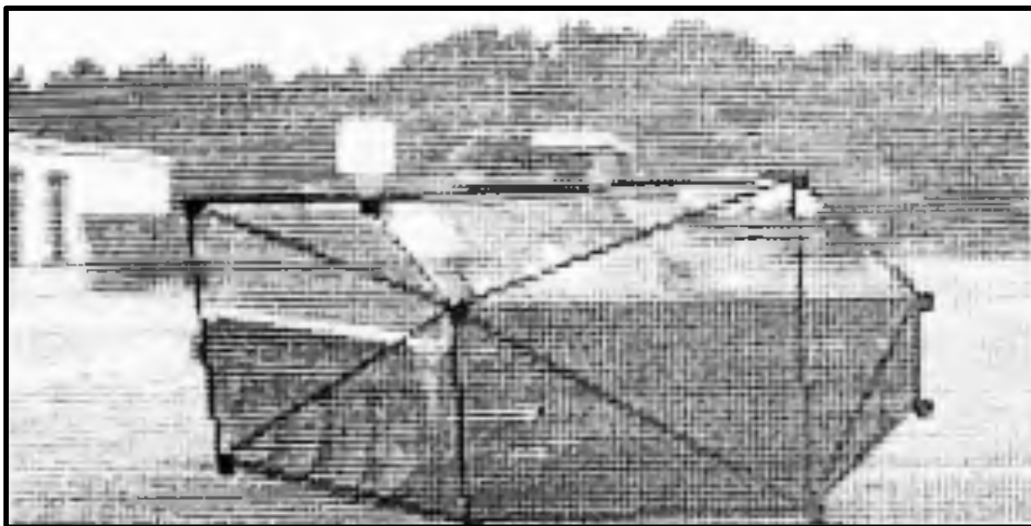
In the combination, Broggi implements Huttenlocher’s pattern matching technique—that segments edges, stores edge segments in a multi-scale tree, and analyzes the edge segments—as part of detecting the location of a preceding vehicle. Ex.1003, ¶62. Huttenlocher’s pattern matching technique would be applied to the images obtained by Broggi to identify “possibly matching features” corresponding to the bottom corners and/or top of the preceding vehicle. *See* Ex.1005, 170-171; Ex.1006, 370, 373-374; *infra* [1.4.1]-[1.4.3]; Ex.1003, ¶62. For example, the image data may be processed to detect edges (in accordance with Broggi and/or Huttenlocher)² and Huttenlocher’s pattern matching technique

² Both Broggi and Huttenlocher disclose detecting edges in images. Ex.1005, 171; Ex.1006, 373-374; Ex.1003, ¶61. As explained by Dr. Rodriguez, it would have been obvious to a POSITA that the Broggi-Huttenlocher combination would implement Broggi’s edge detection, Huttenlocher’s edge detection, or both Broggi’s edge detection and Huttenlocher’s edge detection. Ex.1003, ¶61. In this

would be applied to segment the edges, store edge segments in a multi-scale tree, and analyze the edge segments to detect the bottom corners and/or the top of the preceding vehicle. A POSITA would have understood, based on Broggi's description, that Huttenlocher's pattern matching technique may be utilized for detecting the bottom corners, the top, or both the bottom corners and the top of the preceding vehicle. Ex.1005, 170-171; Ex.1003, ¶62. Once the preceding vehicle is identified and a corresponding location is determined, Broggi automatically follows the preceding vehicle by calculating a steering angle for a desired path to the location of the preceding vehicle and controls the steering of the vehicle accordingly. *See infra* [1.3], [9.0]; Ex.1003, ¶62. Implementing Huttenlocher's pattern matching technique would provide advantages for Broggi, including improved vehicle detection and efficient use of processing resources. Ex.1006, 379 ("alignment can be performed with a small amount of information"); Ex.1003, ¶62.

regard, using either Broggi's edge detection or Huttenlocher's edge detection would have been the simple substitution of one known element (Broggi's or Huttenlocher's edge detection) for another (the other of Huttenlocher's or Broggi's edge detection). Ex.1003, ¶61. Further, using both Broggi's and Huttenlocher's edge detection would be the combination of familiar elements according to known methods to yield predictable results. Ex.1003, ¶61.

A POSITA would have had a reasonable expectation of success in using Huttenlocher's pattern matching technique as Broggi's "traditional pattern matching technique" for vehicle detection because Huttenlocher provides an explicit example of using its disclosed pattern matching technique to detect a vehicle. Ex.1005, 171; Ex.1006, 375, Figs. 2, 11 (showing a "personnel carrier used in recognition," and the "[l]ocal alignment of two views of a personnel carrier."); Ex.1003, ¶63.



Ex.1006, Fig. 11 (in part)

c) Broggi-Huttenlocher-Brady

A POSITA would have been motivated to modify the combined Broggi-Huttenlocher method discussed above to implement Brady's teaching of keeping an object list containing identified vehicle(s) with corresponding positional data (a vehicle log) because doing so would have been the combination of prior art

elements (platooning, per Broggi-Huttenlocher, with Brady’s teaching of keeping a vehicle log) according to known methods to yield predictable results (platooning, per Broggi-Huttenlocher, using a vehicle log to keep track of a preceding vehicle and associated position information). *KSR*, 550 U.S. at 416; Ex.1003, ¶64.

Broggi provides “an experimental autonomous vehicle equipped with vision systems and automatic steering capability” for lane following and platooning, including a processing system “based on a standard 450 MHz Pentium II processor.” Ex.1005, 165. Despite Broggi’s focus on vehicle detection and tracking for platooning, Broggi omits implementation details how the associated data is processed and stored. Ex.1005, 170-172, 173 (noting that the described system “is able to continuously capture images into a circular buffer in main memory, therefore, not requiring a synchronization with the processing”); Ex.1003, ¶65.

Brady provides such implementation details in the same context of “classifying and tracking vehicles” captured “in real-time[.]” Ex.1007, 3:59-62, 11:21-25; *see* Ex.1005, 172 (discussing “tracking an already found” vehicle). In the combination, Broggi stores information regarding a preceding vehicle—identified using Broggi-Huttenlocher—in a vehicle log, per Brady. Ex.1007, 11:21-25. Consistent with the disclosures of Broggi and Brady, the vehicle log would include an object list identifying the preceding vehicle and associated positional information. Ex.1003, ¶66. Specifically, the positional information associated with

the preceding vehicle included in the object list would include a relative location of the preceding vehicle and an associated distance, in accordance with Broggi's platooning method. Ex.1007, 11:21-25 (a vehicle log includes "including vehicles' associated track histories, inertial history 104 of the scene...and potential future track positions"). *See infra* [1.4.4]; Ex.1005, 170 ("[T]he [preceding] vehicle is localized and tracked using a single monocular image sequence; the correct distance is refined thanks to stereo vision."); Ex.1003, ¶66. Broggi's method would reference and update the object list over time (updating the positional information to reflect the current location of the preceding vehicle and/or keep a log of past locations) to perform the functions associated with platooning, including determining a desired path and associated steering angle. Ex.1005, 173, Fig. 21; Ex.1003, ¶66.

A POSITA would have looked at Brady's teachings because they would have advantageously provided a known mechanism for tracking vehicle positions over time, which would improve Broggi's platooning through accurate and consistent tracking of the preceding vehicle positions used in the associated vehicle path determinations, thereby improving the user experience during platooning. Ex.1007, 11:21-25; Ex.1003, ¶67.

A POSITA would have had a reasonable expectation of success in combining Brady's object list with the Broggi-Huttenlocher combination because

Brady discloses that such an object list may be used in the context of identifying and tracking vehicles in real-time, as performed in the Broggi-Huttenlocher combination. Ex.1007, 11:21-25, 1:8-11 (“tracking objects in images provided by real-time video”); Ex.1005, Fig. 19, Table I; Ex.1003, ¶68. Thus, Brady provides implementation details for maintaining and storing information for vehicle tracking suitable for use with Broggi’s platooning method. Ex.1003, ¶68. Accordingly, a POSITA would have had a reasonable expectation of success in implementing Brady’s vehicle log to track preceding vehicles and associated positional information as part of the combined Broggi-Huttenlocher method of platooning. Ex.1003, ¶68.

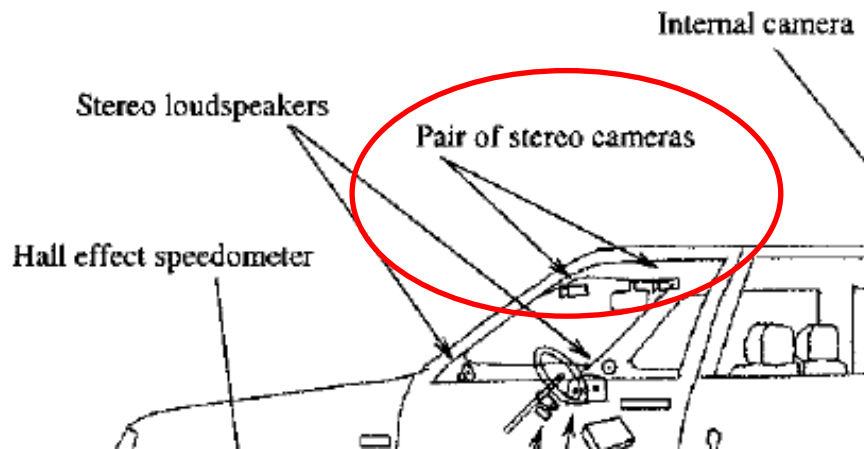
5. Claim 1.

[1.0] A method for assisting guidance of a motor vehicle on the basis of image data, the method comprising:

Broggi discloses or renders obvious [1.0] because Broggi discloses platooning, which provides assisted guidance and controls steering of a motor vehicle to follow a preceding vehicle based on captured image data. Ex.1003, ¶¶69-73.

First, Broggi discloses *a method for assisting guidance of a motor vehicle*. Broggi describes platooning, the “**automatic following of the preceding vehicle[.]**” Ex.1005, 166; Ex.1003, ¶70.

Second, Broggi's platooning is *on the basis of image data*. Broggi explains that "an autonomous vehicle must...**detect vehicles and potential obstacles** on its path in order to perform...[p]latooning." Ex.1005, 164. Broggi's detection of vehicles is performed using image data captured from cameras within the vehicle as reflected in Figure 1 of Broggi, showing an example of an "**autonomous vehicle equipped with vision systems** and automatic steering capability." Ex.1005, 165; Ex.1003, ¶71.



Ex.1005, Fig. 1 (in part, annotated)

Broggi explains "[v]ehicles are localized and tracked using a **single monocular image sequence** whilst a distance refinement is computed using **stereo vision**." Ex.1005, 164. "A mechanical device provides autonomous steering capabilities....The **output fed by the vision system is used to turn the steering**

wheel to maintain the vehicle inside the lane or **follow the leading vehicle.**”

Ex.1005, 166; Ex.1003, ¶72.

Thus, Broggi discloses or renders obvious *a method for assisting guidance of a motor vehicle* (controlling steering of a motor vehicle to follow a preceding vehicle) *on the basis of image data* (based on a monocular image sequence and/or stereo vision). Ex.1003, ¶¶69-73.

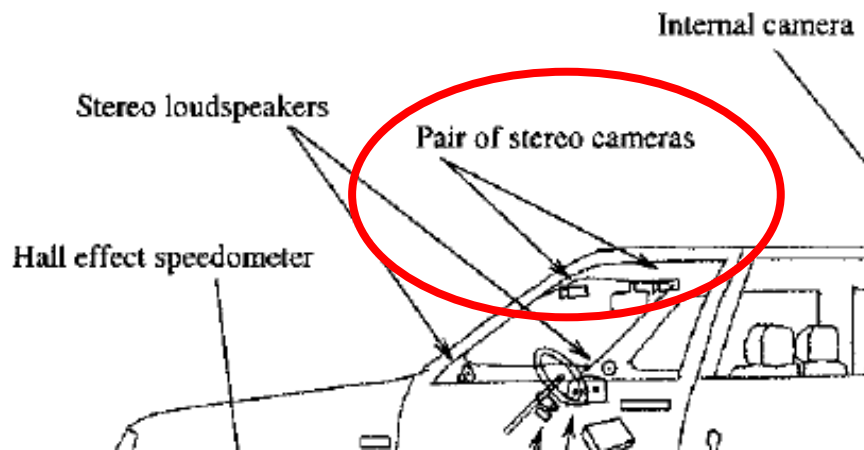
[1.1] acquired image data³ using an imaging sensor from a surrounding field of the motor vehicle;

Broggi discloses or renders obvious [1.1] because Broggi discloses image data is captured using cameras mounted within the motor vehicle and captures the environment around a motor vehicle during platooning. Ex.1003, ¶¶74-82.

First, Broggi renders obvious *acquir[ing] image data using an imaging sensor* by disclosing acquiring image data using cameras within a motor vehicle. Ex.1005, 165, Fig. 1 (showing an “autonomous vehicle equipped with vision systems and automatic steering capability” that includes a pair of stereo cameras for capturing a monocular image sequence and/or stereo vision); Ex.1003, ¶75.

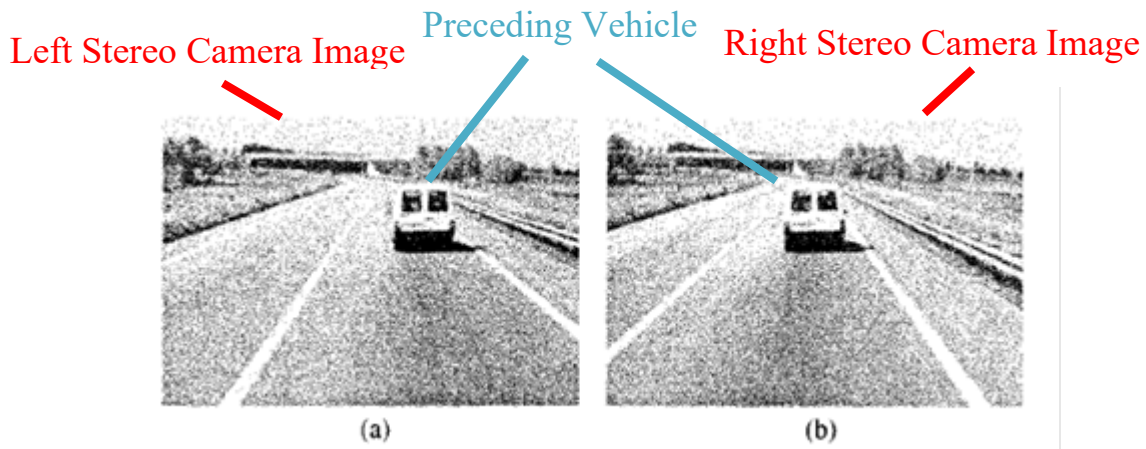
³ Notwithstanding §112 issues, Petitioner interprets “acquired” as “acquiring” for purposes of this Petition. Ex.1003, ¶74. Petitioner reserves the right to raise §112 challenges in other forums.

Broggi's vehicle includes a "stereoscopic vision system consisting of two low-cost synchronized **cameras able to acquire pairs of grey level images** simultaneously." Ex.1005, 165. Consistent with the '805 patent, a POSITA would have understood that Broggi's cameras are an example of an imaging sensor, because such cameras contain a sensor. Ex.1001, 2:56-57, Fig. 2; Ex.1003, ¶¶75-76, 78-81.



Ex.1005, Fig. 1 (in part, annotated)

Second, Broggi renders obvious that the acquired image data is *from a surrounding field of the motor vehicle* because Broggi discloses that it captures images using "passive sensors...to **sense the surrounding environment.**" Ex.1005, 164-165, Fig. 2. The "surrounding environment" of Broggi is the same *surrounding field* claimed in the '805 patent. Ex.1003, ¶77.



Ex.1005, Fig 2 (annotated)

In view of the '805 patent specification, a POSITA would have understood “a surrounding field of the motor vehicle” to include an area outside the motor vehicle that may be captured by an imaging sensor/camera but does not require the entire surrounding field of the motor vehicle (360-degree view). This is because the '805 patent describes an image sensor aligned with the travel direction of a vehicle. Ex.1001, 7:15-22, Figs. 2-3. Thus, the '805 patent only captures the field in front of the motor vehicle (*i.e.*, less than a 360-degree view). Ex.1003, ¶¶78-81.

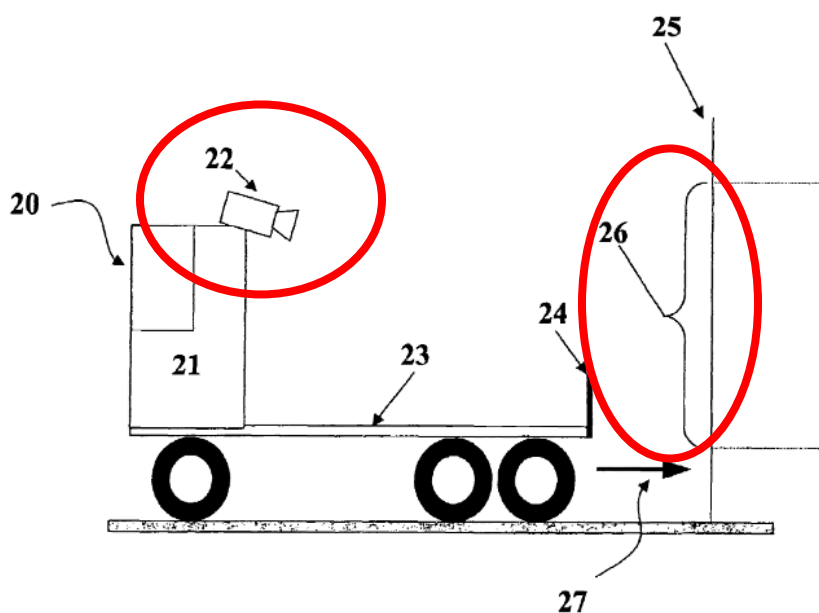
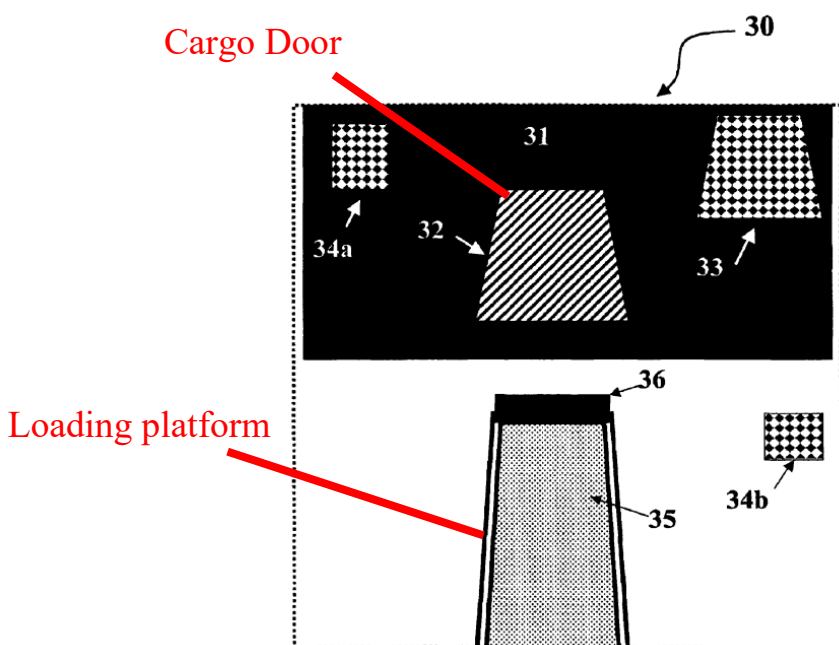


Figure 2

Ex.1001, Fig. 2 (annotated)



Ex.1001, Fig. 3 (annotated)

Thus, Broggi discloses or renders obvious *acquir[ing] image data* (acquiring image data using a monocular image sequence and/or stereo vision) *using an imaging sensor* (acquired using one and/or both of the stereo cameras) *from a surrounding field of the motor vehicle* (acquired images are from the surrounding environment of the motor vehicle, e.g., the surrounding field in front of the vehicle where a preceding vehicle of a platoon is positioned). Ex.1003, ¶¶74-82.

[1.2] extracting from the acquired image data positional parameters of at least one potential destination relative to the motor vehicle; and

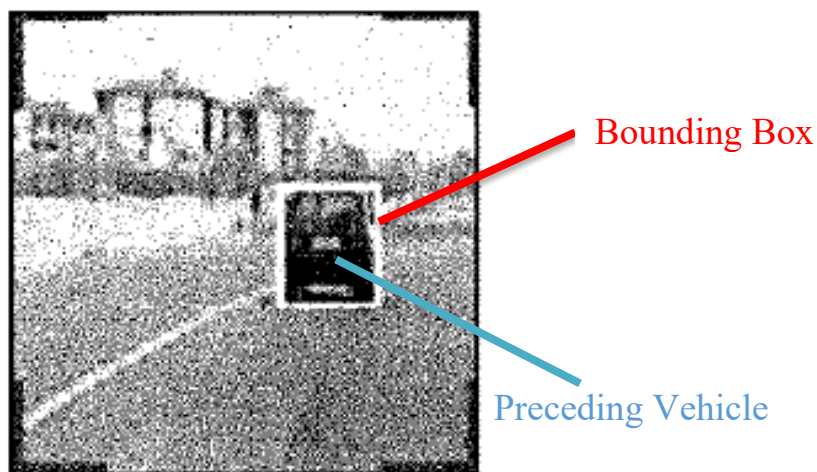
Broggi discloses or renders obvious [1.2] because Broggi renders obvious extracting a location of a preceding vehicle in a platoon from the image data. Ex.1003, ¶¶83-89. The location of the preceding vehicle represents a potential destination of the motor vehicle. Ex.1003, ¶83. Broggi describes that a bounding box defining a relative location of the preceding vehicle and an associated distance are extracted from images acquired using a monocular image sequence and/or stereo vision to determine the location of a preceding vehicle relative to the motor vehicle. Ex.1003, ¶83.

As discussed in [1.1], Broggi acquires images using a monocular image sequence and/or stereo vision that are used in platooning, including “estimat[ing the] position of the preceding vehicle.” Ex.1005, 164-165; Ex.1003, ¶84. Broggi explains that the motor vehicle “determine[s] its position with respect to the lane,

to compute road geometry, to detect generic obstacles on the path, and **to localize a leading vehicle**” using images acquired by the vehicle’s cameras. Ex.1005, 165; Ex.1003, ¶84.

First, Broggi *extract[s]...positional parameters [from the acquired image data]* by extracting a relative location and associated distance of the preceding vehicle from the acquired image data as part of platooning. Ex.1005, 170 (“[T]he [preceding] vehicle is localized and tracked using a single monocular image sequence; the correct distance is refined thanks to stereo vision.”)⁴; Ex.1003, ¶85. This extraction is performed on image data through the analysis of “a specific region of the image” acquired using a monocular image sequence and/or stereo vision. Ex.1005, 170, 171 (describing “the search area” for each image). The relative location of the preceding vehicle is represented by a bounding box. Ex.1005, 171. An example of a bounding box and corresponding preceding vehicle is shown in Fig. 16, while an example of the distance refinement is shown in Fig. 17. Ex.1005, 172; Ex.1003, ¶85.

⁴ Broggi’s teaching is similar in scope to the ’805 patent, which describes relative position data, not precise coordinates. Ex.1001, 3:13-22 (describing “**relative positional data**”), 6:8-13 (“object...whose position relative to the imaging sensor is known”); Ex.1003, ¶85.



Ex.1005, Fig. 16 (annotated)



Fig. 17. Distance refinement: (a) left and right stereo images; (b) incorrect result of the detection step (the lower part of the bounding box indicates a wrong distance); (c) superimposition of stereo images with a null offset; and (d) superimposition of correctly shifted stereo images.

Ex.1005, Fig. 17

The location of the bounding box within the image (defining a relative location of the preceding vehicle) is used to compute the distance to the preceding vehicle relative to the vehicle. Ex.1005, 172 (“the offset of the bounding boxes containing the vehicle, measured in both images, is used to compute the vehicle distance.”); Ex.1003, ¶¶85-87. Accordingly, Broggi renders obvious *extracting from the acquired image data positional parameters* including (1) the location of the preceding vehicle relative to the motor vehicle, as identified by the bounding box; and (2) the distance to the preceding vehicle. Ex.1003, ¶¶85-87.

Second, the location of a preceding vehicle is a *potential destination relative to the motor vehicle* because “[w]hen the [p]latooning functionality is activated, the target point is centered on the preceding vehicle[.]” Ex.1005, 174; Ex.1003, ¶88. Thus, the extracted positional parameters (location and distance) of the preceding vehicle represent at least one potential destination relative to the following motor vehicle. The *potential destination* being an object—e.g., a preceding vehicle—is consistent with how the ’805 patent uses the term “destination,” referring to a destination as an object (e.g., cargo door of a dock). Ex.1001, 7:25-31, 7:50; Ex.1003, ¶88.

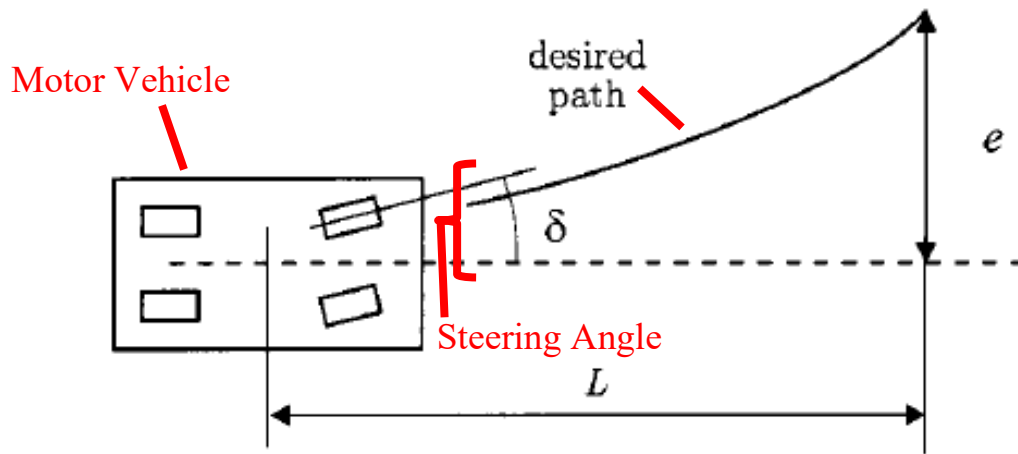
Thus, Broggi discloses or renders obvious *extracting from the acquired image data positional parameters* (a bounding box defining a relative location of the preceding vehicle and an associated distance are extracted from images

acquired using a monocular image sequence and/or stereo vision) of *at least one potential destination relative to the motor vehicle* (location of the preceding vehicle relative to the motor vehicle). Ex.1003, ¶¶83-89.

[1.3] calculating at least one trajectory describing an optimized travel path using the positional parameters so as to assist a subsequent vehicle guidance for one of the potential destinations,

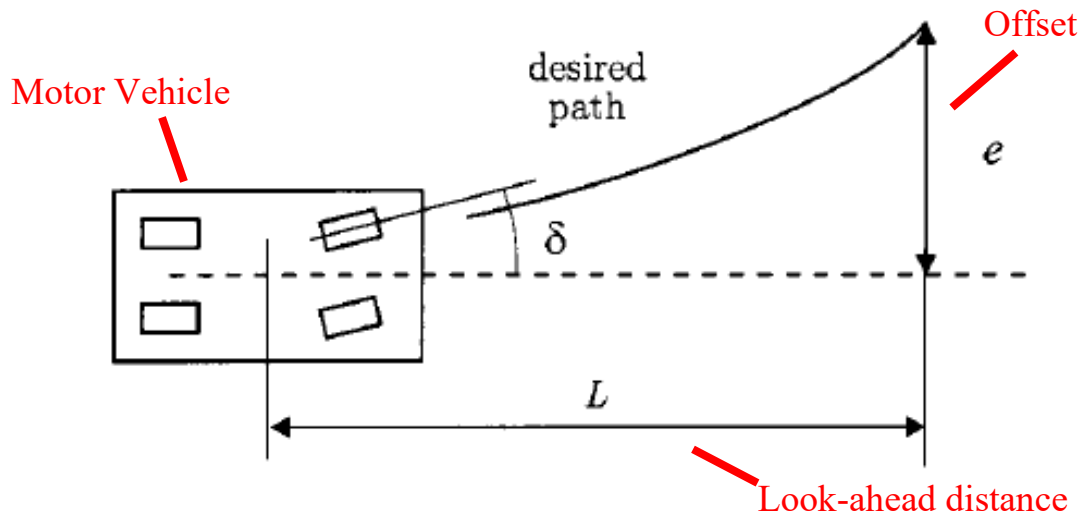
Broggi discloses or renders obvious [1.3] because Broggi discloses calculating a steering angle for a desired path using the relative location and associated distance of the preceding vehicle to control steering of a motor vehicle during platooning to guide the motor vehicle to the location of the preceding vehicle. Ex.1003, ¶¶90-101.

First, Broggi discloses *calculating at least one trajectory describing an optimized travel path* by calculating a steering angle δ for a desired path as shown in Figure 21. Ex.1003, ¶91.



Ex.1005, Fig. 21 (annotated)

Figure 21 shows a steering angle δ representing an angle to the left of a forward path for the motor vehicle, which corresponds to the direction of the desired path from the current vehicle heading of the motor vehicle. Ex.1005, Fig. 21, 173; Ex.1003, ¶92. The steering angle is a *trajectory* describing the desired path because the steering angle defines the direction the vehicle will follow along the desired path from the current position. Ex.1005, Fig. 21, 173; Ex.1003, ¶92. The desired path extends from the current position of the motor vehicle to the target point, which “is centered on the preceding vehicle” during platooning. Ex.1005, Fig. 21, 173-174. The target point is ahead of the motor vehicle by a “look-ahead distance L ” and an “offset e existing between the vehicle heading and the desired path[.]” Ex.1005, Figs. 21-22, 173-174; Ex.1003, ¶92.



Ex.1005, Fig. 21 (annotated)

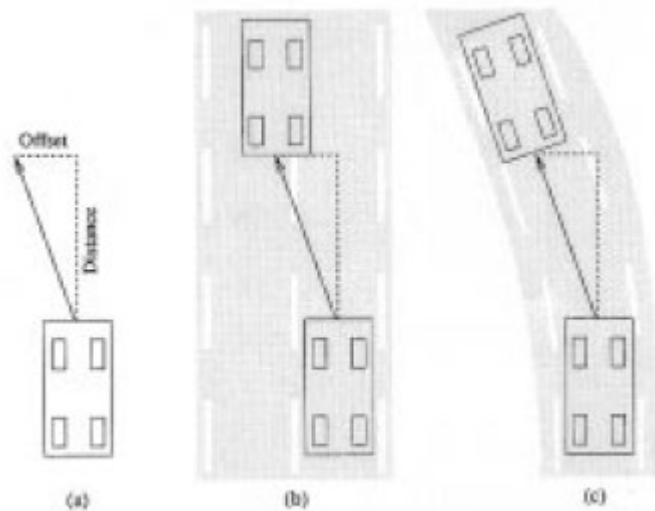


Fig. 22. Evaluation of the proper error signal for a Platooning application.

Ex.1005, Fig. 22

Second, Broggi's desired path is an *optimized travel path* because it is optimized for "**automatically follow[ing]** the vehicle ahead" as part of the described platooning functionality. Ex.1005, 175, Figs. 21-22; Ex.1003, ¶93.

Broggi's desired path is also optimized because it provides a path reachable in view of the vehicle's capabilities, which is consistent with the '805 patent rejecting destinations that are unreachable based on the capability of the vehicle when calculating the trajectory describing an optimized path. Ex.1001, 6:35-39, claims 6-7; Ex.1005, 173 (citing Ex.1008); Ex.1008, 171 (ARGO control system considers vehicle capability in steering wheel movements); Ex.1003, ¶93. The '805 patent does not define "optimized travel path," nor limit an "optimized travel path" to a singular, best path or trajectory. *See* Ex.1001, 2:48-52, 3:62-63; Ex.1003, ¶94.

Third, Broggi discloses the steering angle (*at least one trajectory*) for the desired path is *calculat[ed]...using the positional parameters*, including the relative location and associated distance of the preceding vehicle extracted from the acquired image data. Ex.1003, ¶95.

As described in [1.2], Broggi extracts *positional parameters* by extracting a relative location and associated distance of the preceding vehicle from the acquired image data as part of platooning. Ex.1005, 170-172. The steering angle is *calculat[ed]* through the control scheme shown in Figure 20, that relies upon the relative location and associated distance of the preceding vehicle determined from the preceding vehicle detection process, which is part of the vision data processing. *See* Ex.1005, Figs. 19-20, Table I; Ex.1003, ¶¶96-97.

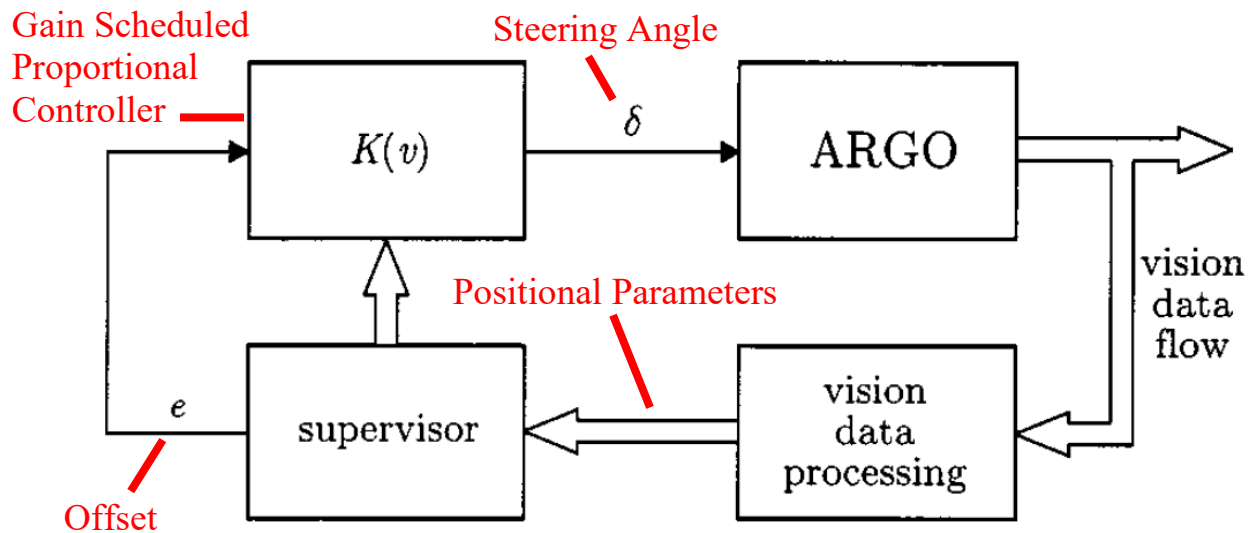


Fig. 20. Control scheme with the gain scheduled proportional controller.

Ex.1005, Fig. 20 (annotated)

Broggi explains that “[t]he command steering angle δ is obtained with a variable gain proportional controller,” and “[t]he steering control for the [p]latooning functionality is based on a gain scheduled proportional controller whose error input is **evaluated using the estimated position of the preceding vehicle.**” Ex.1005, 173, 164-165. The relative location and/or distance of the preceding vehicle is utilized by the supervisor and gain scheduled proportional controller to select and output the appropriate steering angle for the desired path to the motor vehicle. Ex.1005, Fig. 20, Abstract (explaining that Broggi’s methods are implemented on an experimental vehicle “ARGO”); Ex.1003, ¶¶97-99.

Fourth, Broggi's steering angle and corresponding desired path are used *to assist a subsequent vehicle guidance for one of the potential destinations*. When performing the platooning functionality, Broggi's motor vehicle is automatically steered to follow the preceding vehicle. Ex.1005, 164; Ex.1003, ¶100. As discussed in [1.2], the location of the preceding vehicle is *at least one potential destination* of Broggi's vehicle because during platooning, "the target point is centered on the preceding vehicle," and a desired path extends from the motor vehicle to the target point. Ex.1005, 174-175, Fig. 21; Ex.1003, ¶100. The steering angle and corresponding desired path *assist[s] a subsequent vehicle guidance for one of the potential destinations* by assisting guidance of the vehicle to automatically follow the preceding vehicle. Ex.1005, 164-165; Ex.1003, ¶100.

Thus, Broggi discloses or renders obvious *calculating at least one trajectory describing an optimized travel path using the positional parameters* (calculating a steering angle describing a desired path using the relative location and associated distance of the preceding vehicle) *so as to assist a subsequent vehicle guidance for one of the potential destinations* (the steering angle is used for controlling steering of a motor vehicle during platooning to the location of the preceding vehicle). Ex.1003, ¶¶90-101.

[1.4.0] wherein the extracting includes: performing an edge detection and edge segmentation on the image data so as to break down the image data into a plurality of edge segments and storing interrelationships of the plurality of edge segments in a mathematical tree structure;

Broggi in view of Huttenlocher renders obvious [1.4.0] because Broggi and Huttenlocher both disclose performing edge detection. Huttenlocher further details segmenting edges into a plurality of edge segments and storing the edge segments in a multi-scale mathematical tree structure that indicates the interrelationships between the edge segments based on granularity. Ex.1003, ¶¶102-109.

As discussed in [1.2], Broggi performs bounding box detection by (1) determining “two corners representing the bottom of the bounding box around the vehicle” and (2) detecting “the top part of the bounding box, which is looked for in a specific region whose location is again determined by perspective and size constraints.” Ex.1005, 171. Determining this bounding box in Broggi includes *performing an edge detection* by extracting edges from the images acquired using a monocular image sequence and/or stereo vision. Ex.1005, 171 (“**vertical and horizontal edges are extracted** and thresholded, and symmetries are computed in these domains as well.”); Ex.1003, ¶103.

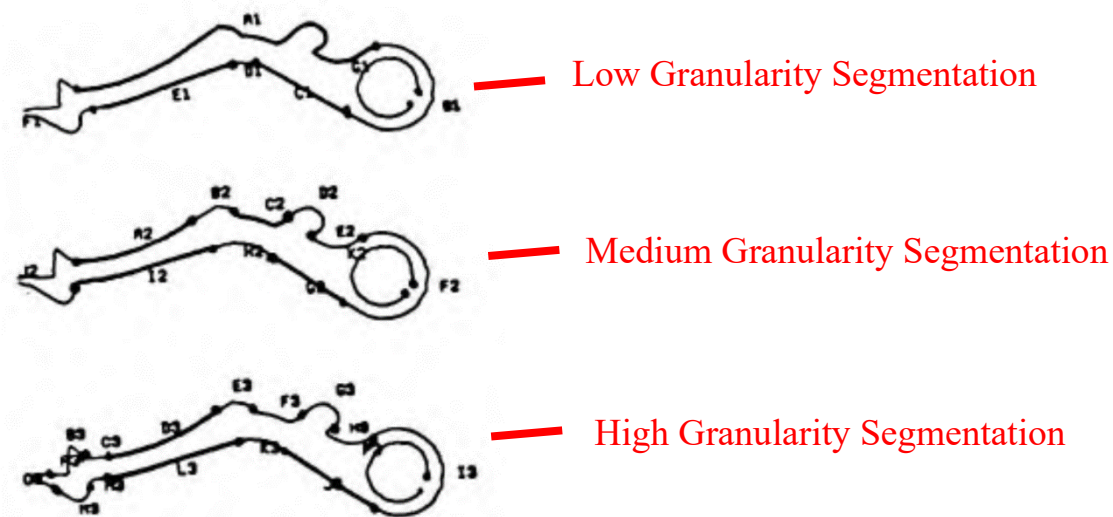
For the vehicle bounding box detection, Broggi explains that a “traditional pattern matching technique is used,” but to the extent [1.4.0] is not explicitly taught, it would have been obvious to combine Broggi’s teachings with

Huttenlocher. Ex.1005, 171; Ex.1003, ¶104; *see* VIII.C.4.b. In the combination, Broggi implements Huttenlocher’s known pattern matching technique—that segments edges, stores edge segments in a multi-scale tree, and analyzes the edge segments—as part of detecting the location of a preceding vehicle. Ex.1003, ¶104. In the combination, Huttenlocher renders obvious an image analysis matching technique that includes *performing an edge detection and edge segmentation on the image data so as to break down the image data into a plurality of edge segments* (detecting and segmenting edge contours) *and storing interrelationships of the plurality of edge segments in a mathematical tree structure* (storing interrelationships of the plurality of edge segments in a multi-scale mathematical tree structure). Ex.1003, ¶104.

Huttenlocher discloses an image analysis pattern matching technique that includes *performing an edge detection...on the image data* by using an edge detector on an input image. Ex.1006, 373 (describing an object recognition system that “uses edge-based shape features,” where an image “is processed by an edge detector[.]”); Ex.1003, ¶104. In the combination, Broggi acquires images using a monocular image sequence and/or stereo vision, which are processed using

Huttenlocher's known pattern matching technique, which includes performing edge detection.⁵ Ex.1003, ¶104.

Huttenlocher also discloses an image analysis pattern matching technique that includes *performing...edge segmentation on the image data so as to break down the image data into a plurality of edge segments*. Ex.1006, 373; Ex.1003, ¶105. Figure 3 shows an example of “a three-level scale-space curvature segmentation of the edge contours” of a widget as an example of edge segmentation. Ex.1006, 373.

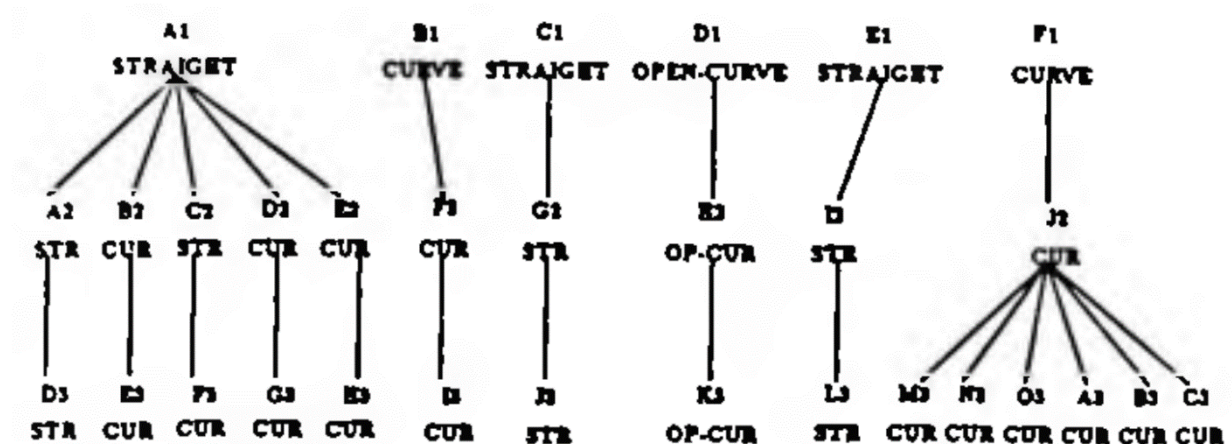


Ex.1006, Fig. 3 (annotated)

⁵ As discussed in VIII.C.4.b., the combination may utilize Broggi's edge detection, Huttenlocher's edge detection, or both Broggi's edge detection and Huttenlocher's edge detection. Ex.1003, ¶104.

In the combination, the images (acquired using Broggi's monocular image sequence and/or stereo vision) are processed using Huttenlocher's known pattern matching technique, which includes performing edge segmentation to break down the image data into a plurality of edge segments. Ex.1003, ¶106.

Huttenlocher also discloses *storing interrelationships of the plurality of edge segments in a mathematical tree structure* by storing the plurality of edge segments in a multi-scale mathematical tree structure based on granularity. Ex.1003, ¶107. Huttenlocher explains that the segmentations (e.g., the three levels of segmentations in Fig. 3) “form a (multi-rooted) tree, where each region at a coarse scale corresponds to one or more regions at each finer scale. Figure 4 shows this scale-space segment tree.” Ex.1006, 373-374, Figs. 3-4; Ex.1003, ¶107.



Ex.1006, Fig. 4

As shown, the tree of Fig. 4 stores the *interrelationships of the plurality of edge segments* based on granularity and relative position. Ex.1003, ¶107. Each level of granularity shown in Fig. 3 corresponds to a new layer in the tree shown in Fig. 4, with the lowest level of granularity at the top of the tree and each finer level of granularity corresponding to the next layer. Ex.1006, 374, Figs. 3-4; Ex.1003, ¶107.

As Dr. Rodriguez explains, Huttenlocher's multi-scale segmentation tree, as reflected in Figure 4, is a *mathematical tree structure* because it includes the typical features of a mathematical tree structure, including nodes with defined relations including branching from one node to multiple nodes and multiple levels of relations (i.e., a root node with children nodes, and those children nodes potentially having one or more additional children nodes). Ex.1003, ¶108 (citing Ex.1006, Figs. 3-4). This is in line with the description of a *mathematical tree structure* in the specification of the '805 Patent, which explains that “[m]any different proven methods for creating and organizing such a hierarchical tree structure are available to one skilled in the art[.]” Ex.1001, 4:45-51. Like the '805 Patent, in which “the edges and segments [are] stored in parameters in the branches of the hierarchical tree” (Ex.1001, 4:65-5:3), Huttenlocher similarly stores segments and parameters, such as “its label” and “the type of segment” in each layer of branches. Ex.1006, 373-374, Figs. 3-4; Ex.1003, ¶108.

Thus, Broggi in view of Huttenlocher renders obvious *wherein the extracting includes performing an edge detection* (extracting edges, as taught by Broggi and/or Huttenlocher) *and edge segmentation on the image data so as to break down the image data into a plurality of edge segments* (segmenting edges, as detailed by Huttenlocher) *and storing interrelationships of the plurality of edge segments in a mathematical tree structure* (storing the plurality of edge segments in a multi-scale mathematical tree structure based on granularity and relative position). Ex.1003, ¶¶102-109.

[1.4.1] analyzing the plurality of edge segments for the presence of a geometric object associated with a geometrical form that may at least partially describe a potential destination so as to identify one or more potential geometric objects;

Broggi in view of Huttenlocher renders obvious [1.4.1] because Broggi discloses that pattern matching techniques, such as Huttenlocher's, would be used to identify the presence of a geometric object associated with a geometrical form (the bottom corners of a preceding vehicle) that at least partially describes a potential destination of the vehicle (the location of the preceding vehicle).

Ex.1003, ¶¶110-113. For example, as discussed in [1.2] and [1.4.0], Broggi performs bounding box detection by (1) determining “two corners representing the bottom of the bounding box around the vehicle” and (2) detecting “the top part of the bounding box, which is looked for in a specific region whose location is again determined by perspective and size constraints.” Ex.1005, 171. Accordingly,

Broggi analyzes the image data *for the presence of a geometric object* (bottom corners of a preceding vehicle) *associated with a geometrical form* (shape associated with bottom corners of a preceding vehicle) *that may at least partially describe a potential destination* (location of the preceding vehicle) *so as to identify one or more potential geometric objects* (potential bottom of the bounding box), but does not explicitly disclose that *a plurality of edge segments* are being analyzed for this purpose. Ex.1005, 171. Broggi explains that for vehicle bounding box detection, a “traditional pattern matching technique is used,” but does not provide details of the pattern matching techniques for implementation within its platooning functionality. Ex.1005, 171; Ex.1003, ¶110.

As discussed in VIII.C.4.b, it would have been obvious to combine Broggi and Huttenlocher. In the combination, Broggi implements Huttenlocher’s known pattern matching technique—that analyzes the edge segments for the presence of geometric objects—as part of detecting the location of a preceding vehicle. Huttenlocher describes at least two steps—coarse-scale alignment and fine-scale matching—for its known pattern matching technique. As described in detail below, in the combination, at least the coarse-scale alignment step of Huttenlocher’s pattern matching technique renders obvious [1.4.1], while the fine-scale matching step renders obvious [1.4.2]. Ex.1003, ¶111.

Huttenlocher renders obvious *analyzing the plurality of edge segments for the presence of a geometric object*. Huttenlocher explains that “coarse level descriptions are [] used to determine **which model features can potentially match** which image features. These possible matching features form the set of pairs, P , for the alignment algorithm.” Ex.1006, 374. That is, the coarse scale edge segments are analyzed to identify geometrical features in the image that “potentially match” with corresponding features of an object (bottom corners of a preceding vehicle in the combination with Broggi) to be detected. Ex.1006, 374; Ex.1003, ¶111. Huttenlocher explains that “[p]oints for use by the alignment algorithm are obtained from the features” based on the types of segments stored in the multi-scale segmentation tree (closed segments of contour and straight segments). Ex.1006, 374; Ex.1003, ¶111. Thus, in the combination, the coarse level alignment of Huttenlocher (based on analyzing the coarse scale edge segments of the tree structure) would be utilized to identify a “potential match” for the bottom corners of a preceding vehicle. Ex.1003, ¶111.

This is similar to the '805 patent, which looks for geometric shapes corresponding to the typical shapes found in a potential destination. Ex.1003, ¶112 (citing Ex.1001, 4:51-56, 3:39-43 and explaining that flexibility provided by Huttenlocher's pattern matching technique would be advantageous in vehicle detection given the varying degrees of vehicle designs).

Thus, Broggi in view of Huttenlocher renders obvious *analyzing the plurality of edge segments for the presence of a geometric object associated with a geometrical form that may at least partially describe a potential destination* (analyzing coarse level descriptions of edge segments for presence of a bottom corner of a preceding vehicle associated with a bottom corner of a model vehicle) *so as to identify one or more potential geometric objects* (identifying potential bottom corners of a preceding vehicle by identifying potentially matching image features). Ex.1003, ¶¶110-113.

[1.4.2] analyzing the one or more potential geometric objects for plausibility using a matching algorithm so as to identify one or more plausible objects;

Broggi in view of Huttenlocher renders obvious [1.4.2] because, as noted in [1.4.1], the fine-scale matching step of Huttenlocher’s matching technique renders obvious [1.4.2]. Ex.1003, ¶¶114-117.

The coarse scale alignment step is utilized by Huttenlocher to identify features of an image that are a “potential match” for the bottom corners of a preceding vehicle. Then, for **“scoring how well an alignment matches an image, fine scale model features are used.”** Ex.1006, 374; Ex.1003, ¶115. That is, fine-scale matching is utilized to score how likely or plausible a “potential match” (from the coarse scale alignment) is to being an actual match or “plausible object.” Ex.1006, 374; Ex.1003, ¶115. When the score of Huttenlocher’s fine-scale

matching step indicates a “potential match” is a match for the bottom corners of a preceding vehicle, then the *potential geometric object* is identified as a *plausible object*. Ex.1003, ¶115. This is because, in accordance with Broggi, the *potential geometric object* and, therefore, the *plausible object*, are a match for a bottom corner of a model vehicle (bottom corner of a preceding vehicle), but not necessarily for the entire preceding vehicle or associated bounding box. See Ex.1005, 170 (discussing “the detection of the two bottom corners of a rectangular bounding box”), 171 (discussing that if “no correct bounding boxes exist,” then “a backtracking approach is used” where a different location is checked such that “a new search for a bounding box is performed”); Ex.1003, ¶115. Accordingly, the fine-scale matching step of Huttenlocher’s matching technique is *analyzing the one or more potential geometric for plausibility so as to identify one or more plausible objects*.

Further, the fine-scale matching step as well as using Huttenlocher’s matching technique more generally disclose *using a matching algorithm* as required by [1.4.2] because each follow a sequence of steps for matching patterns as commonly known in the art.. See Ex.1009, 20 (Microsoft Computer Dictionary defining algorithm as “[a] finite sequence of steps for solving a logical or mathematical problem”); Ex.1006, 372-373 (explaining how an alignment is scored); Ex.1003, ¶116.

Thus, Broggi in view of Huttenlocher renders obvious *analyzing the one or more potential geometric objects for plausibility using a matching algorithm* (scoring one or more geometric objects identified as a “potential match” (from Huttenlocher’s coarse scale alignment step) using Huttenlocher’s fine-scale matching step) *so as to identify one or more plausible objects* (identifying the bottom corners of a possible preceding vehicle). Ex.1003, ¶¶114-117.

[1.4.3] performing an additional acceptance analysis so as to identify at least one accepted object, the additional acceptance analysis including analyzing a shape of the image formation of each object in the image data⁶ based on knowledge of at least one imaging property of the imaging sensor relative to the surrounding field; and

Broggi alone or in view of Huttenlocher discloses or renders obvious [1.4.3] because Broggi renders obvious the detection of the top part of the bounding box and distance refinement to identify a preceding vehicle using perspective and size constraints and a known stereo camera set-up, and Huttenlocher discloses an alignment step that accounts for the distortions of shapes in the image formation. Ex.1003, ¶¶118-126.

First, Broggi’s detecting “**the top part of the bounding box**, which is looked for in a specific region whose location is again **determined by perspective**

⁶ For purposes of this Petition, “each object in the image data” is understood to include the claimed “one or more plausible objects.” See Ex.1003, ¶118.

and size constraints” renders obvious *performing an additional acceptance analysis so as to identify at least one accepted object...including analyzing a shape of the image formation of each object in the image data based on knowledge of at least one imaging property of the imaging sensor relative to the surrounding field*. Ex.1003, ¶119. Broggi describes after locating the bottom corners of a vehicle, the “process is followed by the detection of the top part of the bounding box[.]” Ex.1005, 171. This identification of the “top part of the bounding box” is *an additional acceptance analysis* because it is an additional analysis step of Broggi’s vehicle detection that confirms the relevant portion of the image includes the top of the preceding vehicle associated with the previously detected bottom corners, which completes the bounding box. *See* Ex.1005, 170; Ex.1003, ¶119.

Further, detecting the top part of the bounding box is an *acceptance analysis so as to identify at least one accepted object* because if the top of the bounding box/preceding vehicle is unable to be located then the plausible object (identified as corresponding to the bottom corners of a preceding vehicle as discussed in [1.4.1]-[1.4.2]) is not accepted. *See* Ex.1005, 171-172; Ex.1003, ¶120. For instance, Broggi explains that if “no correct bounding boxes exist,” then “a backtracking approach is used” where a different location is checked. Ex.1005, 171 (“a new search for a bounding box is performed”). On the other hand, if the top

part of the vehicle is identified, then this completes the bounding box for the preceding vehicle. *See* Ex.1005, 1725, Fig. 16; Ex.1003, ¶120.

Further, detecting the top part of the bounding box includes *analyzing a shape of the image formation of each object in the image data based on knowledge of at least one imaging property of the imaging sensor relative to the surrounding field* because the top of the bounding box is “looked for in a specific region whose location is again **determined by perspective and size constraints.**” Ex.1005, 171, 172 (describing the “Distance Refinement” step of the “Vehicle Detection Processing Steps”); Ex.1003, ¶121. Further, Broggi explains that, based on these perspective and size constraints, the search area is analyzed to identify a shape corresponding to the top of the vehicle by taking “into account knowledge about **the typical vehicles’ aspect ratio.**” Ex.1005, 172, Fig. 15; Ex.1003, ¶121. The ’805 patent describes an example *imaging property of the imaging sensor relative to the surrounding field* to include “knowledge of the camera position and camera imaging geometry” Ex.1001, 7:39-41 (“based on the knowledge of the camera position and camera imaging geometry, objects...would be eliminated...for acceptance analysis”); Ex.1003, ¶121. These are the same types of imaging properties Broggi is taking into account when Broggi describes considering the “perspective effect” of parameters such as “camera orientation, position, optics, etc.” Ex.1005, 166; Ex.1003, ¶121.

The final identification of the position of the preceding vehicle further includes determining a distance to the preceding vehicle. Ex.1005, 172; Ex.1003, ¶122. Broggi describes a first estimate of the distance based on the position of the bounding box with the understanding that “it may assume wrong values since it may happen that the lower part of the vehicle is not correctly detected.” Ex.1005, 172-173 (“the lower part of the bounding box indicates a wrong distance”). A distance refinement is performed to provide a more accurate distance utilizing “stereo-based techniques” using two cameras. Ex.1005, 172. Together, the detection of the top of the preceding vehicle and Broggi’s distance refinement renders obvious an *additional acceptance analysis* as they are being performed in addition to the detecting of the bottom corners of the preceding vehicle in detecting and determining a relative position of the preceding vehicle. Ex.1003, ¶122.

Further, Broggi’s distance refinement step—that is part of identifying the preceding vehicle and associated position—is also performed *based on knowledge of at least one imaging property of the imaging sensor relative to the surrounding field*. Ex.1003, ¶124. Broggi states “**[s]ince the stereo [camera] set-up is known, once the same pattern enclosed into the bounding box is detected on the right image, a simple triangulation allows to measure the vehicle distance.**” Ex.1005, 172. A POSITA would have understood that to perform the triangulation of the distance to the vehicle, the relative positions of the cameras in the stereo camera

set-up would be accounted for as described by Broggi and, therefore be *based on knowledge of at least one imaging property of the imaging sensor relative to the surrounding field*. Ex.1003, ¶¶123-124.

Alternatively, Broggi in view of Huttenlocher renders obvious [1.4.3]. Ex.1003, ¶125.⁷ As discussed immediately above, Broggi’s detection of the top of the bounding box is *performing an additional acceptance analysis so as to identify at least one accepted object based on knowledge of at least one imaging property of the imaging sensor relative to the surrounding field*. In using Huttenlocher’s pattern matching technique as the “traditional pattern matching technique” used to detect the top of the preceding vehicle in Broggi, Huttenlocher’s pattern matching technique *analyz[es] a shape of the image formation of each object in the image*

⁷ As explained in VIII.C.4.b, a POSITA would have understood that Huttenlocher’s pattern matching technique may be utilized for detecting the bottom corners, the top, or both the bottom corners and the top of the preceding vehicle in Broggi’s platooning method. Ex.1005, 170-171; Ex.1003, ¶125. This alternative position for [1.4.3] is based on using Huttenlocher’s pattern matching technique for detecting both the bottom corners (*see* [1.4.1]-[1.4.2]) and the top of the preceding vehicle [1.4.3].

data because edge segments extracted from an acquired image are analyzed to detect objects within the image. Ex.1003, ¶125 (explaining that the phrase *shape of the image formation* includes how the shape of an object may be distorted as captured in an image and citing Ex.1001, 3:54-58). In Huttenlocher, the orientation of a shape relative to the imaging sensor, and therefore distortions of the shape in the image formation, are accounted for by the aligning step of Huttenlocher's pattern matching technique because the alignment step "approximates perspective viewing by orthographic projection plus a scale factor which is proportional to the viewing distance." Ex.1006, 377; Ex.1003, ¶125. Therefore, detecting the top of the preceding vehicle using the object detection method of Huttenlocher is *performing an additional acceptance analysis...including analyzing a shape of the image formation of each object in the image data*. Ex.1003, ¶125.

Thus, Broggi alone or Broggi in view of Huttenlocher renders obvious *performing an additional acceptance analysis so as to identify at least one accepted object* (detecting the top part of the bounding box and distance refinement to identify a preceding vehicle), *the additional acceptance analysis including analyzing a shape of the image formation of each object in the image data based on knowledge of at least one imaging property of the imaging sensor relative to the surrounding field* (detecting the top part of the bounding box and distance refinement identifying the preceding vehicle is determined using

perspective and size constraints and a known stereo camera set-up, per Broggi, and/or by analyzing using Huttenlocher's pattern matching technique). Ex.1003, ¶¶118-126.

[1.4.4] storing at least one accepted object that corresponds to a most proximate destination together with corresponding relative positional data in an object list.

Broggi in view of Brady renders obvious [1.4.4] because it discloses storing the preceding vehicle and corresponding location and distance in an object list. Ex.1003, ¶¶127-131.

As discussed in [1.0]-[1.4.3], Broggi-Huttenlocher provides a method of controlling steering of a motor vehicle to follow a preceding vehicle through the implementation of "platooning." Ex.1003, ¶128. And as discussed in VIII.C.4.c, it would have been obvious to combine Brady with Broggi and Huttenlocher. In the combination, Broggi *stor[es] at least one accepted object that corresponds to a most proximate destination* by storing a preceding vehicle identified using Broggi's bounding box detection (implementing Huttenlocher's pattern matching technique). *See supra* [1.4.3]; Ex.1003, ¶128. The identified preceding vehicle *corresponds to a most proximate destination* because the current location of the immediately preceding vehicle is the next or most proximate destination of the vehicle during platooning. Ex.1003, ¶128. Brady provides details regarding the storage of data in object lists in the same context of "classifying and tracking

vehicles” captured “in real-time,” like the platooning of Broggi-Huttenlocher.

Ex.1007, 3:59-62, 11:21-25; Ex.1005, 172 (discussing “tracking an already found” vehicle).

Brady describes a method for identifying and tracking vehicles in a roadway scene. Ex.1007, Abstract. Brady discloses storing identified vehicles with corresponding positional data in an object list. Ex.1007, 11:21-25. For example, the system of Brady “maintains oversight of the scene, including **keeping a vehicle log** 102 of all vehicles currently within the scene, including vehicles’ associated track histories, inertial history 104 of the scene...and potential future track positions....” Ex.1007, 11:21-25. In the combination, vehicles detected by Broggi, including at least the identified preceding vehicle (a name or an identifier associated with the identified preceding vehicle), are *stored...in an object list*, such as a vehicle log, per Brady. *See* Ex.1007, 11:21-25; Ex.1005, 166 (discussing “obstacle detection,” “lane detection,” and “localization and tracking of a target vehicle”), 164 (“Vehicles are localized and tracked”); Ex.1003, ¶129.

The identified preceding vehicle would be stored in the list *together with corresponding relative positional data*, such as a relative location of the preceding vehicle and an associated distance to the vehicle, because Brady suggests logging positional information related to detected vehicles. *See* Ex.1007, 11:21-25 (noting that a vehicle log includes “vehicles’ associated track histories, inertial history 104

of the scene...and potential future track positions”); *supra* [1.2]; Ex.1003, ¶130.

The track histories of the vehicles include the positional data of the vehicles, and as discussed in [1.2], Broggi utilizes the relative position of the preceding vehicle during platooning. *See* Ex.1007, 11:21-25; *supra* [1.2]; Ex.1003, ¶130. Broggi’s method would reference and update the object list over time (updating the information to reflect the current position of the preceding vehicle relative to the vehicle and/or keep a log of past positions) to perform the functions associated with platooning, such as determining a desired path and associated steering angle. Ex.1005, 173, Fig. 21; Ex.1003, ¶130.

Thus, Broggi in view of Huttenlocher and Brady renders obvious *storing at least one accepted object that corresponds to a most proximate destination together with corresponding relative positional data* (storing the most proximate preceding vehicle and corresponding location and distance) *in an object list* (stored in a vehicle log). Ex.1003, ¶¶127-131.

6. Claim 2.

[2.0] The method as recited in claim 1, further comprising processing the mathematical tree structure using a tree traversal algorithm.

Broggi-Huttenlocher-Brady renders obvious claim 1. Further, Broggi in view of Huttenlocher renders obvious [2.0] because Huttenlocher discloses analyzing a multi-scale mathematical tree structure by analyzing coarse-scale then

fine-scale features stored in the tree structure as part of the coarse-scale alignment and fine-scale matching discussed in [1.4.1]-[1.4.2]. Ex.1003, ¶¶132-134.

A POSITA would have understood that starting with the “coarse level descriptions” of the tree structure and then using the corresponding “fine scale model features” represents a traversal of the tree structure using a tree traversal algorithm because it starts on one end of the tree (top of Fig. 4) and proceeds towards another end of the tree (bottom of Fig. 4). *See* Ex.1006, 374, Fig. 4. Further, Huttenlocher explains that “coarse level descriptions are [] used to determine which model features can potentially match which image features. These possible matching features form the set of pairs, P , for the alignment algorithm.” Ex.1006, 374. Then fine-scale matching is utilized to score how likely or plausible a “potential match” (from the coarse scale alignment) is to being an actual match for an object. Ex.1006, 374; Ex.1003, ¶133. This approach is like the ’805 patent, which similarly describes a tree traversal algorithm where “based on the knowledge of the typical geometric shape of a destination, the edges and segments stored in parameters in the branches of the hierarchical tree are analyzed to check if they are able to be pieced together to form geometric objects which describe suitable, typical destinations.” Ex.1001, 4:65-5:3. Ex.1003, ¶133.

Thus, Broggi in view of Huttenlocher and Brady renders obvious *processing the mathematical tree structure using a tree traversal algorithm* (analyzing multi-

scale mathematical tree structure by analyzing coarse then fine features as stored in the tree structure). Ex.1003, ¶¶132-134.

7. Claim 9.

[9.0] The method as recited in claim 1, further comprising performing an at least semi-automatic vehicle guidance to the most proximate destination using the at least one trajectory.

Broggi-Huttenlocher-Brady renders obvious claim 1. Further, Broggi discloses or renders obvious [9.0] because Broggi discloses that its motor vehicle automatically follows the preceding vehicle during platooning using a steering angle for a desired path to the preceding vehicle's location. Ex.1003, ¶¶135-138.

As discussed in [1.3], Broggi calculates a steering angle for a desired path using the relative location and associated distance of the preceding vehicle, where the steering angle is used for controlling steering of the motor vehicle during platooning to follow the preceding vehicle (e.g. to the current location of the preceding vehicle). *See supra* [1.3]. In this way, Broggi's platooning is the automatic guidance of an autonomous vehicle to a target (the location of the preceding vehicle) following a steering angle for a desired path to the preceding vehicle. *See supra* [1.3]; Ex.1003, ¶137. Full automatic guidance of an autonomous vehicle in this manner is *at least semi-automatic vehicle guidance*. Ex.1003, ¶¶136-137.

Thus, Broggi in view of Huttenlocher and Brady renders obvious *performing an at least semi-automatic vehicle guidance to the most proximate destination using the at least one trajectory* (automatically controlling steering of the motor vehicle to follow a preceding vehicle using a steering angle for a desired path).

Ex.1003, ¶¶135-138.

8. Claim 10.

[10.0] The method as recited in claim 9, further comprising using at least one of an audible and a visual signaling during the vehicle guidance to assist a driver of the vehicle in observing the trajectory.

Broggi-Huttenlocher-Brady renders obvious claim 9. Further, Broggi discloses or renders obvious [10.0] because Broggi discloses the use of acoustic signaling and optical signals during platooning to provide a warning or indication related to the path of travel to the driver. Ex.1003, ¶¶139-142.

Broggi's autonomous vehicle has system functionalities where "the driver can select the level of system intervention." Ex.1005, 166. The vehicle includes several output devices, including "acoustical (stereo loudspeakers) and optical (LED-based control panel) devices [] used to issue warnings to the driver in case dangerous conditions are detected[.]" Ex.1005, 165; Ex.1003, ¶140. An "LED row on the control panel encodes the vehicle position within the lane, while the right or left speakers warn in case the vehicle is approaching too much to the right or left lane marking." Ex.1005, 166; Ex.1003, ¶104. Broggi renders obvious *using at least*

one of an audible (stereo loudspeakers to provide lane warnings) *and a visual signaling* (an LED row reflecting the vehicle position in the lane) while the vehicle is driving. Ex.1003, ¶140. Further, while primarily discussed in the context of supervised driving, Broggi does not limit the implementation of such safety measures to just the supervised driving mode. Ex.1005, 165-166; Ex.1003, ¶140. Broggi describes more generally that these output devices are installed in the vehicle “to issue warnings to the driver in case dangerous conditions are detected,” which can be during any implementation of autonomous driving, including platooning. Ex.1005, 165-166; Ex.1003, ¶140. Thus, Broggi renders obvious that audible and visual signaling warnings would be used *during the vehicle guidance to assist a driver of the vehicle in observing the trajectory*. See Ex.1005, 165; Ex.1003, ¶140.

A POSITA would have been motivated, and found it obvious, to use the known approach of audio and visual indicators used in supervised driving mode for providing the same information to a “driver” while in automatic steering mode. Ex.1003, ¶141. Providing the indications while in automatic steering mode would provide useful information that may allow a driver to know if they should take control of the vehicle due to a failure in the system. For example, an auditory warning that the vehicle is too far to one side of the lane may indicate the driver

needs to take control to avoid leaving the road and/or entering into a wrong lane during platooning. Ex.1003, ¶141 (describing scenarios where this may occur).

Thus, Broggi in view of Huttenlocher and Brady renders obvious *using at least one of an audible* (acoustic signaling) *and a visual signaling* (optical signals) *during the vehicle guidance to assist a driver of the vehicle in observing the trajectory* (acoustic signaling and optical signals are used during platooning to provide a warning or indication related to the path of travel). Ex.1003, ¶¶139-142.

D. Ground 2: Claims 6-8 and 11 are obvious over Broggi-Huttenlocher-Brady-Bertozzi.

1. Bertozzi

Bertozzi is a book titled “Automatic Vehicle Guidance: The Experience of the ARGO Autonomous Vehicle” written by several of the same authors as Broggi.

Bertozzi describes the same ARGO vehicle discussed in Broggi but provides additional information and details. *Compare* Ex.1008, 73 (Figure 6.10 showing the “ARGO vehicle”) *with* Ex.1005, 165 (Figure 1 showing the “ARGO prototype vehicle”).

2. Reasons to Combine Broggi-Huttenlocher-Brady-Bertozzi

a) Analogous Art

Bertozzi is analogous art to the '805 patent because it is in the same field of endeavor: image processing and the detection of objects (e.g., vehicles) in images,

including vehicle detection in images for automated driving. Ex.1001, 1:6-9; Ex.1008, 163 (“The vision system”), 171, 174 (“Automatic Driving” functionality). Ex.1003, ¶144. Bertozzi is reasonably pertinent to a particular problem addressed by the ’805 patent, namely, automated control of a vehicle based on image analysis. Ex.1001, 6:53-56; Ex.1008, 171, 174; Ex.1003, ¶144.

b) Broggi-Huttenlocher-Brady-Bertozzi

A POSITA would have been motivated and found it obvious to use additional configuration details of the autonomous vehicle described in Bertozzi with the Broggi-Huttenlocher-Brady combination that performs vehicle platooning because a teaching, suggestion, or motivation in the prior art (Broggi and Bertozzi both describe the same autonomous vehicle) would have led one of ordinary skill to combine the references (the platooning method of Broggi-Huttenlocher-Brady with Bertozzi’s further vehicle configuration details). Ex.1005, 164; Ex.1008, 161; Ex.1003, ¶145.

Likewise, a POSITA would have been motivated to implement Bertozzi’s additional configuration details as part of platooning—as taught by the Broggi-Huttenlocher-Brady—because doing so would have been the combination of prior art elements (the platooning method of Broggi-Huttenlocher-Brady and Bertozzi’s vehicle configuration) according to known methods to yield predictable results (using Bertozzi’s vehicle configuration in platooning). *KSR*, 550 U.S. at 416;

Ex.1003, ¶146. Bertozzi provides details regarding the configuration of an ARGO vehicle that a POSITA would have looked for to implement and improve Broggi's disclosed platooning. Further, Bertozzi details safety systems that a POSITA would have recognized provided several benefits to Broggi's platooning, including at least protecting the vehicle and passengers, improving the user experience (by avoiding sudden or dangerous movements), and avoiding accidents. Ex.1003, ¶146.

In the combination, a POSITA would merely be implementing details of Broggi's vehicle that were used and/or contemplated, but not explicitly detailed in Broggi. For example, a vehicle performing platooning—per Broggi-Huttenlocher-Brady—would utilize the control system “emergency feature” described in Bertozzi to “avoid sudden and therefore dangerous movements of the steering wheel” based on vehicle speed. Ex.1008, 171 (“at a low speed, two consecutive positions of the steering wheel can be quite different; on the other hand, when driving at high speed, only small steering wheel movements are permitted.”). Further, in the combination, the autonomous vehicle would use its display to “display[] the results of the process on a 6” on-board color monitor.” Ex.1008, 168-169; Ex.1005, 165 (ARGO vehicle includes “a color monitor”). For example, the monitor would “present[] a bi-dimensional reconstruction of the road scene” with data resulting from the vision data flow, such as the location of the preceding

vehicle, the desired path and associated trajectory to the location of the preceding vehicle, and “the position of obstacles.” Ex.1008, 168-169; Ex.1003, ¶147.

A POSITA would have had a reasonable expectation of success in using the configuration details of Bertozzi—limiting steering wheel movements based on vehicle speed and outputting processing results to an on-board monitor—with the Broggi-Huttenlocher-Brady combination because Bertozzi describes using these configuration details in the same autonomous vehicle described in Broggi. *See* Ex.1005, 164; Ex.1008, 161. Further, a POSITA would have recognized that the benefits associated with the configuration details described in Bertozzi (avoiding sudden and/or dangerous movements as well as being provided a visual indication of the data resulting from the vision data flow) would have been equally applicable and beneficial in the context of the Broggi-Huttenlocher-Brady combination. Accordingly, a POSITA had a reasonable expectation of success in combining Bertozzi with Broggi-Huttenlocher-Brady. Ex.1003, ¶148.

3. Claim 6

[6.0] The method as recited in claim 1, wherein the calculation of the at least one trajectory includes considering a steering property and a capability of the motor vehicle.

Broggi-Huttenlocher-Brady renders obvious claim 1. Further, Broggi in view of Bertozzi renders obvious [6.0] because Bertozzi discloses considering the current position of the steering wheel and permitted degree of steering wheel

movement at a given speed when calculating a steering angle in an ARGO vehicle such as Broggi's motor vehicle. Ex.1003, ¶¶149-154.

As described in [1.3], Broggi discloses *calculating at least one trajectory describing an optimized travel path* by calculating a steering angle for a desired path. Ex.1003, ¶150. Figure 20, reflects how the data collected from image acquisition and processing, including a relative location and associated distance of the preceding vehicle, is passed to a supervisor. *See* Ex.1005, 173 (“The command steering angle δ is obtained with a variable gain proportional controller....[T]he supervisor uses the results to select the most appropriate gain for the proportional controller and estimate the error signal.”), 164-165 (“The steering control for the Platooning functionality is based on a gain scheduled proportional controller whose error input is evaluated using the estimated position of the preceding vehicle.”), Fig. 20; Ex.1003, ¶150.

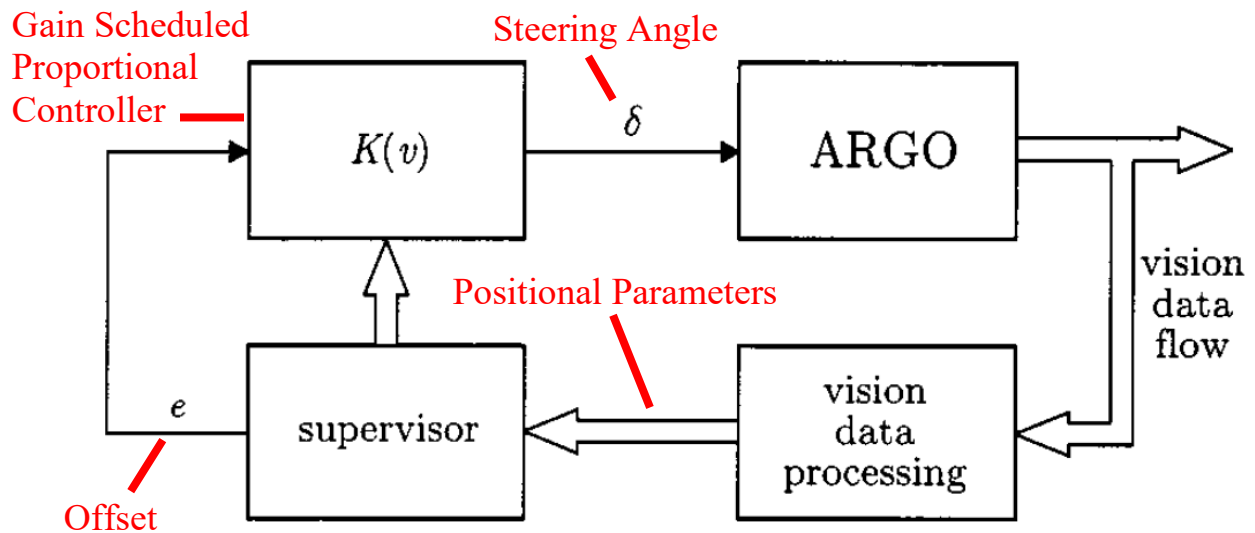


Fig. 20. Control scheme with the gain scheduled proportional controller.

Ex.1005, Fig. 20 (annotated)

Bertozzi provides further details regarding the control system. *See generally* Ex.1008, 161-175; Ex.1003, ¶151. Bertozzi explains that “a software module is used to compute signals to be issued to the steering wheel actuator” Ex.1008, 171; Ex.1003, ¶151. As noted immediately above, Broggi uses a supervisor and variable gain proportional controller as its software modules to determine a steering angle and control navigation. *See* Ex.1005, 173, Fig. 20; Ex.1003, ¶151.

Bertozzi seeks to “avoid sudden and therefore dangerous movements of the steering wheel” while driving. Ex.1008, 171. Accordingly, “when the vehicle is moving at a low speed, two consecutive positions of the steering wheel can be

quite different; on the other hand, when driving at a high speed, only small steering wheel movements are permitted.” Ex.1008, 171; Ex.1003, ¶152.

As discussed in VIII.D.2.b, it would have been obvious to combine Bertozzi with Broggi-Huttenlocher-Brady. In the combination, a vehicle performing platooning—per Broggi-Huttenlocher-Brady—would consider a steering property (current position of the steering wheel) and a capability of the motor vehicle (amount of steering change allowed at a given speed) when determining a steering angle for a desired path to the preceding vehicle. Ex.1003, ¶153. This would ensure that sudden or dangerous movements are avoided, per Bertozzi. *See* Ex.1008, 171; Ex.1003, ¶153.

Thus, Broggi in view of Bertozzi renders obvious *the calculation of the at least one trajectory* (calculating a steering angle for a desired path) *includes considering a steering property and a capability of the motor vehicle* (the steering angle calculation takes into consideration the current position of the steering wheel and permitted degree of steering wheel movement at a given speed). Ex.1003, ¶¶149-154.

4. Claim 7

[7.0] The method as recited in claim 6, further comprising rejecting a potential destination that is not reachable given the steering property and capability of the motor vehicle.

Broggi-Huttenlocher-Brady-Bertozzi renders obvious claim 6. Broggi in view of Bertozzi renders obvious [7.0] because Broggi in view of Bertozzi renders obvious rejecting the current location of a preceding vehicle that cannot be reached due to steering angle limitations and safety considerations. Ex.1003, ¶¶155-157.

As discussed in [6.0], it would have been obvious to a POSITA that a vehicle performing platooning—per Broggi-Huttenlocher-Brady—would consider a steering property (current position of the steering wheel) and a capability of the motor vehicle (amount of steering change allowed at a given speed) when determining a steering angle for a desired path to the preceding vehicle. Ex.1003, ¶156. This ensures that sudden or dangerous movements are avoided. *See* Ex.1008, 171; Ex.1003, ¶156. For this same reason, it would have been obvious to *reject[] a potential destination that is not reachable given the steering property and capability of the motor vehicle*, such as a current location of a preceding vehicle that cannot be reached due to steering angle limitations. Because the system would be unable to calculate a desired path to the current location of the preceding vehicle given the safety constraints, the system would reject the potential destination (current location of the preceding vehicle) as not being reachable given

the steering property and capability of the vehicle (current position of the steering wheel and amount of steering change allowed at a given speed). Ex.1003, ¶156. Further, it would have been obvious in such situations to provide an audible and/or visual warning to indicate the rejection via Broggi’s “acoustical (stereo loudspeakers) and optical (LED-based control panel) devices [] used to issue warnings to the driver in case dangerous conditions are detected” and/or via the “on-board color monitor.” Ex.1005, 165; Ex.1003, ¶156; *see also* VIII.C.8:[10.0].

Thus, Broggi in view of Bertozzi renders obvious *rejecting a potential destination that is not reachable given the steering property and capability of the motor vehicle* (rejecting a current location of a preceding vehicle as unreachable given the current position of the steering wheel and the amount of steering change allowed at a given speed). Ex.1003, ¶¶155-157.

5. Claim 8

[8.0] The method as recited in claim 1, further comprising informing a driver of the motor vehicle about a position of at least one potential destination and about the at least one trajectory.

Broggi-Huttenlocher-Brady renders obvious claim 1. Broggi in view of Bertozzi renders obvious [8.0] because Broggi in view of Bertozzi renders obvious providing information via output devices regarding the path of the vehicle and the position of the preceding vehicle during operation of an ARGO vehicle. Ex.1003, ¶¶158-160.

As discussed in VIII.D.2.b, in the combination the autonomous vehicle would use its “on-board color monitor” to “present[] a bi-dimensional reconstruction of the road scene” including the location of the preceding vehicle, the desired path to the location of the preceding vehicle, and the position of obstacles. Ex.1005, Fig. 20-22; Ex.1008, 168-169; Ex.1003, ¶159. In this manner, the system informs the driver of the current location of the preceding vehicle in the platoon (i.e., a position of at least one potential destination) and the trajectory of the desired path following the preceding vehicle to its current location (i.e., at least one trajectory). Ex.1005, Fig. 20-22; Ex.1008, 168-169; Ex.1003, ¶159.

Thus, Broggi in view of Bertozzi renders obvious *informing a driver of the motor vehicle about a position of at least one potential destination and about the at least one trajectory* (providing information via output devices, such as the on-board color monitor, of the current location of the preceding vehicle and the trajectory of the desired path to the current location of the preceding vehicle). Ex.1003, ¶¶158-160.

6. Claim 11

[11.0] The method as recited in claim 9, further comprising: continuously monitoring a position of the stored at least one accepted object during the vehicle guidance.

Broggi-Huttenlocher-Brady renders obvious claim 9. Broggi in view of Brady renders obvious [11.0] because Broggi in view of Brady renders obvious

continuously tracking the position of the detected preceding vehicles stored during platooning. Ex.1003, ¶¶161-165.

Broggi explains that during platooning, images are continuously acquired and processed through a series of steps including inverse perspective mapping (IPM), lane detection, obstacle detection, and vehicle detection, as reflected in Figures 19-20 and Table I. Ex.1005, 173 (“is able to continuously capture images”); Ex.1003, ¶¶162-163.

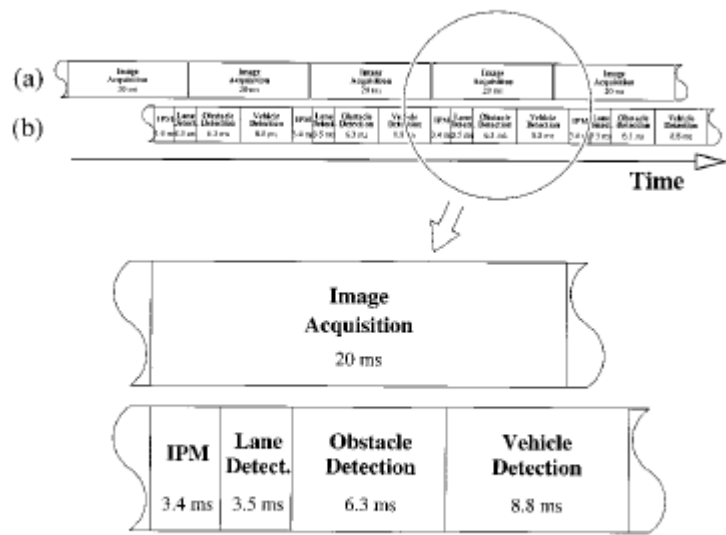


Fig. 19. Image acquisition (a) and processing (b) performance.

Ex.1005, Fig. 19

TABLE I
TIMINGS OF PROCESSING STEPS

	Pentium 200MMX	Pentium II 450MMX	Speedup
IPM	9.9 ms	3.4 ms	2.9
Lane Detection	14.4 ms	3.5 ms	4.1
Obstacle Detection	17.5 ms	6.3 ms	2.7
Vehicle Tracking	24.8 ms	8.8 ms	2.8
Vehicle Detection	47.6 ms	19.9 ms	2.4

Ex.1005, Table I

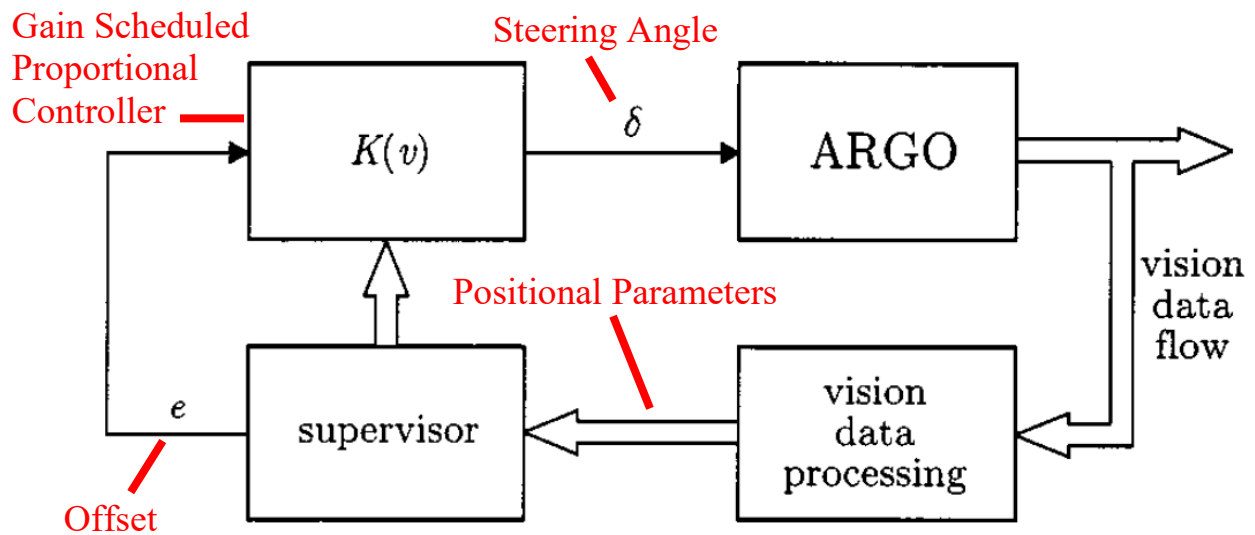


Fig. 20. Control scheme with the gain scheduled proportional controller.

Ex.1005, Fig. 20 (annotated)

Broggi explains the refresh rate of the cameras imposes a sampling time on the vision system used in platooning. Ex.1005, 174 (“The controller sampling time is imposed by the vision system....”); Ex.1003, ¶164. As described in [1.4.3]-[1.4.4], the claimed *at least one accepted object* is an identified preceding vehicle whose location is defined by a bounding box. A POSITA would have understood

that the presence of the vision data processing within a control loop with a certain sampling rate represents *continuous monitoring* of the location of the preceding vehicle. Ex.1003, ¶164. The constant refreshing of the image data in the control loop ensures that the position of the preceding vehicle is updated and kept current and, as a result, the steering angle and associated desired path are continuously adjusted according to the latest position of the preceding vehicle. Ex.1003, ¶164.

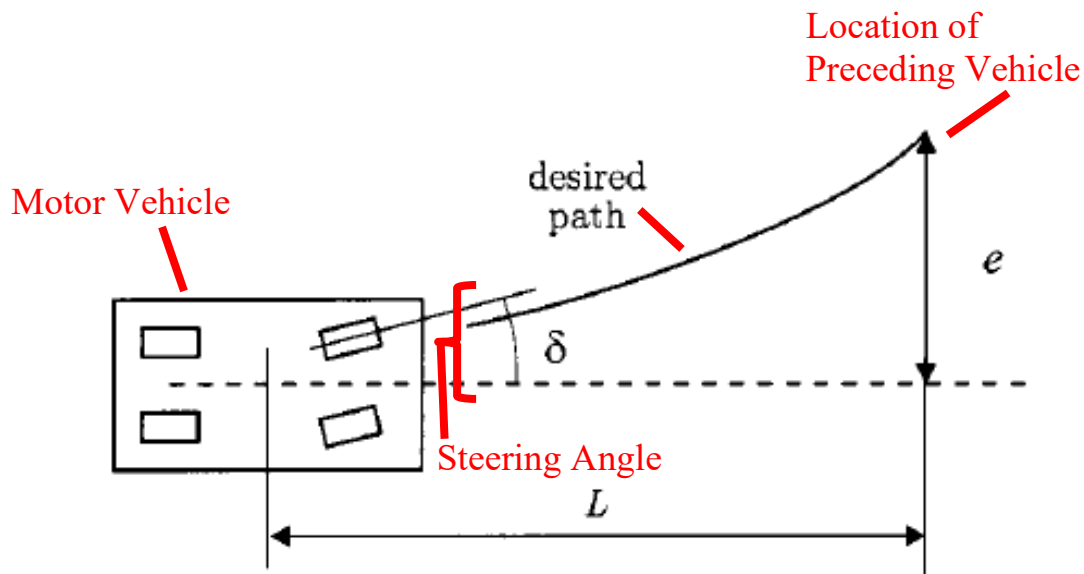
Thus, Broggi in view of Brady renders obvious *continuously monitoring a position of the stored at least one accepted object* (tracking the position of vehicles detected and stored per Brady) *during the vehicle guidance* (vehicle guidance during platooning). Ex.1003, ¶¶161-165.

[11.1] selecting a new most proximate destination went⁸ the most proximate destination is no longer easily reachable;

Broggi in view of Bertozzi renders obvious [11.1] because Broggi in view of Bertozzi renders obvious selecting a new location of the preceding vehicle when a previous location of the preceding vehicle is no longer reachable by the motor vehicle. Ex.1003, ¶¶166-172.

⁸ Petitioner interprets claim 11 as reciting *selecting a new most proximate destination [when] the most proximate destination is no longer easily reachable*. See Ex.1003, ¶166.

During platooning, Broggi's motor vehicle calculates a steering angle and corresponding desired path to the current location of the preceding vehicle, as reflected in Figure 21:



Ex.1005, Fig. 21 (annotated)

Broggi in view of Bertozzi renders obvious selecting a new location of a preceding vehicle when a previous location is no longer reachable by the motor vehicle in at least three ways. Ex.1003, ¶¶167-168.

First, as discussed in [7.0], Broggi in view of Bertozzi renders obvious rejecting a current location of the preceding vehicle as unreachable based on the current position of the steering wheel and the amount of steering change allowed at a given speed. When the current location of the preceding vehicle (i.e., the current most proximate destination) is rejected for no longer being reachable, the system

would select a new location (i.e., a new most proximate destination) for the vehicle. Ex.1003, ¶169. The new location would be a location that the vehicle can reach given the current location of the vehicle, the current position of the steering wheel, and the amount of steering change allowed at the given speed of the vehicle. Ex.1003, ¶169. For example, in some instances, movement of the preceding vehicle will result in the preceding vehicle returning to a location relative to the vehicle that is reachable given the steering safety constraints. Ex.1003, ¶169. That is, the new location of the preceding vehicle is reachable from the current location of the vehicle based on the current position of the steering wheel and the amount of steering change allowed at the current speed of the vehicle. In this manner, Broggi in view of Bertozzi *select[s] a new most proximate destination* (new location of the preceding vehicle) *[when] the most proximate destination is no longer easily reachable* (previous current location of the preceding vehicle is no longer reachable due to steering safety constraints). Ex.1003, ¶169.

Second, as discussed in [11.0], during platooning Broggi continuously tracks and updates the current position of the preceding vehicle and adjusts the steering angle and associated desired path to follow the preceding vehicle. As Broggi's motor vehicle passes each current location of the preceding vehicle (i.e., the *most proximate destination*), that location is no longer easily reachable because

Broggi's motor vehicle is beyond the location and traveling away from the location. Ex.1003, ¶170. As Broggi's motor vehicle passes the previous current locations of the preceding vehicle (*[when] the most proximate destination is no longer easily reachable*), the system selects a new current location of the preceding vehicle (*selecting a new most proximate destination*) based on the steering safety constraints of Bertozzi discussed in [6.0] and [7.0]. Ex.1003, ¶170.

Third, it would have been obvious for Broggi to select a new most proximate destination (location of a new preceding vehicle) when the current most proximate destination (current location of a previous preceding vehicle) is no longer easily reachable due to the presence of a new immediately preceding vehicle for one or more reasons (previous preceding vehicle pulls off the road or a new vehicle pulls in between the previous preceding vehicle and the motor vehicle).Ex.1003, ¶171. In such instances, the new preceding vehicle would become the preceding vehicle in Broggi's platooning and the corresponding current location of the new preceding vehicle (i.e., *a new most proximate destination*) would be selected taking into consideration the current location of the vehicle and the steering safety constraints of Bertozzi. Ex.1003, ¶171.

Thus, Broggi in view of Bertozzi renders obvious *selecting a new most proximate destination* (selecting a new location of the preceding vehicle) *[when] the most proximate destination is no longer easily reachable* (when the stored

location of the current preceding vehicle is no longer reachable by the motor vehicle). Ex.1003, ¶¶166-172.

[11.2] wherein the new most proximate destination is selected based on an active position of the motor vehicle and in determining the at least one accepted object that is best reachable, considering a steering properties and a capability of the vehicle; and

Broggi in view of Bertozzi renders obvious [11.2]. Ex.1003, ¶¶173-175.

As discussed in [11.1], Broggi in view of Bertozzi renders obvious selecting a new location of a preceding vehicle when a previous location is no longer reachable by the motor vehicle in at least three ways: (1) in response to rejecting a current location of the preceding vehicle as unreachable based on steering safety constraints; (2) in response to passing a previous current location of the preceding vehicle; and (3) in response to a new vehicle becoming the immediately preceding vehicle. In each instance, selecting the new most proximate destination includes determining the preceding vehicle that is best reachable based on the current position of the vehicle during platooning (i.e., *an active position of the motor vehicle*), the current position of the steering wheel (i.e., *a steering properties...of the vehicle*), and the amount of steering change allowed at the current speed of the vehicle (i.e., *a capability of the vehicle*). See [11.1]; Ex.1003, ¶174. The current location of the preceding vehicle that is best reachable is selected as the desired location for the vehicle. Ex.1003, ¶174.

Thus, Broggi in view of Bertozzi renders obvious *the new most proximate destination* (the new current location of a preceding vehicle) *is selected based on an active position of the motor vehicle* (the current position of the vehicle during platooning) *and in determining the at least one accepted object that is best reachable considering a steering properties and a capability of the vehicle* (determining the preceding vehicle best reachable taking into consideration the current position of the steering wheel and permitted degree of steering wheel movement at the given speed of the vehicle). Ex.1003, ¶¶173-175.

[11.3] computing a new trajectory describing a new optimized travel path based on the active position.

Broggi discloses or renders obvious [11.3]. Ex.1003, ¶¶176-180.

As described in [11.0]-[11.2], Broggi in view of Bertozzi renders obvious *continuously monitoring a position of the stored at least one accepted object during the vehicle guidance and selecting a new most proximate destination [when] the most proximate destination is no longer easily reachable*. Broggi further discloses determining a desired path for the vehicle based on the new most proximate destination. Ex.1005, Fig. 20-22; Ex.1003, ¶177. For example, Broggi discloses calculating a steering angle describing the new desired path between the current position of the vehicle during platooning and a new current location of a preceding vehicle. Ex.1003, ¶177.

During platooning, Broggi's motor vehicle continuously calculates a steering angle and corresponding desired path for each selected new current location of a preceding vehicle, as reflected in Figures 20 and 21:

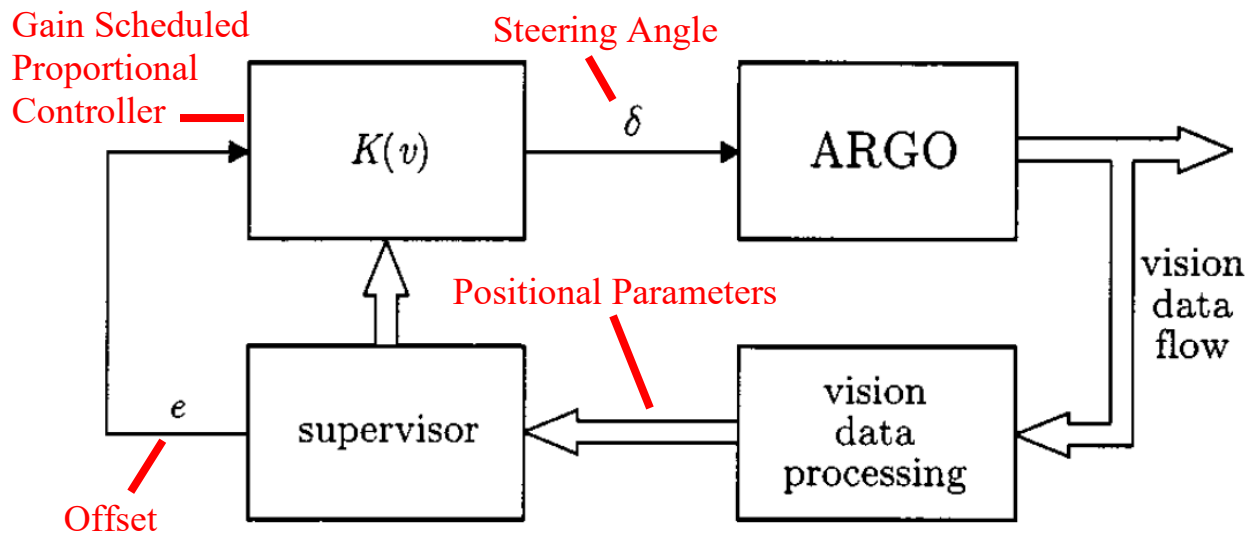
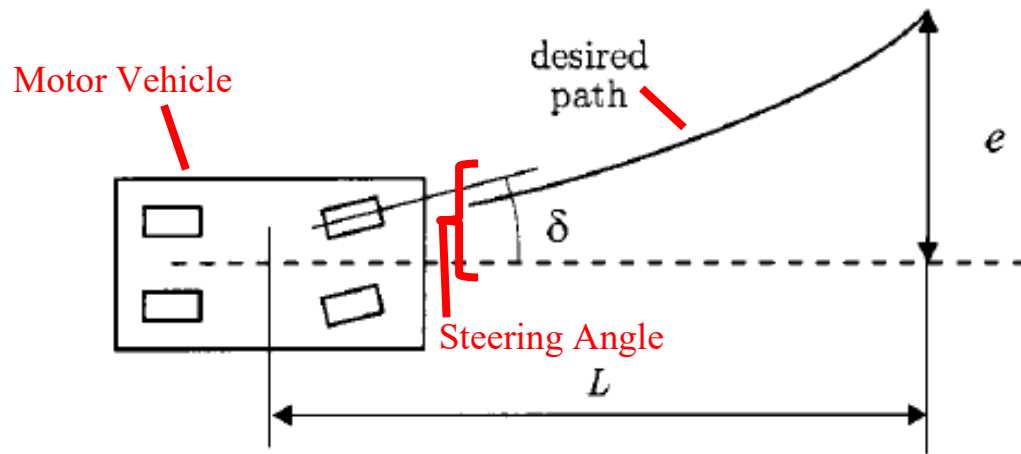


Fig. 20. Control scheme with the gain scheduled proportional controller.

Ex.1005, Fig. 20 (annotated)



Ex.1005, Fig. 21 (annotated)

As discussed in Ground 1:[1.3], computing the steering angle and corresponding desired path in Broggi's platooning is *calculating a...trajectory describing a[n]...optimized travel path* and is based on the active position of the motor vehicle. Accordingly, when the steering angle and corresponding desired path are calculated for the *new most proximate destination* (selected as discussed in [11.1]-[11.2]), Broggi is *calculating a new trajectory describing a new optimized travel path based on the active position* of the motor vehicle. Ex.1003, ¶¶178-179.

Thus, Broggi in view of Bertozzi renders obvious *computing a new trajectory* (new steering angle) *describing a new optimized travel path based on the active position* (a new desired path extends from the current position of the vehicle to the new current location of a preceding vehicle based on the new steering angle). Ex.1003, ¶¶176-180.

IX. BROGGI, HUTTENLOCHER, AND BERTOZZI ARE PRINTED PUBLICATIONS

Petitioner submits the Declaration of Dr. Hall-Ellis (Ex.1015) to show that Broggi (Ex.1005), Huttenlocher (Ex.1006), and Bertozzi (Ex.1008) were publicly accessible to POSITAs more than a year before the earliest priority date of the '805 patent (June 16, 2004).

Reference	Publicly Available By
Broggi	September 1, 2000
Huttenlocher	September 26, 1989
Brady	December 16, 1999

Ex.1015, ¶69.

Broggi was publicly accessible by September 1, 2000, because Broggi was publicly available, cataloged, and indexed at the University of Wisconsin Madison Libraries by September 1, 2000. Ex.1015, ¶¶49-56.

Huttenlocher was publicly accessible by September 26, 1989, because Huttenlocher was publicly available, cataloged, and indexed at the Carlson Science & Engineering Library at the University of Rochester by September 26, 1989.

Ex.1015, ¶¶57-62.

Bertozzi was publicly accessible by September 27, 1999, because Bertozzi was publicly available, cataloged, and indexed at the Morgan Library at Colorado State University by September 27, 1999. Ex.1015, ¶¶63-68.

X. DISCRETIONARY DENIAL IS INAPPROPRIATE

A. No basis for §325(d) denial

The Board should not deny this Petition under §325(d) because the grounds herein are neither cumulative nor redundant to the prosecution of the '805 patent. The Examiner did not consider Broggi, Huttenlocher, Brady, or Bertozzi, or the combination of the references as presented in this Petition.

B. No basis for *Fintiv* denial

The Board balances six factors in considering denial under §314. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (Mar. 20, 2020) (precedential). These factors strongly favor institution. The district court case is in its very early stages. Patent Owner filed its complaint on April 12, 2024 (Ex.1010) and trial is not scheduled to start until May 14, 2026. Ex.1011 (proposed scheduling order). Petitioner has worked diligently to prepare this Petition, which is being filed well within the one-year timeframe allowed by Congress.

1. No evidence regarding a stay

No motion to stay has been filed, so the Board should not infer the outcome of such a motion. *Sand Revolution II, LLC v. Continental Intermodal Group – Trucking LLC*, IPR2019-01393, Paper 24, 7 (June 16, 2020) (informative). Thus, this factor is neutral on discretionary denial.

2. Parallel proceeding trial date

This factor weighs against discretionary denial because the projected trial date—based on median time-to-trial statistics—is in January of 2027⁹, which is after the projected date for the Board to issue a Final Written Decision in June of 2027. While trial is currently proposed¹⁰ for May 14, 2026 (Ex.1011, 4), the Board recognizes “that scheduled trial dates are unreliable and often change.” *See* Director’s Memorandum on Discretionary Denials (Ex.1013), 8. Because the projected trial date is approximately seven months *after* the Board’s expected date for issuing a Final Written Decision, this factor weighs against discretionary denial.

3. Investment in the parallel proceeding

The investment in the co-pending litigation has been minimal. A claim construction hearing has not yet occurred, fact discovery is not scheduled until April 11, 2025, and expert discovery is not scheduled until November 20, 2025. Ex.1011, 3-6; *see PEAG LLC v. Varta Microbattery GmbH*, IPR2020-01214, Paper 8, 17 (Jan. 6, 2021). This lack of investment favors institution.

⁹ The current average time-to-trial for the district court hearing the co-pending litigation is 33.1 months. *See* Ex.1012.

¹⁰ The district court has not entered an order scheduling a trial date.

Moreover, Petitioner only learned which claims were being asserted in August 2024. *See* Ex.1014 (infringement contentions cover pleading). Since then, Petitioner has worked expeditiously to file this petition within four months. As of this filing, Patent Owner has not yet served its final infringement contentions. Under *Fintiv*, Petitioner’s prompt filing “weigh[s] against exercising the authority to deny institution.” *Fintiv*, Paper 11 at 11.

4. Overlapping issues with the parallel proceeding

The co-pending litigation is in its early stages. Petitioner served its preliminary invalidity contentions on October 24, 2024 and supplemental invalidity contentions on November 27, 2024. However, Petitioner will not serve its final invalidity contentions until May 22, 2025, near when the Board would issue an institution decision in this case. Ex.1011, 3. The extent of overlap is thus speculative at this point in time.

5. Petitioner is a defendant

Petitioner is a defendant in the co-pending litigation. That is true of most Petitioners in IPR proceedings, making this factor neutral. *See HP Inc. v. Slingshot Printing LLC*, IPR2020-01084, Paper 13, 9 (Jan. 14, 2021).

6. Other circumstances

“[T]he PTAB will not deny institution of an IPR or PGR under *Fintiv* (i) when a petition presents compelling evidence of unpatentability.” Ex.1013, 9.

Here, the petition—along with Dr. Rodriguez’s expert testimony—plainly shows that the ’805 patent claims no more than well-known subject matter. This compelling evidence of unpatentability renders the other *Fintiv* factors moot.

Because the *Fintiv* factors are either neutral or weigh against discretionary denial, institution should not be discretionarily denied.

C. No basis for *General Plastic* denial

The ’805 patent has not been challenged in any prior IPR petition, so *General Plastic* discretionary institution does not apply to this Petition. *General Plastic*, IPR2016-01357, Paper 19, 16 (Sept. 6, 2016) (precedential).

XI. CONCLUSION

The Challenged Claims are unpatentable.

Respectfully submitted,

Dated: January 3, 2025
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XII. MANDATORY NOTICES

A. Real party-in-interest

Pursuant to 37 C.F.R. § 42.8(b)(1), Petitioner certifies that the real party-in-interest is Tesla, Inc.

B. Related matters

Pursuant to 37 C.F.R. § 42.8(b)(2), to the best knowledge of the Petitioner, the '805 patent is or was involved in the following cases:

Case Heading	Number	Court	Filed
<i>Intellectual Ventures II LLC v. Tesla, Inc</i>	<i>WDTX-1-24-cv-00390</i> (terminated)	WDTX	Apr. 11, 2024
<i>Intellectual Ventures II LLC v. Tesla, Inc.</i>	<i>WDTX-6-24-cv-00188</i> (pending)	WDTX	Apr. 12, 2024
<i>Intellectual Ventures II LLC v. Tesla, Inc.</i>	<i>WDTX-1-24-cv-00884</i> (transferred)	WDTX	Apr. 12, 2024

C. Lead and back-up counsel and service information

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Please address all correspondence in this proceeding to lead and back-up counsel. Petitioner consents to service in this proceeding by email at the addresses above.

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), Petitioner hereby certifies, in accordance with and reliance on the word count provided by the word-processing system used to prepare this Petition, that the number of words in this paper is 13,995. Pursuant to 37 C.F.R. § 42.24(d), this word count excludes the table of contents, table of authorities, mandatory notices under § 42.8, certificate of service, certificate of word count, appendix of exhibits, and any claim listing.

Dated: January 3, 2025

/Jonathan R. Bowser/
Jonathan R. Bowser
Lead Counsel for Petitioner
Registration No. 54,574

CERTIFICATE OF SERVICE

The undersigned certifies that, in accordance with 37 C.F.R. §42.6(e) and 37 C.F.R. §42.105, service was made on Patent Owner as detailed below.

Date of service January 3, 2025

Manner of service PRIORITY MAIL EXPRESS

Documents served Petition for *Inter Partes* Review Under 35 U.S.C. § 312 and 37 C.F.R. § 42.104 of U.S. 7,336,805;
Petitioner's Power of Attorney;
Petitioner's Exhibit List; and
Exhibits 1001-1015.

Persons served Kowert, Hood, Munyon, Rankin & Goetzel, P.C.
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