

PATENT COOPERATION TREATY
PCT
INTERNATIONAL SEARCH REPORT
(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 1115965	FOR FURTHER ACTION	
See Form PCT/ISA/220 as well as, where applicable, item 5 below.		
International application No. PCT/US2018/065041	International filing date (<i>day/month/year</i>) 11/12/2018	(Earliest) Priority Date (<i>day/month/year</i>) 07/12/2018
Applicant DIDI RESEARCH AMERICA, LLC		

This international search report has been prepared by this International Search Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 5 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of:

- the international application in the language in which it was filed.
- a translation of the international application into _____ which is the language of a translation furnished for the purpose of international search (Rules 12.3(a) and 23.1(b)).

b. This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. **Certain claims were found unsearchable** (see Box No. II).

3. **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

- the text is approved as submitted by the applicant.
- the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- the text is approved as submitted by the applicant.
- the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

- a. the figure of the **drawings** to be published with the abstract is Figure No. 7
 - as suggested by the applicant.
 - as selected by this Authority, because the applicant failed to suggest a figure.
 - as selected by this Authority, because this figure better characterizes the invention.
- b. none of the figures is to be published with the abstract.

Box No. IV Text of the abstract (Continuation of item 5 of the first sheet)

An array of micro mirrors is used to beam steer a laser for Light Detection and Ranging (LiDAR) applications. The micro mirrors in the array are driven in a nonlinear motion to synchronize motion. The system comprises a spring, a combdrive actuator with stator and rotor fingers, a shaft, a limiter to limit a range of mirror motion. A method of using the array comprises steps of providing drive signals, determining oscillation of mirrors out of sync, altering the drive signal to change phase difference. The method comprises steps of identifying a steady state of operation and starting to rotate the system at an initial phase to operate at the steady state. The method comprises steps of moving mirrors having first and second steady states of operations and configuring the mirrors to have starting parameters to operate at the first steady state.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2018/065041

A. CLASSIFICATION OF SUBJECT MATTER**G02B 26/10 (2006.01)** G01S 17/93 (2006.01) G01S 7/481 (2006.01)

According to International Patent Classification (IPC)

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G02B, G01S, B81B

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)

Fampat: LIDAR, LADAR, laser radar, light, beam, optical, detect, range, scan, deflect, direct, guide, mirror, reflective, combdrive, interdigit, finger, actuator, microelectromechanical, MEMS, micromechanical, micro-opto-electromechanical, MOEMS, synchronization, sync, micromirror, limiter, block, restrain, stop, non-linear, steady, spring, oscillate, resonate, 激光雷达, 激光, 光, 束流, 波束, 测, 转向, 偏转, 控制, 扫描, 镜, 反射, 反光, 梳状驱动, 梳, 叉指, 微机电, 微型机械, 微光机电, 微镜, 同步, 限制, 停止, 阻止, 非线性, 稳定, 平稳, 弹, 共振, 谐振, 振荡 and other related terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2005/0036196 A1 (BARNEA D. I. ET AL.) 17 February 2005 Para. [0002], [0072], [0076], and fig. 19a	1-16, 20
X A	US 2017/0153445 A1 (GERSON Y. ET AL.) 1 June 2017 Para. [0001], [0025]-[0040], and figs. 1, 3	17-19, 21-40
A	US 2012/0228460 A1 (SUZUKI J.) 13 September 2012 Whole document, especially para. [0140]-[0148], and fig. 10	
A	CN 106353891 A (SHANXI UNIVERSITY OF SCIENCE & TECHNOLOGY) 25 January 2017 Whole document, especially para. [0017], and fig. 1 of the original non-English language document (a machine translation is enclosed only for your reference)	

 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

"E" earlier application or patent but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search

12/03/2019

(day/month/year)

Date of mailing of the international search report

22/03/2019

(day/month/year)

Name and mailing address of the ISA/SG

IP OS
Intellectual Property Office of Singapore
51 Bras Basah Road
#01-01 Manulife Centre
Singapore 189554

Email: pct@ipos.gov.sg

Authorized officer

Huang Wen (Dr)

IPOS Customer Service Tel. No.: (+65) 6339 8616

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2018/065041

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012/0281266 A1 (MOIDU A. J. K.) 8 November 2012 Whole document, especially para. [0038], and fig. 1A	
A	CN 1667449 A (OPUS MICROSYSTEMS) 14 September 2005 Whole document, especially pg. 3, ln. 19, and fig. 2 of the original non-English language document (a machine translation is enclosed only for your reference)	

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/US2018/065041

Note: This Annex lists known patent family members relating to the patent documents cited in this International Search Report. This Authority is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005/0036196 A1	17/02/2005	NONE	
US 2017/0153445 A1	01/06/2017	NONE	
US 2012/0228460 A1	13/09/2012	EP 2503681 A1 WO 2011/061833 A1 CN 102648577 A	26/09/2012 26/05/2011 22/08/2012
CN 106353891 A	25/01/2017	NONE	
US 2012/0281266 A1	08/11/2012	EP 2447755 A1	02/05/2012
CN 1667449 A	14/09/2005	NONE	