



(51) International Patent Classification:  
*G01C 21/32* (2006.01)      *G06K 9/00* (2006.01)  
*G01C 21/36* (2006.01)

(21) International Application Number:  
PCT/US2019/063326

(22) International Filing Date:  
26 November 2019 (26.11.2019)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
62/771,335      26 November 2018 (26.11.2018)    US  
62/795,868      23 January 2019 (23.01.2019)      US  
62/800,845      04 February 2019 (04.02.2019)      US

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(54) Title: LANE MAPPING AND NAVIGATION

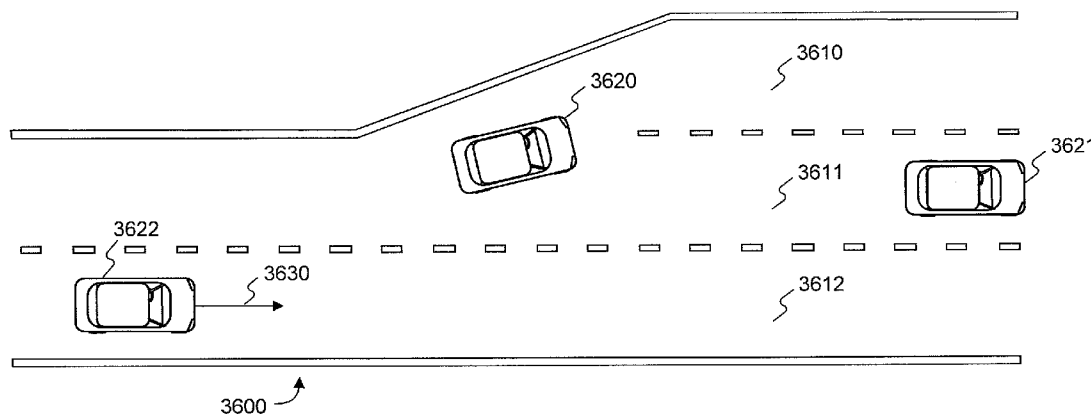


FIG. 36

(57) Abstract: Systems and methods are disclosed for mapping lanes for use in vehicle navigation. In one implementation, at least one processing device may be programmed to receive navigational information from a first vehicle and a second vehicle that have navigated along a road segment including a lane split feature; receive at least one image associated with the road segment; determine, from the first navigational information, a first actual trajectory of the first vehicle and a second actual trajectory of the second vehicle; determine a divergence between the first actual trajectory and the second actual trajectory; determine, based on analysis of the at least one image, that the divergence between the first actual trajectory and the second actual trajectory is indicative of the lane split feature; and update a vehicle road navigation model to include a first target trajectory and a second target trajectory that branches from the first target trajectory after the lane split feature.



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(81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Published:**

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(88) **Date of publication of the international search report:**  
30 July 2020 (30.07.2020)

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2019/063326

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-19, 31

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/US2019/063326

**A. CLASSIFICATION OF SUBJECT MATTER**  
 INV. G01C21/32 G01C21/36 G06K9/00  
 ADD.  
 According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**  
 Minimum documentation searched (classification system followed by classification symbols)  
 G01C G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/095682 A1 (WILSON CHRISTOPHER KENNETH HOOVER [US]) 19 April 2012 (2012-04-19) paragraphs [0061], [0069], [0078], [0081] - [0084], [0100], [0109], [0144] - [0147]; figures 1, 2, 7, 11 -----	1-19,31
A	EP 1 959 236 A1 (AISIN AW CO [JP]) 20 August 2008 (2008-08-20) figures 1, 6 -----	6,17
A	DE 10 2013 211696 A1 (BAYERISCHE MOTOREN WERKE AG [DE]) 24 December 2014 (2014-12-24) the whole document -----	6

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search <b>2 March 2020</b>	Date of mailing of the international search report <b>25/06/2020</b>
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer <b>Kuhn, Robert</b>
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2019/063326

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 2012095682	A1	19-04-2012	EP 2443418 A1	25-04-2012
			TW 201105936 A	16-02-2011
			US 2012095682 A1	19-04-2012
			US 2013158794 A1	20-06-2013
			WO 2010147730 A1	23-12-2010
-----				
EP 1959236	A1	20-08-2008	AT 483953 T	15-10-2010
			CN 101246010 A	20-08-2008
			EP 1959236 A1	20-08-2008
			JP 4861850 B2	25-01-2012
			JP 2008197905 A	28-08-2008
			US 2008208460 A1	28-08-2008
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DE 102013211696	A1	24-12-2014	NONE	
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**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-19, 31

mapping of lane splits or lane merges based on at least one image associated with a road segment and a determined divergence or convergence between a first and a second vehicle trajectory along the road segment.

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2. claims: 20-30, 32

determining of a navigational action to cause a host vehicle to navigate along a determined target trajectory of a vehicle road navigation module, based on information indicative of an environment of a host vehicle.

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