**IN THE UNITED STATES DISTRICT COURT**
**FOR THE NORTHERN DISTRICT OF ILLINOIS**
**EASTERN DIVISION**

| | |
|---|---|
| BRAIN CORPORATION,<br><br>Plaintiff,<br><br>v.<br><br>AVIDBOTS CORP. AND AVIDBOTS USA CORP.,<br><br>Defendant. | Case No. 1:24-cv-12569<br><br>Honorable Jeremy C. Daniel |

**DEFENDANT AVIDBOTS'S SECOND SUPPLEMENTAL NON-INFRINGEMENT AND INVALIDITY CONTENTIONS**



Brain Corporation EX2008
IPR2025-01603

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## TABLE OF EXHIBITS

| Exhibit | Title |
|---|---|
| | '780 Patent Charts |
| A-0 | Non-Infringement Contentions of U.S. Patent No. 10,001,780 |
| A-1 | U.S. Patent No. 10,667,664 ("Sheikh") |
| A-2 | Francisco Amoros et al., *Global Appearance Applied to Visual Map Building and Path Estimation Using Multiscale Analysis*, Hindawi Publishing Corporation, Mathematical Problems in Engineering, Vol. 2014 Article ID 365417 ("Amoros") |
| A-3 | Kazushi Nakazawa et al., *Movement Control of Accompanying Robot Based on Artificial Potential Field Adapted to Dynamic Environments*, Elec. Engin. in Japan, Vol. 192 ("Nakazawa") |
| A-4 | Wang Tianmiao et al., *Mobile Robot Control Based on Dynamic Potential*, Chinese J. of Sys. Engin. & Elec. Vol. 3 ("Wang") |
| A-5 | U.S. Patent No. 9,286,810 ("Eade") |
| A-6 | U.S. Patent No. 9,380,922 ("Duffley") |
| A-7 | Matthias Nieuwenhuisen et al., *Predictive Potential Field-Based Collision Avoidance for Multicopters*, Remote Sensing and Spatial Information Sciences, Volume XL-1 ("Nieuwenhuisen") |
| A-8 | Hani Safadi, *Local Path Planning Using Virtual Potential Field*, McGill University School of Computer Science ("Safadi") |
| A-9 | U.S. Patent Pub. 2008/0059015 ("Whittaker") |
| A-10 | U.S. Patent No. 5,758,298 ("Guldner") |
| A-11 | Product and System Art Identified in Table III.B.1.c |
| A-12 | Avidbots System Prior Art Identified in Section III.B.1.c |
| | '539 Patent Charts |
| B-0 | Non-Infringement Contentions of U.S. Patent No. 10,379,539 |
| B-1 | U.S. Patent No. 10,667,664 ("Sheikh") |
| B-2 | U.S. Patent No. 9,286,810 ("Eade") |
| B-3 | U.S. Patent Pub. 2008/0059015 ("Whittaker") |
| B-4 | U.S. Patent No. 5,758,298 ("Guldner") |
| B-5 | Francisco Amoros et al., *Global Appearance Applied to Visual Map Building and Path Estimation Using Multiscale Analysis*, Hindawi Publishing Corporation, Mathematical Problems in Engineering, Vol. 2014 Article ID 365417 ("Amoros") |
| B-6 | Brett R. Fajen et al., *A Dynamical Model of Visually-Guided Steering, Obstacle Avoidance, and Route Selection*," Int'l J. of Comp. Vision, Vol. 54 ("Fajen") |

| Exhibit | Title |
|---|---|
| B-7 | Matthias Nieuwenhuisen et al., *Predictive Potential Field-Based Collision Avoidance for Multicopters*, Remote Sensing and Spatial Information Sciences, Volume XL-1 ("Nieuwenhuisen") |
| B-8 | Hani Safadi, *Local Path Planning Using Virtual Potential Field*, McGill University School of Computer Science ("Safadi") |
| B-9 | Wang Tianmiao et al., *Mobile Robot Control Based on Dynamic Potential*, Chinese J. of Sys. Engin. & Elec. Vol. 3 ("Wang") |
| B-10 | Product and System Art Identified in Table III.C.1.c |
| B-11 | Avidbots System Prior Art Identified in Section III.C.1.c |
| '325 Patent Charts | |
| C-0 | Non-Infringement Contentions of U.S. Patent No. 10,274,325 |
| C-1 | Stachness et al., *Springer Handbook of Robotics, Chapter 46: Simultaneous Localization and Mapping*, Springer (2d ed.) ("SLAM Handbook") |
| C-2 | U.S. Patent No. 9,952,053 ("Fong (053)") |
| C-3 | U.S. Patent No. 9,538,892 ("Fong (892)") |
| C-4 | Peter Biber and Wolfgang Straßer, *nScan-Matching: Simultaneous Matching of Multiple Scans and Application to SLAM*, Proceedings 2006 IEEE International Conference on Robotics and Automation, 2006 ("Biber") |
| C-5 | Lu and Milios, *Globally Consistent Range Scan Alignment for Environment Mapping*, 4 Autonomous robots 333–49 (1997) ("Lu") |
| C-6 | U.S. Patent No. 10,667,664 ("Sheikh") |
| C-7 | Product and System Art Identified in Table III.D.1.c |
| C-8 | Avidbots System Prior Art Identified in Section III.D.1.c |
| '576 Patent Charts | |
| D-0 | Non-Infringement Contentions of U.S. Patent No. 10,823,576 |
| D-1 | Stachness et al., *Springer Handbook of Robotics, Chapter 46: Simultaneous Localization and Mapping*, Springer (2d ed.) ("SLAM Handbook") |
| D-2 | U.S. Patent No. 9,952,053 ("Fong (053)") |
| D-3 | Peter Biber and Wolfgang Straßer, *nScan-Matching: Simultaneous Matching of Multiple Scans and Application to SLAM*, Proceedings 2006 IEEE International Conference on Robotics and Automation, 2006 ("Biber") |
| D-4 | Lu and Milios, *Globally Consistent Range Scan Alignment for Environment Mapping*, 4 Autonomous robots 333–49 (1997) ("Lu") |
| D-5 | U.S. Patent No. 9,233,472 ("Angle") |
| D-6 | U.S. Patent No. 10,667,664 ("Sheikh") |

| Exhibit | Title |
|---|---|
| D-7 | Product and System Art Identified in Table III.E.1.c |
| D-8 | Avidbots System Prior Art Identified in Section III.E.1.c |
| | '436 Patent Charts |
| E-0 | Non-Infringement Contentions of U.S. Patent No. 10,728,436 |
| E-1 | JPH10206150 ("Matsuyama") |
| E-2 | JP2012189874 ("Asakura") |
| E-3 | JP2009216600 ("Oita") |
| E-4 | U.S. Patent No. 8,542,875 ("Eswara") |
| E-5 | U.S. Patent No. 9,076,214 ("Tsutsumi") |
| E-6 | U.S. Patent Pub. No. 2013/0044951 ("Cherng") |
| E-7 | U.S. Patent No. 9,122,948 ("Zhu") |
| E-8 | Product and System Art Identified in Table III.F.1.c |
| E-9 | WO 2011/146259 A2 ("Rosenstein") |

Pursuant to L.P.R. 2.3, Defendant Avidbots Corp. and Avidbots USA Corp. (collectively "Defendant" or "Avidbots") hereby provides its Initial Non-Infringement and Invalidity Contentions ("Initial Contentions") concerning the non-infringement and invalidity of U.S. Patent Nos. 10,001,780 ("the '780 Patent"), 10,379,539 ("the '539 Patent"), 10,274,325 ("the '325 Patent"), 10,823,576 ("the '576 Patent"), and 10,728,436 ("the '436 Patent") (collectively, the "Asserted Patents").

## I. INTRODUCTION

On March 31, 2025, Plaintiff Brain Corporation ("Plaintiff" or "Brain") served its Disclosure of Asserted Claims and Preliminary Infringement Contentions ("Infringement Contentions") and asserted the following claims (collectively, the "Asserted Claims"):

| Asserted Patent | Asserted Claims |
|---|---|
| '780 Patent | 1–14 and 17–18 |
| '539 Patent | 1, 3, 4, 6–8, 10–14, and 16 |
| '325 Patent | 1, 5, 7, 14, and 17 |
| '576 Patent | 12, 17, 21–24, and 36 |
| '436 Patent | 1–3, 6–7, 9, 11, and 16–18 |

Avidbots contends that it does not infringe each of the Asserted Claims, and that each of the Asserted Claims is invalid under at least 35 U.S.C. §§ 101, 102, 103, and/or 112. The non-infringement, prior art and invalidity arguments identified in these Initial Non-Infringement and Invalidity Contentions are identified with respect to the currently asserted claims only. Avidbots reserves the right to supplement these Initial Non-Infringement and Invalidity Contentions and rely on additional references with respect to claims later identified by Plaintiff or based on newly discovered evidence. Avidbots further reserves the right to modify, amend, or supplement these Initial Non-Infringement and Invalidity Contentions to the extent the Court permits Plaintiff to



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amend, supplement, or otherwise modify its Infringement Contentions, including by modifying the claims asserted, and to the full extent permitted by the Local Patent Rules.

In addition, Plaintiff's Infringement Contentions are entirely deficient, and fail to provide allegations as to how the accused products infringe each and every claim element. *See* Defendant's Exhibits A0, B0, C0, D0, and E0 (Apr. 14, 2025). Plaintiff has therefore prejudiced Avidbots's ability to understand, for purposes of preparing its Initial Contentions, what Plaintiff alleges to be the scope of the Asserted Claims and the scope of the prior art. Avidbots reserves the right to amend these Initial Non-Infringement and Invalidity Contentions if and when Plaintiff provides proper infringement contentions as to each Asserted Claim.

**A. Priority Date**

The Initial Contentions are based on the earliest alleged priority date identified by Plaintiff in its Infringement Contentions.

Nothing in the Initial Contentions shall be understood as an agreement that any Asserted Patent is entitled to claim priority to the dates identified by Plaintiff, or to any provisional priority document. Avidbots does not agree that any of the evidence produced with Plaintiff's Infringement Contentions or shortly after service of Plaintiff's Infringement Contentions demonstrates that the Asserted Patents are entitled to the priority dates Plaintiff asserts. Avidbots reserves the right to amend the Initial Contentions and identify additional prior art references if Plaintiff is permitted by the Court to later assert an even earlier priority date, or if the asserted priority dates are found to be invalid, and later priority dates are appropriate.

Any reference to an "asserted priority date" in the Initial Contentions refers to the priority date identified in Plaintiff's Infringement Contentions. Reference to a "priority date" or an "asserted priority date" should not be construed to mean that Avidbots agrees that any of the Asserted Patents are in fact entitled to such priority date, or that Plaintiff has provided proper

notice as to its contentions for a priority date. To the extent Plaintiff alleges that any prior art reference or system relied on in the Initial Invalidity Contentions does not actually qualify as prior art to an Asserted Patent, Avidbots reserves the right to rebut those allegations (*e.g.*, by demonstrating an earlier date for the challenged prior art and/or a later priority date for a particular Asserted Patent and/or Asserted Claim).[1] Likewise, to the extent Plaintiff successfully establishes a priority date before any of the prior art references relied on by Avidbots, then those references serve as evidence of secondary considerations of obviousness, particularly, contemporaneous invention by others.

**B. Claim Construction**

The Initial Non-Infringement and Invalidity Contentions are based on (1) Avidbots's present understanding of the Asserted Claims, and (2) the claim constructions Plaintiff appears to be using based on the Infringement Contentions, all without regard to whether Avidbots agrees with Plaintiff's apparent or expressed claim constructions. Further and in light of Brain's deficient Infringement Contentions, Brain's claim constructions appear to be inconsistent and/or unsupported. Avidbots reserves the right to supplement or otherwise amend these Initial Non-Infringement and Invalidity Contentions in response to any court-ordered clarifications on claim constructions, any report from any expert witness for Plaintiff regarding the scope of the claims, any briefing filed by Plaintiff relating to the scope of the claims, and any position taken by Plaintiff concerning claim scope, infringement, or invalidity.

Avidbots takes no position on any matter of claim construction in these Initial Non-Infringement and Invalidity Contentions. If Avidbots's disclosures herein are consistent with any

[1] Avidbots reserves the right to rely on additional documents and evidence to rebut any efforts by Plaintiff to allege any reference was not publicly available or otherwise available as prior art.

explicit, apparent, or implied claim constructions in Plaintiff's Infringement Contentions, no inference is intended and no inference should be drawn that Avidbots agrees with any of Plaintiff's apparent claim constructions. Any statement herein describing or tending to describe any claim element is provided solely for the purpose of understanding and/or applying the cited prior art. In addition, to the extent that these Initial Non-Infringement and Invalidity Contentions rely on or otherwise embody a particular order in which the steps of method claims are performed, Avidbots does not necessarily propose that the method claims must be limited to such order, although Avidbots may later propose such an order.

Nothing herein should be read to suggest that Avidbots agrees that any particular claim term is sufficiently definite, enabled or supported by the written description to meet the requirements of 35 U.S.C. § 112. Likewise, nothing herein should be read to suggest that Avidbots agrees that the preamble of any claim is or is not limiting.

Prior art not included in these Initial Non-Infringement and Invalidity Contentions, whether or not now known to Avidbots, might become relevant depending on the claim constructions proposed by the parties and/or the Court's claim construction rulings. Avidbots reserves all rights to supplement or modify the positions and information in these Initial Non-Infringement and Invalidity Contentions, including, without limitation, the prior art and grounds of invalidity set forth herein, after the Court has construed any term of the Asserted Claims.

## C. Ongoing Discovery and Supplementation

Avidbots bases these Initial Non-Infringement and Invalidity Contentions on its current knowledge and understanding of the Asserted Patents, Plaintiff's Infringement Contentions, and other facts and information available as of the date of these contentions. Plaintiff's Infringement Contentions are deficient and fail to provide sufficient allegations as to how the accused products infringe each and every claim limitation; rather, they simply parrot the claim language and then

cite various documents that, in many instances, facially do not meet the claim language. Plaintiff therefore has prejudiced Avidbots's ability to understand, for purposes of preparing these Initial Non-Infringement and Invalidity Contentions, what Plaintiff alleges to be the scope of the Asserted Claims. Avidbots's Initial Non-Infringement and Invalidity Contentions generally are set forth with equal or greater specificity, and in no instance with less specificity, than Plaintiff's Infringement Contentions. Avidbots reserves the right to amend these Initial Non-Infringement and Invalidity Contentions if and when Plaintiff provides proper infringement contentions as to each Asserted Claim.

Avidbots's investigation into prior art—including prior art identified in these disclosures, third-party prior art (including system art and related evidence), documents, and knowledgeable witnesses—is ongoing. Furthermore, Avidbots anticipates seeking and obtaining discovery, including third-party discovery, that further evidences and supports the invalidity of the Asserted Claims. Thus, Avidbots expects to present additional information and evidence in support of these Initial Non-Infringement and Invalidity Contentions, and to revise, amend, and/or supplement these Initial Non-Infringement and Invalidity Contentions accordingly, including through its Final Non-Infringement and Invalidity Contentions, in a manner consistent with the Federal Rules of Civil Procedure and the Court's rules and applicable orders.

Avidbots further reserves the right to rely on statements or admissions from those owing a duty of candor, such as named inventors, prosecution counsel, and others involved in the prosecution of the patent applications or related applications, concerning the scope of the prior art relevant to the Asserted Patents found in, *inter alia*, the following: the respective prosecution histories of the Asserted Patents and related patent applications; any deposition testimony of the

named inventors; and the papers filed and any evidence submitted by Plaintiff in connection with this litigation or any other litigation or invalidity proceeding involving the Asserted Patents.

Avidbots reserves the right to modify and/or supplement these Initial Non-Infringement and Invalidity Contentions with an explanation of why the Asserted Claims are invalid under 35 U.S.C. § 102(f)–(g) in the event Avidbots obtains additional evidence that the named inventors did not invent (either alone or in conjunction with others) the subject matter claimed or that the claimed subject matter was invented by others.

Prior art not identified in this disclosure, whether known or not known to Avidbots, may become relevant, including prior art concerning the state of the art at the time of invention, as well as simultaneous or near-simultaneous independent invention by others. For instance, Avidbots is currently unaware of the extent, if any, to which Plaintiff will contend that limitations of the Asserted Claims are not disclosed in the prior art identified by Avidbots. To the extent that such an issue arises, Avidbots reserves the right to identify other references that would disclose, practice, or render obvious the allegedly missing limitation(s) of the disclosed subject matter.

**D. Prior Art Identification and Citations Thereto**

In these Initial Non-Infringement and Invalidity Contentions, Avidbots identifies specific, exemplary portions of prior art references that disclose the elements of the Asserted Claims. While Avidbots has identified exemplary disclosures for each element, they do not necessarily identify every disclosure of the same element in each prior art reference. A person of ordinary skill in the art would read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field and would rely upon other information including other publications and general scientific or engineering knowledge. Avidbots therefore reserves the right to rely upon other unidentified portions of the prior art references and on other publications

and prior art products and expert testimony to provide context and to aid in the understanding and interpretation of the identified portions of the prior art.

Avidbots also reserves the right to rely upon (1) other portions of the cited prior art references, other publications, prior art products, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including on the basis of modifying or combining certain cited references; (2) admissions relating to prior art in the Asserted Patents or related patents, the prosecution histories of the Asserted Patents or related patents; (3) counterparts of any U.S. or foreign patents identified in these Initial Non-Infringement and Invalidity Contentions; and (4) any prior art references, other publications, prior art products, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art used during any proceeding at the Patent Office involving the Asserted Patents. For prior art identified as system art or as prior invention, Avidbots reserves the right to rely on embodiments of those systems (whether in physical, digital, or other form) to demonstrate its invalidity arguments. Where a prior art reference includes citations to other references, those other references are considered incorporated by reference for context.

The references discussed in the claim charts may disclose the elements of the Asserted Claims explicitly and/or inherently, and/or they may be relied upon to show the state of the art in the relevant time frame. The suggested obviousness combinations are provided in the alternative to Avidbots's anticipation contentions and are not to be construed to suggest that any reference included in the combinations is not by itself anticipatory.

Where Avidbots identifies in the claim charts a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure as well as any text relating to the figure in the specification and prosecution history in addition to the figure

itself. Similarly, where an identified portion of text refers to a figure or other material, the identification should be understood to include the referenced figure or other material as well.

Avidbots's identification of a prior art document or system as a "primary" (or "base") reference, or a "secondary" (or "supplemental") reference, is for purposes of convenience only, and nothing prevents Avidbots from relying on any reference disclosed in these Initial Non-Infringement and Invalidity Contentions in any way in a combination of prior art references. *Schwendimann v. Neenah, Inc.*, 82 F.4th 1371, 1384 (Fed. Cir. 2023) ("[C]haracterizing references "as 'primary' and 'secondary' is merely a matter of presentation with no legal significance.").

**E. No Patentable Weight**

Avidbots reserves the right to argue that various portions of the Asserted Claims, such as an intended use or result, nonfunctional descriptive material, and certain preamble language, are entitled to no patentable weight. Mapping of a portion of an Asserted Claim to a prior art reference does not represent that such portion of the claim is entitled to patentable weight when comparing the claimed subject matter to the prior art.

**F. Unenforceability**

Because discovery is ongoing, Avidbots reserves the right to argue that the Asserted Patents are unenforceable. For instance, Avidbots reserves the right to supplement, amend, or modify its Initial Contentions if evidence is developed in the course of litigation that shows the patentee and/or its agents obtained the Asserted Patents through inequitable conduct before the United States Patent and Trademark Office. As a further, non-limiting example, Avidbots also reserves the right to supplement, amend, or modify its Initial Contentions if evidence is developed that shows Brain has misused the Asserted Patents by asserting them against Avidbots in a sham litigation or is seeking to expand the Asserted Patents' scope or duration.

## II. STATE OF THE ART PRIOR TO THE ASSERTED PATENTS[2]

The subject matter of the Asserted Claims was well understood to those of skill in the art as of the respective priority dates of the Asserted Patents. To describe the state of the art at the time of the alleged inventions, in addition to the references listed on the face of the Asserted Patents and those references listed in Section III and charted in Exhibits A1 through E9, Avidbots may rely on at least the references listed below and any admitted prior art discussed in the Asserted Patents and file histories[3]:

### A. Prior Art Patents / Patent Publications

| Patent / Publication No. | First Named Inventor | Date of Issue / Publication |
|---|---|---|
| U.S. Patent No. 5,111,401 | Hobart Evertt Jr. | May 5, 1992 |
| U.S. Patent No. 5,696,675 | Kyoko Nakamura | Dec. 9, 1997 |
| U.S. Patent No. 5,758,298 | Jurgen Guldner | May 26, 1998 |
| U.S. Patent No. 5,793,900 | Illah Reza Nourbakhsh | Aug. 11, 1998 |
| U.S. Patent No. 5,793,934 | Rudolf Bauer | Aug. 11, 1998 |
| U.S. Patent No. 6,667,592 | Stephen Jacobs | Dec. 23, 2003 |
| U.S. Patent No. 7,170,252 | Akira Maeki | Jan. 30, 2007 |
| U.S. Patent No. 7,502,065 | Naoto Nakahara | Mar. 10, 2009 |
| U.S. Patent No. 7,965,890 | Eran Marcus | June 21, 2011 |
| U.S. Patent No. 8,185,239 | You-Wei Teng | May 22, 2012 |
| U.S. Patent No. 8,300,890 | Deepak Gaikwad | Oct. 30, 2012 |
| U.S. Patent No. 8,542,875 | Lalitha M. Eswara | Sept. 24, 2013 |
| U.S. Patent No. 8,903,589 | Boris Sofman | Dec. 2, 2014 |
| U.S. Patent No. 8,918,241 | Tien-Chen Chen | Dec. 23, 2014 |

[2] To the extent that any prior art reference listed in §§ II.A–C was not disclosed by July 1, 2014, Avidbots is not contending herein that the reference reflected the state of the art at the time of the alleged invention of the '436 Patent.

[3] Per Avidbots's email correspondence dated April 16, 2025, Avidbots contends at this time that only the charted prior art references herein (Exhibits A1–E9) invalidate Brain's Asserted Claims under Sections 102 and/or 103, whether alone or in combination. Avidbots reserves the right to supplement these Contentions, including its charted references, in view of Avidbots's further investigation into the prior art, supplementation by or additional discovery from Brain, or orders of the Court. In addition, Avidbots reserves the right to rely on non-charted references in describing the state of the art. (*See* Avidbots (ElDessouki) 4/16/2025 Email to Brain.)

| Patent / Publication No. | First Named Inventor | Date of Issue / Publication |
|---|---|---|
| U.S. Patent No. 8,948,913 | Sunglok Choi | Feb. 3, 2015 |
| U.S. Patent No. 8,954,191 | Dong Hoon Yi | Feb. 10, 2015 |
| U.S. Patent No. 9,076,214 | Shohei Tsutsumi | Jul. 7, 2015 / Feb. 14, 2013 |
| U.S. Patent No. 9,122,948 | Jiajun Zhu | Sept. 1, 2015 / Oct. 5, 2011 |
| U.S. Patent No. 9,174,672 | Shuqing Zeng | Nov. 3, 2015 |
| U.S. Patent No. 9,192,869 | Toshio Moriya | Nov. 24, 2015 |
| U.S. Patent No. 9,208,384 | William Y. Conwell | Dec. 8, 2015 / Nov. 14, 2008 |
| U.S. Patent No. 9,216,745 | Paul A. Beardsley | Dec. 22, 2015 |
| U.S. Patent No. 9,233,472 | Colin Angle | Jan. 12, 2016 |
| U.S. Patent No. 9,286,810 | Ethan Eade | Mar. 15, 2016 |
| U.S. Patent No. 9,304,001 | Soon Yong Park | Apr. 5, 2016 |
| U.S. Patent No. 9,380,922 | Samuel Duffley | Jul. 5, 2016 |
| U.S. Patent No. 9,400,501 | Mark Schnittman | Jul. 26, 2016 |
| U.S. Patent No. 9,404,756 | Phillip Fong | Aug. 2, 2016 |
| U.S. Patent No. 9,519,289 | Mario Munich | Dec. 13, 2016 / May 26, 2016 |
| U.S. Patent No. 9,534,899 | Jens-Steffen Gutmann | Jan. 3, 2017 / May 30, 2013 |
| U.S. Patent No. 9,538,892 | Phillip Fong | Jan. 10, 2017 / Apr. 10, 2014 |
| U.S. Patent No. 9,864,377 | Bruce Welty | Jan. 9, 2018 / Apr. 1, 2016 |
| U.S. Patent No. 9,910,444 | Ethan Eade | Mar. 6, 2018/Jun. 2, 2016 |
| U.S. Patent No. 9,952,053 | Phillip Fong | Apr. 24, 2018 / Aug. 1, 2016 |
| U.S. Patent No. 10,093,021 | Aliakbar Aghamohammadi | Oct. 9, 2018 / Jun. 24, 2016 |
| U.S. Patent No. 10,209,063 | Peter Elving Anderson-Sprecher | Feb. 19, 2019 / Oct. 3, 2015 |
| U.S. Patent No. 10,383,497 | Seung-beom Han | Aug. 20, 2019 |
| U.S. Patent No. 10,667,664 | Faizan Sheikh | Jun. 2, 2020 / Oct. 27, 2016 |
| U.S. Patent No. 11,927,965 | Ali Ebrahimi Afrouzi | Mar. 12, 2024 / Feb. 29, 2016 |
| U.S. Patent Pub. 2004/0117079 | Jarl Hulden | Jun. 17, 2004 |
| U.S. Patent Pub. 2006/0188168 | Vitaly S. Sheraizin | Aug. 24, 2006 |
| U.S. Patent Pub. 2008/0059015 | William Whittaker | Mar. 6, 2008 |
| U.S. Patent Pub. 2008/0294338 | Nakju Doh | Nov. 27, 2008 |
| U.S. Patent Pub. 2012/0121161 | Ethan Eade | May 17, 2012 |
| EU Patent No. 1 240 562 | Bret Wallach | Jun. 16, 2004 |
| EU Patent No. 2 343 615 | Shoji Tanaka | Oct. 31, 2018/Jul. 13, 2011 |
| Japanese Patent Pub. No. 10206150A (also published as Japanese Patent No. 3265212) | Takashi Matsuyama | Aug. 7, 1998 |

| Patent / Publication No. | First Named Inventor | Date of Issue / Publication |
|---|---|---|
| Japanese Patent Pub. No. 2009216600 | Shinya Oita | Sept. 24, 2009 |
| Japanese Patent Pub. No. 2012-189874 (also published as Japanese Patent No. 5769455) | Yasuo Asakura | Oct. 4, 2012 |
| KR Patent No. 101048098 | Lee Do-heon | Jul. 11, 2011 |
| KR Patent No. 10-2010-0027683 | Le Do-heon | Mar. 11, 2010 |
| WO 2011/146259 A2 | Michael T. Rosenstein | Nov. 24, 2011 |
| JP Patent App. No. 2009288930 | Masaki Takahashi | Dec. 10, 2009 |
| U.S. Patent Pub. No. 2015/0261223 | Philip Fong | Sep. 17, 2015 |

**B. Prior Art Publications**

| Citation | Publication Date |
|---|---|
| Basic Research Series: Optical Information Technology State-of-the-Art Report | 1993 |
| Bernard Feverjon et al., *A Local Based Approach for Path Planning of Manipulators with a High Number of Degrees of Freedom*, IEEE Int'l Conf. on Robotics and Automation | 1987 |
| Brett R. Fajen et al., *A Dynamical Model of Visually-Guided Steering, Obstacle Avoidance, and Route Selection*," Int'l J. of Comp. Vision, Vol. 54 | 2003 |
| Christoph Rosmann et al., *Efficient Trajectory Optimization Using a Spares Model*, 2013 Eur. Conf. on Mobile Robots | Sep. 2013 |
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| David G. Lowe, *Object Recognition from Local Scale-Invariant Features* | 1999 |
| Dieter Fox et al., *The Dynamic Window Approach to Collision Avoidance*, IEEE Robotics and Automation Magazine, Vol. 4(1) | Apr. 1997 |
| Francisco Amoros et al., *Global Appearance Applied to Visual Map Building and Path Estimation Using Multiscale Analysis*, Hindawi Publishing Corporation, Mathematical Problems in Engineering, Vol. 2014 Article ID 365417 | Jul. 22, 2014 |
| Garry Berkovic and Ehud Shafir*, Optical Methods for Distance and Displacement Measurements* | Sept. 11, 2012 |
| Handbook of Optical Systems, Vol. 4: Survey of Optical Instruments | 2008 |
| Hani Safadi, *Local Path Planning Using Virtual Potential Field*, McGill University School of Computer Science | Apr. 18, 2007 |
| J.M. Rueger, Electronic Distance Measurement, 3rd Ed. | 1990 |

| Citation | Publication Date |
|---|---|
| J.M. Rueger, Electronic Distance Measurement, 4th Ed. | 1996 |
| Kazushi Nakazawa et al., *Movement Control of Accompanying Robot Based on Artificial Potential Field Adapted to Dynamic Environments*, Elec. Engin. in Japan, Vol. 192 | Feb. 2014 |
| Khalid Yousif et al., *An Overview to Visual Odometry and Visual SLAM: Applications to Mobile Robotics,* Intell. Ind. Syst. Vol. 1, 289 | Nov. 13, 2015 |
| Laurent Itti, Christof Koch, and Ernst Niebur, *A Model of Saliency-Based Visual Attention for Rapid Scene Analysis* | Nov. 1998 |
| Lina J. Karam, Nabil G. Sadaka, Rony Ferzli, and Zoran A. Ivanovski, *An Efficient Selective Perceptual-Based Super-Resolution Estimator* | Dec. 2011 |
| Lu and Milios, *Globally Consistent Range Scan Alignment for Environment Mapping*, Autonomous robots, 4 Autonomous robots 333–49 (1997) | 1997 |
| Lu Yin et al., *A New Potential Field Method for Mobile Robot Path Planning in the Dynamic Environments*, Asian J. of Control, Vol. 11(2) | Mar. 2009 |
| Matthias Nieuwenhuisen et al., *Predictive Potential Field-Based Collision Avoidance for Multicopters*, Remote Sensing and Spatial Information Sciences, Volume XL-1 | Sep. 4, 2013 |
| Mejdl Safran and Steven Haar, *Arduino and Android Powered Object Tracking Robot* | Nov. 27, 2012 |
| Oscar Montiel et al., *Optimal Path Planning Generation for Mobile Robots Using Parallel Evolutionary Artificial Potential Field*, J. Intell. Robot Sys. | Sep. 20, 2014 |
| Oussama Khatib, *Real-Time Obstacle Avoidance for Manipulators and Mobile Robots*, Int'l J. of Robotics Research, Vol. 5(1) | 1986 |
| P. Payeur, *Improving Robot Path Planning Efficiency with Probabilistic Virtual Environment Models*, IEEE Int'l Conf. on Virtual Environments | Jul. 2004 |
| Peter Biber and Wolfgang Straßer, *nScan-Matching: Simultaneous Matching of Multiple Scans and Application to SLAM*, Proceedings 2006 IEEE International Conference on Robotics and Automation, 2006 | 2006 |
| Pierre Melchior et al., *Robust Path Planning for Mobile Robot Based on Fractional Attractive Force*, 2009 American Control Conf. | Jun. 2009 |
| Qian Jia & Xingsong Wang, *An Improved Potential Field Method for Path Planning*, 2010 Chinese Control and Decision Conference | 2010 |
| Qian Xu, Chaitali Chakrabarti, and Lina J. Karam, *A Distributed Canny Edge Detector and its Implementation on FGPA* | 2011 |
| Richard Szeliski, *Image Alignment and Stitching: A Tutorial*, Foundations and Trends in Computer Vol. 2 | 2006 |
| Sean Quinlan & Oussama Khatib, *Elastic Bands: Connecting Path Planning and Control*, IEEE Int'l Conference on Robotics and Automation | 1998 |
| Srenivas Varadarajan and Lina J. Karam, *An Improved Perception-Based No-Reference Objective Image Sharpness Metric Using Iterative Edge Refinement* | 2008 |

| Citation | Publication Date |
|---|---|
| Srenivas Varadarajan, Chaitali Chakrabarti, Lina J. Karam, and Judit Martinez Bauza, *A Distributed Psycho-Visually Motivated Canny Edge Detector* | 2010 |
| Srenivas Varadarajan, Lina J. Karam, and Dinei Florencio, *Background Recovery from Video Sequences Using Motion Parameters* | 2009 |
| Stachness et al., *Springer Handbook of Robotics, Chapter 46: Simultaneous Localization and Mapping*, Springer (2d ed.) | Jun. 26, 2016 |
| Suzuki and Abe, *Topological Structural Analysis of Digitized Binary Images by Border Following* | 1983 |
| Wang Tianmiao et al., *Mobile Robot Control Based on Dynamic Potential*, Chinese J. of Sys. Engin. & Elec. Vol. 3 | Mar. 31, 1992 |
| Ya-Chun Chang & Yoshio Yamamoto, *Path Planning of Wheeled Mobile Robot with Simultaneous Free Space Locating Capability*, Int'l Serv. Robotics | Nov. 25, 2008 |
| Yong K. Hwang & Narenda Ahuja, *A Potential Field Approach to Path Planning*, IEEE Transactions on Robotics and Automation, Vol. 8(1) | Feb. 1992 |
| Wolfgang Hess et al., *Real-time loop closure in 2D LIDAR SLAM*, 2016 IEEE Internation Conference on Robotics and Automation | May 16–21, 2016 |
| Zhenyu Wu et al., *Collision Avoidance for Mobile Robots Based on Artificial Potential Field and Obstacle Envelope Modelling*, Assembly Automation, Vol 36(3) | Aug. 1, 2016 |
| Kaiqi Huang, Liangsheng Wang, Tieniu Tan, and Steve Maybank, *A Real-Time Object Detecting and Tracking System for Outdoor Night Surveillance* | 2008 |
| Subramanian Saravankumar et al., *Multipoint potential field method for path planning of autonomous underwater vehicles in 3D space*, Intel Serv Robots 2013 | Oct. 6, 2013 |
| Javier Minguez et al., *Abstracting Vehicle Shape and Kinematic Constraints from Obstacle Avoidance Methods*, Autonomous Robots, Vol. 20(1) | Feb. 3, 2006 |
| Alan Conrad Bovik, Marianna Clark, Wilson S. Geisler, *Multichannel Texture Analysis Using Localized Spatial Filters* | Jan. 1990 |
| John Canny, *A Computational Approach to Edge Detection* | Nov. 1986 |
| Edwin B. Olson, *Robust and Efficient Robotic Mapping*, Massachusetts Institute of Technology | 2008 |
| Giorgio Grisetti, et al, *Nonlinear Constraint Network Optimization for Efficient Map Learning*, 10 IEEE Transactions on Intelligent Transportation Systems 428 | Sep., 2009 |
| Edwin Olson, et al, *Fast Iterative Alignment of Pose Graphs with Poor Initial Estimates*, Proceedings of the 2006 IEE Conference on Robotics and Automation | May, 2006 |
| John Folkesson and Henrik I. Christensen, *Closing the Loop with Graphical SLAM*, 23 IEEE Transactions on Robotics 731 | Aug., 2007 |

| Citation | Publication Date |
|---|---|
| Carlos Estrada, et al, *Hierarchical SLAM: Real-Time Accurate Mapping of Large Environments*, 21 IEEE Transactions on Robotics 588 | Aug., 2005 |
| Tim Bailey and Hugh Durrant-Whyte, *Simultaneous Localization and Mapping (SLAM): Part II*, IEEE Robotics & Optimization Magazine | Sep. 2006 |
| Seongsoo Lee and Sukhan Lee, *Embedded visual SLAM: Applications for low-cost consumer robots*, 20 IEEE Robotics & Automation Magazine 83 | 2013 |

### C. Prior Art Systems

| Product / System |
|---|
| Neato XV-11 |
| Neato XV Signature Pro |
| iRobot Roomba 880 |
| Kärcher RoboCleaner RC3000 |
| The Dottie |
| Orazio |
| iRobot Scooba |
| Kiva Systems (n/k/a Amazon Robotics) |
| Locus Robotics |
| Google Self-Driving Car Project (n/k/a Waymo) |
| BMW M235i |
| Avidbots ARS-2 |
| Avidbots Neo |

## III. INVALIDITY UNDER 35 U.S.C. §§ 102 AND 103

Avidbots contends that the Asserted Claims are invalid as anticipated by the prior art under 35 U.S.C. § 102 and/or as obvious in view of the prior art, the knowledge of a person having ordinary skill in the art, and/or secondary factors of obviousness under 35 U.S.C. § 103.

### A. Legal Standards

#### 1. Anticipation

Under 35 U.S.C. § 102, anticipation occurs when a prior art reference or system discloses each and every element of a claimed invention, either explicitly or inherently. This means that if

a prior art reference or system describes the same invention as the claim, the claim is considered anticipated and therefore not patentable.

**2. Obviousness**

Under 35 U.S.C. § 103, "[a] patent for a claimed invention may not be obtained … if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing data of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains." The analysis of obviousness looks at (1) the scope and content of the prior art; (2) the differences between the claims and the prior art; (3) the level of ordinary skill in the art; and (4) secondary considerations of non-obviousness.[4]

The U.S. Supreme Court decision in *KSR International Co. v. Teleflex Inc.*[5] ("*KSR*") reiterated that patents that are based on new combinations of elements or components already known in a technical field may be found to be obvious. The Supreme Court in *KSR* rejected a rigid application of the "teaching, suggestion, or motivation [to combine]" test.[6] "In determining whether the subject matter of a patent claim is obvious, neither the particular motivation nor the avowed purpose of the patentee controls. What matters is the objective reach of the claim."[7] "Under the correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the

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[4] *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966).

[5] 550 U.S. 398 (2007).

[6] *Id.* at 418.

[7] *Id.*

manner claimed."[8] In particular, the Supreme Court emphasized the principle that "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results."[9] A key inquiry is whether the "improvement is more than the predictable use of prior art elements according to their established function."[10] If a person of ordinary skill can implement a predictable variation, Section 103 likely bars its patentability.[11] The rationale to combine or modify prior art references is significantly stronger when the references seek to solve the same problem, come from the same field, and correspond well.[12]

In view of *KSR*, the PTO issued a set of guidelines for evaluating whether a claim is obvious in view of prior art. *See* Examination Guidelines for Determining Obviousness Under 35 U.S.C. § 103 in View of the Supreme Court Decision in *KSR International Co. v. Teleflex Inc*.[13] These guidelines identified various rationales for finding a claim obvious, including:

(a) Combining prior art elements according to known methods to yield predictable results;

(b) Simple substitution of one known element for another to obtain predictable results;

(c) Use of known technique to improve similar devices (methods, or products) in the same way;

(d) Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;

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[8] *Id.* at 420.

[9] *Id.* at 415.

[10] *Id.* at 416–17.

[11] *Id.* at 416–17.

[12] *In re Inland Steel Co.*, 265 F.3d 1354, 1362 (Fed. Cir. 2001) (allowing two references to be combined as invalidating art under similar circumstances where the art "focus[ed] on the same problem … c[a]me from the same field of art [and] … the identified problem found in the two references correspond[ed] well").

[13] 72 Fed. Reg. 57,526 (Oct. 10, 2007).

(e) "Obvious to try"—choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;

(f) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to a person of ordinary skill in the art; and

(g) Some teaching, suggestion, or motivation in the prior art that would have led a person of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

Certain of these rationales are discussed more specifically below for each of the asserted patents. The fact that others are not discussed more specifically should not be interpreted as an admission or concession that it does not apply. To the contrary, the discussion below simply provides more explanation of these specific rationales.

## B. Prior Art Invalidity of U.S. Patent No. 10,001,780

### 1. Identification of Prior Art[14]

Avidbots identifies the following prior art now known to Avidbots that anticipate or render obvious one or more of the Asserted Claims of the '780 Patent. Each of the following patents, publications, systems, and products is prior art under at least 35 U.S.C. §§ 102(a)(1) or (2), as applicable. Avidbots's reliance on each prior art reference below includes the reference itself, anything incorporated by the reference, and any testimony by those with knowledge of the reference, such as named authors and inventors.

#### a. Patents and Patent Publications

| Patent / Publication No. | First Named Inventor | Date of Issue / Publication |
|---|---|---|
| U.S. Patent No. 9,286,810 | Ethan Eade | Mar. 15, 2016 |
| U.S. Patent No. 9,380,922 | Samuel Duffley | Jul. 5, 2016 |

[14] *See supra* note 3.

| Patent / Publication No. | First Named Inventor | Date of Issue / Publication |
|---|---|---|
| U.S. Patent No. 10,667,664 | Faizan Sheikh | Jun. 2, 2020/Oct. 27, 2016 |
| EU Patent No. 1 240 562 | Bret Wallach | Jun. 16, 2004 |
| EU Patent No. 2 343 615 | Shoji Tanaka | Oct. 31, 2018/Jul. 13, 2011 |
| KR Patent No. 10-2010-0027683 | Le Do-heon | Mar. 11, 2010 |
| U.S. Patent Pub. 2004/0117079 | Jarl Hulden | Jun. 17, 2004 |
| U.S. Patent Pub. 2008/0059015 | William Whittaker | Mar. 6, 2008 |
| U.S. Patent No. 5,111,401 | Hobart Evertt Jr. | May 5, 1992 |
| U.S. Patent No. 5,696,675 | Kyoko Nakamura | Dec. 9, 1997 |
| U.S. Patent No. 5,758,298 | Jurgen Guldner | May 26, 1998 |
| U.S. Patent No. 5,793,934 | Rudolf Bauer | Aug. 11, 1998 |
| U.S. Patent No. 8,185,239 | You-Wei Teng | May 22, 2012 |
| U.S. Patent No. 8,918,241 | Tien-Chen Chen | Dec. 23, 2014 |
| U.S. Patent No. 8,948,913 | Sunglok Choi | Feb. 3, 2015 |
| U.S. Patent No. 9,192,869 | Toshio Moriya | Nov. 24, 2015 |
| U.S. Patent No. 9,910,444 | Ethan Eade | Mar. 6, 2018/Jun. 2, 2016 |
| JP Patent App. No. 2009288930 | Masaki Takahashi | Dec. 10, 2009 |
| U.S. Patent Pub. No. 2015/0261223 | Philip Fong | Sep. 17, 2015 |
| KR Patent No. 101048098 | Lee Do-heon | Jul. 11, 2011 |
| U.S. Patent No. 9,174,672 | Shuqing Zeng | Nov. 3, 2015 |
| U.S. Patent No. 9,216,745 | Paul A. Beardsley | Dec. 22, 2015 |

**b. Printed Publications**

| Citation | Publication Date |
|---|---|
| Francisco Amoros et al., *Global Appearance Applied to Visual Map Building and Path Estimation Using Multiscale Analysis*, Hindawi Publishing Corporation, Mathematical Problems in Engineering, Vol. 2014 Article ID 365417 | Jul. 22, 2014 |
| Kazushi Nakazawa et al., *Movement Control of Accompanying Robot Based on Artificial Potential Field Adapted to Dynamic Environments*, Elec. Engin. in Japan, Vol. 192 | Feb. 2014 |

| Citation | Publication Date |
|---|---|
| Matthias Nieuwenhuisen et al., *Predictive Potential Field-Based Collision Avoidance for Multicopters*, Remote Sensing and Spatial Information Sciences, Volume XL-1 | Sep. 4, 2013 |
| Hani Safadi, *Local Path Planning Using Virtual Potential Field*, McGill University School of Computer Science | Apr. 18, 2007 |
| Wang Tianmiao et al., *Mobile Robot Control Based on Dynamic Potential*, Chinese J. of Sys. Engin. & Elec. Vol. 3 | Mar. 31, 1992 |
| Sean Quinlan & Oussama Khatib, *Elastic Bands: Connecting Path Planning and Control*, IEEE Int'l Conference on Robotics and Automation | 1998 |
| Ya-Chun Chang & Yoshio Yamamoto, *Path Planning of Wheeled Mobile Robot with Simultaneous Free Space Locating Capability*, Int'l Serv. Robotics | Nov. 25, 2008 |
| Oscar Montiel et al., *Optimal Path Planning Generation for Mobile Robots Using Parallel Evolutionary Artificial Potential Field*, J. Intell. Robot Sys. | Sep. 20, 2014 |
| Zhenyu Wu et al., *Collision Avoidance for Mobile Robots Based on Artificial Potential Field and Obstacle Envelope Modelling*, Assembly Automation, Vol 36(3) | Aug. 1, 2016 |
| Qian Jia & Xingsong Wang, *An Improved Potential Field Method for Path Planning*, 2010 Chinese Control and Decision Conference | 2010 |
| Lu Yin et al., *A New Potential Field Method for Mobile Robot Path Planning in the Dynamic Environments*, Asian J. of Control, Vol. 11(2) | Mar. 2009 |
| P. Payeur, *Improving Robot Path Planning Efficiency with Probabilistic Virtual Environment Models*, IEEE Int'l Conf. on Virtual Environments | Jul. 2004 |
| Pierre Melchior et al., *Robust Path Planning for Mobile Robot Based on Fractional Attractive Force*, 2009 American Control Conf. | Jun. 2009 |
| Oussama Khatib, *Real-Time Obstacle Avoidance for Manipulators and Mobile Robots*, Int'l J. of Robotics Research, Vol. 5(1) | 1986 |
| Bernard Feverjon et al., *A Local Based Approach for Path Planning of Manipulators with a High Number of Degrees of Freedom*, IEEE Int'l Conf. on Robotics and Automation | 1987 |
| Yong K. Hwang & Narenda Ahuja, *A Potential Field Approach to Path Planning*, IEEE Transactions on Robotics and Automation, Vol. 8(1) | Feb. 1992 |
| Dieter Fox et al., *The Dynamic Window Approach to Collision Avoidance*, IEEE Robotics and Automation Magazine, Vol. 4(1) | Apr. 1997 |
| Dave Ferguson et al., *Planning Long Dynamically Feasible Maneuvers for Autonomous Vehicles*, Int'l J. of Robotics Research, Vol. 28(8) | Jun. 26, 2009 |
| Christoph Rosmann et al., *Efficient Trajectory Optimization Using a Spares Model*, 2013 Eur. Conf. on Mobile Robots | Sep. 2013 |

| Citation | Publication Date |
|---|---|
| Subramanian Saravankumar et al., *Multipoint potential field method for path planning of autonomous underwater vehicles in 3D space*, Intel Serv Robots 2013 | Oct. 6, 2013 |
| Javier Minguez et al., *Abstracting Vehicle Shape and Kinematic Constraints from Obstacle Avoidance Methods*, Autonomous Robots, Vol. 20(1) | Feb. 3, 2006 |

**c. Prior Art Products and Systems**

| Product / System |
|---|
| Neato XV-11 |
| Neato XV Signature Pro |
| iRobot Roomba 880 |
| Kärcher RoboCleaner RC3000 |
| The Dottie |
| Orazio |
| iRobot Scooba |
| Kiva Systems (n/k/a Amazon Robotics) |
| Locus Robotics |
| Google Self-Driving Car Project (n/k/a Waymo) |
| BMW M235i |
| Avidbots ARS-2[15] |

[15] Avidbots contends that none of its accused products infringes Brain's Asserted Claims. *See, e.g.*, Exs. A0, B0, C0, D0, and E0 to these Contentions. In view of Brain's allegations of infringement, however, and as set forth in Exs. A0, B0, C0, D0, and E0 to these Contentions and *infra* § VII, to the extent any accused Avidbots product is deemed to infringe any Asserted Claims of this patent, the Avidbots ARS-2 and/or Avidbots Neo systems predate such patent and may anticipate and/or render obvious (alone or in combination with other prior art cited herein) such claims under Brain's theory of infringement. *See, e.g.*, AVID0022656 (discussing the first sale of the ARS-2 in October 2015 in an email); AVID0022657–2675 (discussing the first sale of the ARS-2 in October 2015 in a presentation); AVID0007900–7902 (describing a public demonstration of the Neo in Rochester, NY, in October 2016); AVID0022481–23064 (disclosing functions of Avidbots's prior art systems). Additional information is set forth in the attached claim charts for the Avidbots ARS-2 and Avidbots Neo, Exs. A12, B11, C8, and D8. Moreover, Avidbots produced for inspection on the source code review machine prior art / prior use source code for either or both of these systems (including versions 0.0.7, 1.0.0.rc0.160906,

*(Cont'd on next page)*

| **Product / System** |
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| Avidbots Neo[16] |

**2. Anticipation**

Avidbots has identified the following prior art known to Avidbots as anticipating the Asserted Claims of the '780 Patent. Each of the references cited below anticipates the Asserted Claims, either expressly or inherently as understood by a person of ordinary skill in the art, depending on the Court's interpretation of the claims. In some instances, Avidbots has treated certain prior art as anticipatory, where certain elements are present based on at least Plaintiff's apparent claim construction in its Infringement Contentions. Exhibits A1–A11 are charts setting forth where in the prior art references each element of the Asserted Claims of the '780 Patent are found. Where Avidbots charts a prior art product or system based on patents and/or printed

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1.0.rc1.161004, and 1.0.0) on May 12, 2025 (*see* Avidbots (Jalali) 5/12/25 email to Brain), and loaded additional versions 0.0.13.rc.160222, 0.0.13, and 0.0.15 onto the review machine on June 18, 2025. As Brain's infringement contentions remain deficient, including for failing to set forth a coherent infringement theory for any Asserted Claim (including by proper reference to Avidbots source code), *see infra* § VII; Exs. A0–E0, Avidbots is unable to provide fulsome claim charts reflecting such invalidity in view of Brain's infringement theories. Indeed, Brain requested its first printouts of Avidbots source code on May 29, 2025, more than two months after Brain first inspected the Avidbots code on March 25, 2025, and no such code is yet reflected in Brain's infringement contentions. Nonetheless, on July 23, 2025, Brain demanded that Avidbots provide invalidity claim charts for the Avidbots ARS-2 and Avidbots Neo. (*See* Brain (Loebbaka) 7/23/25 email to Avidbots.) In response, and in a good-faith effort to avoid a dispute, Avidbots promised to provide invalidity claim charts for the prior art Avidbots ARS-2 and Neo by August 27, 2025, despite Avidbots's objections, provided that those charts need not provide any greater detail as to the Avidbots prior art robots than Brain's initial infringement claim charts provided for the accused Avidbots robots. (*See* Avidbots (Jalali) 7/31/25 email to Brain.) Those claim charts are attached hereto as Exs. A12, B11, C8, and D8. Avidbots's investigation is ongoing, and Avidbots may supplement these contentions as appropriate, including in view of any supplementation by Brain of its infringement contentions concerning the Avidbots accused products. For example, on a meet-and-confer that took place on August 21, 2025, Brain promised to supplement its infringement contentions by September 12, 2025, including to cite to Avidbots source code. (*See* Avidbots (E. Kratzer) 8/21/25 email to Brain.)

[16] *See supra* note 15.

publications related to that product/system, Avidbots reserves the right to rely on such patents and/or printed publications alone as anticipatory references to the Asserted Claims of the '780 Patent. Avidbots has diligently pursued anticipatory prior art, and has charted the art that appears at this time to be anticipatory. In light of Brain's deficient Infringement Contentions and the compressed early case schedule pursued at Brain's insistence, and because these contentions are initial and not final, Avidbots reserves the right to add additional anticipatory references be them patent, published, or system art, as its diligence locates that art and/or as Brain's positions in this case (and/or the known facts of the case) develop such that additional anticipatory art exists.

| Exhibit | Reference |
|---|---|
| A-1 | U.S. Patent No. 10,667,664 ("Sheikh") |
| A-2 | Francisco Amoros et al., *Global Appearance Applied to Visual Map Building and Path Estimation Using Multiscale Analysis*, Hindawi Publishing Corporation, Mathematical Problems in Engineering, Vol. 2014 Article ID 365417 ("Amoros") |
| A-3 | Kazushi Nakazawa et al., *Movement Control of Accompanying Robot Based on Artificial Potential Field Adapted to Dynamic Environments*, Elec. Engin. in Japan, Vol. 192 ("Nakazawa") |
| A-4 | Wang Tianmiao et al., *Mobile Robot Control Based on Dynamic Potential*, Chinese J. of Sys. Engin. & Elec. Vol. 3 ("Wang") |
| A-5 | U.S. Patent No. 9,286,810 ("Eade") |
| A-6 | U.S. Patent No. 9,380,922 ("Duffley") |
| A-7 | Matthias Nieuwenhuisen et al., *Predictive Potential Field-Based Collision Avoidance for Multicopters*, Remote Sensing and Spatial Information Sciences, Volume XL-1 ("Nieuwenhuisen") |
| A-8 | Hani Safadi, *Local Path Planning Using Virtual Potential Field*, McGill University School of Computer Science ("Safadi") |
| A-9 | U.S. Patent Pub. 2008/0059015 ("Whittaker") |
| A-10 | U.S. Patent No. 5,758,298 ("Guldner") |
| A-11 | Product and System Art Identified in Table III.B.1.c |
| A-12 | Avidbots System Art Identified in Table III.B.1.c |

### 3. Obviousness

To the extent that Plaintiff argues that any of the above references do not anticipate the Asserted Claims of the '780 Patent, the claims are invalid as obvious under 35 U.S.C. § 103 in view of these references alone, in combination with the knowledge of a POSITA, and in combination with other references as described below. Exhibits A1–A12 and Section B.1 further identify specific examples of art that alone or in combination render obvious the limitations of the Asserted Claims of the '780 Patent. Additional evidence of obviousness can be found in the references identified in the section identifying prior art patents, publications, and systems.

While some of the above identified prior art may anticipate the asserted claims, this presents no obstacle to also relying on this reference as a basis for invalidity based on obviousness. It is established law that "a rejection for obviousness under § 103 can be based on a reference which happens to anticipate the claimed subject matter." *In re Meyer*, 599 F.2d 1026, 1031 (C.C.P.A. 1979). And to the extent any prior art item cited herein may not fully disclose a limitation of an asserted claim or is alleged by Plaintiff to lack disclosure of the limitation, such limitation is present and identified in another prior art item as shown in the attached claim charts. It would have been obvious to combine the disclosed claim elements based on the teachings of other art in existence at that time, the general knowledge of a person of ordinary skill in the art, and the recognition of similarities between the art and the claimed features. On such basis, on an element-by-element basis, subject to the limitations on combinations set forth below, Avidbots expressly intends to combine one or more prior art items identified herein with each other to address any further contentions from Plaintiff that a particular prior art item supposedly lacks one or more elements of an asserted claim. In other words, Avidbots contends that each charted prior art item can be combined with other charted prior art items if a particular prior art item lacks or does not explicitly disclose an element or feature of an asserted claim. To the extent Avidbots

contends that any one or more prior art references in a combination disclose an element of an Asserted Claim as set forth in Avidbots's respective claim charts attached hereto, Avidbots reserves the right to rely on any one or more of such references, whether alone or in combination, as disclosing or rendering obvious that particular claim limitation.

Specifically, Avidbots asserts that any one of the below combinations would render the Asserted Claims of the '780 patent obvious under Section 103:

- any two charted patent prior art references;
- any two or three charted non-patent literature prior art references;
- any two charted system prior art references; or
- any combination of one or two charted patent prior art references, any one, two, or three charted non-patent literature prior art references, and/or any one or two charted system art references, to a maximum of five references per combination.

Avidbots reserves the right to identify other references that would disclose, practice, or render obvious the allegedly missing limitation(s) of the disclosed subject matter.

**a. Level of Ordinary Skill in the Art**

A person of ordinary skill in the art at the time of the earliest effective filing date of the '780 Patent would have had a Bachelor's degree or higher in electrical or computer engineering (or equivalent discipline) and at least two years' experience in research, design and/or development of autonomous robotics and/or robotic mapping/navigation and/or mechanical engineering and/or a related field. Additional education could substitute for experience, and vice versa.

**b. Scope and Content of the Prior Art**

The background state of the art includes that which is set forth in the patent, the file history, and the prior art references disclosed herein. For example, the '780 Patent generally relates to

route planning via the use of sensors to learn and detect things about the environment. In some embodiments, these routes are planned by autonomous robots. *See* '780 Patent, Abstract. As shown by the prior references disclosed herein and by those set forth in the '780 Patent and file history, autonomous robotic route planning, including the use of sensors to gather data on the environment and update a route, was well-known as the asserted priority date of the '780 Patent.

**c. Motivations to Combine Prior Art**

A person of ordinary skill in the art would have been motivated to combine the above identified prior art items according to the combinations listed in Section III.B.3. A person of skill in the art would have been motivated to combine these references according to these categories because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. Further, a person of skill would be motivated to combine these references according to the combinations listed in Section III.B.3 because the references teach and/or suggest that a person of skill do so. For example, each of the charted non-patent literature provides background information on robotic navigation, including on the use of attractive and repulsive forces and/or potential fields, which were well-known in the art. *See, e.g.*, Nieuwenhuisen, at 293; Fajen, at 23 (explaining that potential field methods arise from calculating attractive and repulsive forces). Each of the charted non-patent literature also discloses innovative robots that autonomously navigate spaces. To the extent that any charted patent does not disclose the use of attractive and repulsive forces and/or potential fields, the patent instructs and/or suggests that a POSITA could use any available method, including potential fields, to enable autonomous navigation. *See, e.g.,* Guldner, 9:41–47; Eade, 27:45–67. Further, any elements claimed in the Asserted Claims would have been obvious to a person of ordinary skill in the art and predictable solutions resulting from routine optimization. Certain of these rationales are discussed more specifically below. The fact that others are not discussed more specifically should not be

interpreted as an admission or concession that it does not apply. To the contrary, the discussion below simply provides more explanation of these specific rationales.

As set forth below, it would have been obvious to a person of ordinary skill in the art to combine the teachings of similar prior art references to render the Asserted Claims obvious. The references identified in the exemplary combinations set forth below are analogous prior art and for at least the reasons set forth below, a person of ordinary skill in the art would have had reasons for combining them. The various teachings, suggestions, and/or reasons to modify any of the references and/or to combine any two or more references come from various sources, including the prior art (specific and as a whole), common knowledge, common sense, predictability, expectations, industry trends, design incentives or need, market demand or pressure, market forces, the nature of the problem faced, and/or the knowledge possessed by one of ordinary skill in the art.

Furthermore, to the extent that Plaintiff argues any modification of a base reference is required to meet the claim elements, such modification was routine and predictable, within the skill of a person of ordinary skill in the art, and a person of ordinary skill in the art would have had a reasonable expectation of success in making such a combination.

The following are exemplary motivations to combine:

- For the Asserted Claims of the '780 Patent, to the extent the references charted in any of Exhibits A1–A12 do not disclose "determin[ing] forces on each of the plurality of points of each route pose, the forces comprising repulsive forces from one or more of the detected points on the one or more objects and attractive forces from one or more of the plurality of points on others of the one or more route poses," it would have been obvious to combine the charted references according to the combinations listed in Section III.B.3. A person of skill in the art would be motivated to combine these references because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. As of the asserted priority date of the '780 Patent, the commercial and academic interest in autonomous robotics—particularly as applied to floor cleaners—was substantial motivation to improve robotic mapping, navigation, and object avoidance. *See, e.g.*, Section III.B.1.c, Prior Art Products and Systems. A person of skill in the art would

have been motivated to combine various teachings on autonomous mapping, navigation, and floor cleaners, including as it related to object detection and avoidance. A person of skill in the art working on robotic floor cleaners would have known that others were also developing techniques for robotic navigation, object avoidance, and route planning, and would have been motivated to research those systems and techniques. Furthermore, a person of skill would have attempted many techniques and systems to determine what would yield the best results, including by looking at other research and development in the field. A person of skill would also understand that the art contained many methods which accomplish substantially similar results, and would have therefore would have understood that disclosure of one method discloses all methods that could reasonably be substituted for the chosen method. Additionally, a person of skill in the art would have had a reasonable expectation of success, as others in the art had already succeeded in disclosing this limitation. *See, e.g.*, Section III.B.1.c, Prior Art Products and Systems. These combinations would have also been obvious to try given that there were a finite number of identified, predictable solutions in the prior art, and there would have been a reasonable expectation of success to simply implement one prior art solution with concepts from prior art in the same field. Moreover, these combinations would have been the result of applying known techniques to a known method—that was ready for improvement—to yield predictable results.

- For the Asserted Claims of the '780 Patent, to the extent the references charted in any of Exhibits A1–A12 do not disclose a "force function associat[ing] zero repulsive force exerted by a first detected point on a first object where a distance between the first detected point and a second point of a first route pose is above a predetermined distance threshold," it would have been obvious to combine the charted references according to the combinations listed in Section III.B.3. A person of skill in the art would be motivated to combine these references because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. As of the asserted priority date of the '780 Patent, the commercial and academic interest in autonomous robotics—particularly as applied to floor cleaners—was substantial motivation to improve robotic mapping, navigation, and object avoidance. *See, e.g.*, Section III.B.1.c, Prior Art Products and Systems. A person of skill in the art would have been motivated to combine various teachings on autonomous mapping, navigation, and floor cleaners, including as it related to object detection and avoidance. A person of skill in the art working on robotic floor cleaners would have known that others were also developing techniques for robotic navigation, object avoidance, and route planning, and would have been motivated to research those systems and techniques. Furthermore, a person of skill would have attempted many techniques and systems to determine what would yield the best results, including by looking at other research and development in the field. A person of skill would also understand that the art contained many methods which accomplish substantially similar results, and would have therefore would have understood that disclosure of one method discloses all methods that could reasonably be substituted for the chosen method. Additionally, a person of skill in the art would have had a reasonable expectation of success, as others in the art had already succeeded in disclosing this limitation. *See, e.g.*, Section III.B.1.c, Prior Art Products and Systems. These combinations would have also been obvious to try given that there were a finite number of identified, predictable solutions

in the prior art, and there would have been a reasonable expectation of success to simply implement one prior art solution with concepts from prior art in the same field. Moreover, these combinations would have been the result of applying known techniques to a known method—that was ready for improvement—to yield predictable results.

- For the Asserted Claims of the '780 Patent, to the extent the references charted in any of Exhibits A1–A12 do not disclose a "[t]he robot of claim 1, wherein the robot comprises a floor cleaner," it would have been obvious to combine the charted references according to the combinations listed in Section III.B.3. A person of skill in the art would be motivated to combine these references because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. As of the asserted priority date of the '780 Patent, the commercial and academic interest in autonomous robotics—particularly as applied to floor cleaners—was substantial motivation to improve robotic mapping, navigation, and object avoidance in the field of floor cleaners. *See, e.g.*, Section III.B.1.c, Prior Art Products and Systems. A person of skill in the art would have been motivated to combine various teachings on autonomous mapping, navigation, and floor cleaners, including as it related to object detection and avoidance. A person of skill in the art working on robotic floor cleaners would have known that others were also developing techniques for robotic navigation, object avoidance, and route planning, and would have been motivated to research those systems and techniques. Furthermore, a person of skill would have attempted many techniques and systems to determine what would yield the best results, including by looking at other research and development in the field. A person of skill would also understand that the art contained many methods which accomplish substantially similar results, and would have therefore would have understood that disclosure of one method discloses all methods that could reasonably be substituted for the chosen method. Additionally, a person of skill in the art would have had a reasonable expectation of success, as others in the art had already succeeded in disclosing this limitation. *See, e.g.*, Section III.B.1.c, Prior Art Products and Systems. These combinations would have also been obvious to try given that there were a finite number of identified, predictable solutions in the prior art, and there would have been a reasonable expectation of success to simply implement one prior art solution with concepts from prior art in the same field. Moreover, these combinations would have been the result of applying known techniques to a known method—that was ready for improvement—to yield predictable results.

- For the Asserted Claims of the '780 Patent, to the extent the references charted in any of Exhibits A1–A12 do not disclose a "defining a force function the force function computing repulsive forces exerted by each of the detected points of the plurality of objects on the plurality of points of the first route pose, wherein each repulsive force comprises a vector," it would have been obvious to combine the charted references according to the combinations listed in Section III.B.3. A person of skill in the art would be motivated to combine these references because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. As of the asserted priority date of the '780 Patent, the commercial and academic interest in autonomous robotics—particularly as applied to floor cleaners—was substantial motivation to improve robotic mapping, navigation, and object avoidance. *See, e.g.*, Section III.B.1.c, Prior Art

Products and Systems. A person of skill in the art would have been motivated to combine various teachings on autonomous mapping, navigation, and floor cleaners, including as it related to object detection and avoidance. A person of skill in the art working on robotic floor cleaners would have known that others were also developing techniques for robotic navigation, object avoidance, and route planning, and would have been motivated to research those systems and techniques. Furthermore, a person of skill would have attempted many techniques and systems to determine what would yield the best results, including by looking at other research and development in the field. A person of skill would also understand that the art contained many methods which accomplish substantially similar results, and would have therefore would have understood that disclosure of one method discloses all methods that could reasonably be substituted for the chosen method. Additionally, a person of skill in the art would have had a reasonable expectation of success, as others in the art had already succeeded in disclosing this limitation. *See, e.g.*, Section III.B.1.c, Prior Art Products and Systems. These combinations would have also been obvious to try given that there were a finite number of identified, predictable solutions in the prior art, and there would have been a reasonable expectation of success to simply implement one prior art solution with concepts from prior art in the same field. Moreover, these combinations would have been the result of applying known techniques to a known method—that was ready for improvement—to yield predictable results.

- For the Asserted Claims of the '780 Patent, to the extent the references charted in any of Exhibits A1–A12 do not disclose a "generat[ing] a map of an environment using data from one or more sensors," it would have been obvious to combine the charted references according to the combinations listed in Section III.B.3. A person of skill in the art would be motivated to combine these references because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. As of the asserted priority date of the '780 Patent, the commercial and academic interest in autonomous robotics—particularly as applied to floor cleaners—was substantial motivation to improve robotic mapping, navigation, and object avoidance. *See, e.g.*, Section III.B.1.c, Prior Art Products and Systems. A person of skill in the art would have been motivated to combine various teachings on autonomous mapping, navigation, and floor cleaners, including as it related to object detection and avoidance. A person of skill in the art working on robotic floor cleaners would have known that others were also developing techniques for robotic navigation, object avoidance, and route planning, and would have been motivated to research those systems and techniques. Furthermore, a person of skill would have attempted many techniques and systems to determine what would yield the best results, including by looking at other research and development in the field. A person of skill would also understand that the art contained many methods which accomplish substantially similar results, and would have therefore would have understood that disclosure of one method discloses all methods that could reasonably be substituted for the chosen method. Additionally, a person of skill in the art would have had a reasonable expectation of success, as others in the art had already succeeded in disclosing this limitation. *See, e.g.*, Section III.B.1.c, Prior Art Products and Systems. These combinations would have also been obvious to try given that there were a finite number of identified, predictable solutions in the prior art, and there would have been a reasonable expectation of success to simply implement one prior art solution with concepts from prior

art in the same field. Moreover, these combinations would have been the result of applying known techniques to a known method—that was ready for improvement—to yield predictable results.

**d. Secondary Considerations of Non-Obviousness**

A patentee bears the burden of production with respect to evidence of secondary considerations of non-obviousness. *ZUP, LLC v. Nash Mfg., Inc.*, 896 F.3d 1365, 1373 (Fed. Cir. 2018). As of the date of these Initial Non-Infringement and Invalidity Contentions, Plaintiff has not identified any evidence of secondary considerations. Avidbots reserves the right to present additional evidence and argument regarding secondary considerations of non-obviousness to the extent Plaintiff purports to identify any such evidence. In any event, as shown in these Initial Non-Infringement and Invalidity Contentions, other companies and individuals described, built, and/or patented the exact same concepts in the '780 Patent before Plaintiff ever did—often many years before. Even where others' invention(s) occurred around the same time as the '780 Patent, such simultaneous invention demonstrates the obviousness of the '780 Patent.

**4. Priority Date**

U.S. Application No. 15/341,612 (hereinafter, "the '612 application"), which led to the '780 Patent, was filed on November 2, 2016. To the extent that Plaintiff asserts that the '780 Patent is entitled to an earlier priority date based on any provisional application or documentation, Plaintiff has the burden of proof and has not demonstrated an earlier priority date.

## C. Prior Art Invalidity of U.S. Patent No. 10,379,539

**1. Identification of Prior Art[17]**

Avidbots identifies the following prior art now known to Avidbots that anticipates or render obvious one or more of the Asserted Claims of the '539 Patent. Each of the following patents,

[17] *See supra* note 3.

publications, systems, and products is prior art under at least 35 U.S.C. §§ 102(a)(1) or (2), as applicable. Avidbots's reliance on each prior art reference below includes the reference itself, anything incorporated by the reference, and any testimony by those with knowledge of the reference, such as named authors and inventors.

**a. Patents and Patent Publications**

| Patent / Publication No. | First Named Inventor | Date of Issue / Publication |
|---|---|---|
| U.S. Patent No. 9,286,810 | Ethan Eade | Mar. 15, 2016 |
| U.S. Patent No. 10,667,664 | Faizan Sheikh | Jun. 2, 2020/Oct. 27, 2016 |
| EU Patent No. 1 240 562 | Bret Wallach | Jun. 16, 2004 |
| EU Patent No. 2 343 615 | Shoji Tanaka | Oct. 31, 2018/Jul. 13, 2011 |
| KR Patent No. 10-2010-0027683 | Le Do-heon | Mar. 11, 2010 |
| U.S. Patent Pub. 2004/0117079 | Jarl Hulden | Jun. 17, 2004 |
| U.S. Patent Pub. 2008/0059015 | William Whittaker | Mar. 6, 2008 |
| U.S. Patent No. 5,111,401 | Hobart Evertt Jr. | May 5, 1992 |
| U.S. Patent No. 5,696,675 | Kyoko Nakamura | Dec. 9, 1997 |
| U.S. Patent No. 5,758,298 | Jurgen Guldner | May 26, 1998 |
| U.S. Patent No. 5,793,934 | Rudolf Bauer | Aug. 11, 1998 |
| U.S. Patent No. 8,185,239 | You-Wei Teng | May 22, 2012 |
| U.S. Patent No. 8,918,241 | Tien-Chen Chen | Dec. 23, 2014 |
| U.S. Patent No. 8,948,913 | Sunglok Choi | Feb. 3, 2015 |
| U.S. Patent No. 9,192,869 | Toshio Moriya | Nov. 24, 2015 |
| U.S. Patent No. 9,910,444 | Ethan Eade | Mar. 6, 2018/Jun. 2, 2016 |
| JP Patent App. No. 2009288930 | Masaki Takahashi | Dec. 10, 2009 |
| U.S. Patent Pub. No. 2015/0261223 | Philip Fong | Sep. 17, 2015 |
| KR Patent No. 101048098 | Lee Do-heon | Jul. 11, 2011 |
| U.S. Patent No. 9,174,672 | Shuqing Zeng | Nov. 3, 2015 |
| U.S. Patent No. 9,216,745 | Paul A. Beardsley | Dec. 22, 2015 |

**b. Printed Publications**

| Citation | Publication Date |
|---|---|
| Francisco Amoros et al., *Global Appearance Applied to Visual Map Building and Path Estimation Using Multiscale Analysis*, Hindawi Publishing Corporation, Mathematical Problems in Engineering, Vol. 2014 Article ID 365417 | Jul. 22, 2014 |
| Brett R. Fajen et al., *A Dynamical Model of Visually-Guided Steering, Obstacle Avoidance, and Route Selection*," Int'l J. of Comp. Vision, Vol. 54 | 2003 |
| Matthias Nieuwenhuisen et al., *Predictive Potential Field-Based Collision Avoidance for Multicopters*, Remote Sensing and Spatial Information Sciences, Volume XL-1 | Sep. 4, 2013 |
| Hani Safadi, *Local Path Planning Using Virtual Potential Field*, McGill University School of Computer Science | Apr. 18, 2007 |
| Wang Tianmiao et al., *Mobile Robot Control Based on Dynamic Potential*, Chinese J. of Sys. Engin. & Elec. Vol. 3 | Mar. 31, 1992 |
| Kazushi Nakazawa et al., *Movement Control of Accompanying Robot Based on Artificial Potential Field Adapted to Dynamic Environments*, Elec. Engin. in Japan, Vol. 192 | Feb. 2014 |
| Sean Quinlan & Oussama Khatib, *Elastic Bands: Connecting Path Planning and Control*, IEEE Int'l Conference on Robotics and Automation | 1998 |
| Ya-Chun Chang & Yoshio Yamamoto, *Path Planning of Wheeled Mobile Robot with Simultaneous Free Space Locating Capability*, Int'l Serv. Robotics | Nov. 25, 2008 |
| Oscar Montiel et al., *Optimal Path Planning Generation for Mobile Robots Using Parallel Evolutionary Artificial Potential Field*, J. Intell. Robot Sys. | Sep. 20, 2014 |
| Zhenyu Wu et al., *Collision Avoidance for Mobile Robots Based on Artificial Potential Field and Obstacle Envelope Modelling*, Assembly Automation Vol 36(3) | Aug. 1, 2016 |
| Qian Jia & Xingsong Wang, *An Improved Potential Field Method for Path Planning*, 2010 Chinese Control and Decision Conference | 2010 |
| Lu Yin et al., *A New Potential Field Method for Mobile Robot Path Planning in the Dynamic Environments*, Asian J. of Control, Vol. 11(2) | March 2009 |
| P. Payeur, *Improving Robot Path Planning Efficiency with Probabilistic Virtual Environment Models*, IEEE Int' Conf. on Virtual Environments | July 2004 |
| Pierre Melchior et al., *Robust Path Planning for Mobile Robot Based on Fractional Attractive Force*, 2009 American Control Conf. | June 2009 |
| Oussama Khatib, *Real-Time Obstacle Avoidance for Manipulators and Mobile Robots*, Int'l J. of Robotics Research, Vol. 5(1) | 1986 |

| Citation | Publication Date |
|---|---|
| Bernard Feverjon et al., *A Local Based Approach for Path Planning of Manipulators with a High Number of Degrees of Freedom*, IEEE Int'l Conf. on Robotics and Automation | 1987 |
| Yong K. Hwang & Narenda Ahuja, *A Potential Field Approach to Path Planning*, IEEE Transactions on Robotics and Automation, Vol. 8(1) | Feb. 1992 |
| Dieter Fox et al., *The Dynamic Window Approach to Collision Avoidance*, IEEE Robotics and Automation Magazine, Vol. 4(1) | Apr. 1997 |
| Dave Ferguson et al., *Planning Long Dynamically Feasible Maneuvers for Autonomous Vehicles*, Int'l J. of Robotics Research, Vol. 28(8) | Jun. 26, 2009 |
| Christoph Rosmann et al., *Efficient Trajectory Optimization Using a Spares Model*, 2013 Eur. Conf. on Mobile Robots | Sep. 2013 |
| Subramanian Saravankumar et al., *Multipoint potential field method for path planning of autonomous underwater vehicles in 3D space*, Intel Serv Robots 2013 | Oct. 6, 2013 |
| Javier Minguez et al., *Abstracting Vehicle Shape and Kinematic Constraints from Obstacle Avoidance Methods*, Autonomous Robots, Vol. 20(1) | Feb. 3, 2006 |

**c. Prior Art Products and Systems**

| Product / System |
|---|
| Neato XV-11 |
| Neato XV Signature Pro |
| iRobot Roomba 880 |
| Kärcher RoboCleaner RC3000 |
| The Dottie |
| Orazio |
| iRobot Scooba |
| Kiva Systems (n/k/a Amazon Robotics) |
| Locus Robotics |
| Google Self-Driving Car Project (n/k/a Waymo) |
| BMW M235i |
| Avidbots ARS-2[18] |

[18] *See supra* note 15.

| Product / System |
|---|
| Avidbots Neo[19] |

**2. Anticipation**

Avidbots has identified the following prior art known to Avidbots as anticipating the Asserted Claims of the '539 Patent. Each of the references cited below anticipates the Asserted Claims, either expressly or inherently as understood by a person of ordinary skill in the art, depending on the Court's interpretation of the claims. In some instances, Avidbots has treated certain prior art as anticipatory, where certain elements are present based on at least Plaintiff's apparent claim construction in its Infringement Contentions. Exhibits B1–B11 are charts setting forth where in the prior art references each element of the Asserted Claims of the '539 Patent are found. Where Avidbots charts a prior art product or system based on patents and/or printed publications related to that product/system, Avidbots reserves the right to rely on such patents and/or printed publications alone as anticipatory references to the Asserted Claims of the '539 Patent. Avidbots has diligently pursued anticipatory prior art, and has charted the art that appears at this time to be anticipatory. In light of Brain's deficient infringement contentions and the compressed early case schedule pursued at Brain's insistence, and because these contentions are initial and not final, Avidbots reserves the right to add additional anticipatory references be them patent, published, or system art, as its diligence locates that art and/or as Brain's positions in this case (and/or the known facts of the case) develop such that additional anticipatory art exists.

| Exhibit | Reference |
|---|---|
| B-1 | U.S. Patent No. 10,667,664 ("Sheikh") |
| B-2 | U.S. Patent No. 9,286,810 ("Eade") |
| B-3 | U.S. Patent Pub. 2008/0059015 ("Whittaker") |

[19] *See supra* note 15.

| Exhibit | Reference |
|---|---|
| B-4 | U.S. Patent No. 5,758,298 ("Guldner") |
| B-5 | Francisco Amoros et al., *Global Appearance Applied to Visual Map Building and Path Estimation Using Multiscale Analysis*, Hindawi Publishing Corporation, Mathematical Problems in Engineering, Vol. 2014 Article ID 365417 ("Amoros") |
| B-6 | Brett R. Fajen et al., *A Dynamical Model of Visually-Guided Steering, Obstacle Avoidance, and Route Selection*," Int'l J. of Comp. Vision, Vol. 54 ("Fajen") |
| B-7 | Matthias Nieuwenhuisen et al., *Predictive Potential Field-Based Collision Avoidance for Multicopters*, Remote Sensing and Spatial Information Sciences, Volume XL-1 ("Nieuwenhuisen") |
| B-8 | Hani Safadi, *Local Path Planning Using Virtual Potential Field*, McGill University School of Computer Science ("Safadi") |
| B-9 | Wang Tianmiao et al., *Mobile Robot Control Based on Dynamic Potential*, Chinese J. of Sys. Engin. & Elec. Vol. 3 ("Wang") |
| B-10 | Product and System Art Identified in Table III.C.1.c |
| B-11 | Avidbots System Art Identified in Table III.C.1.c |

**3. Obviousness**

To the extent that Plaintiff argues that any of the above references do not anticipate the Asserted Claims of the '539 Patent, the claims are invalid as obvious under 35 U.S.C. § 103 in view of these references alone, in combination with the knowledge of a POSITA, and in combination with other references as described below. Exhibits B1–B11 and Section C.1 further identify specific examples of art that alone or in combination render obvious the limitations of the Asserted Claims of the '539 Patent. Additional evidence of obviousness can be found in the references identified in the section identifying prior art patents, publications, and systems.

While some of the above identified prior art may anticipate the asserted claims, this presents no obstacle to also relying on this reference as a basis for invalidity based on obviousness. It is established law that "a rejection for obviousness under § 103 can be based on a reference which happens to anticipate the claimed subject matter." *In re Meyer*, 599 F.2d 1026, 1031 (C.C.P.A. 1979). And to the extent any prior art item cited herein may not fully disclose a

limitation of an asserted claim or is alleged by Plaintiff to lack disclosure of the limitation, such limitation is present and identified in another prior art item as shown in the attached claim charts. It would have been obvious to combine the disclosed claim elements based on the teachings of other art in existence at that time, the general knowledge of a person of ordinary skill in the art, and the recognition of similarities between the art and the claimed features. On such basis, on an element-by-element basis, subject to the limitations on combinations set forth below, Avidbots expressly intends to combine one or more prior art items identified herein with each other to address any further contentions from Plaintiff that a particular prior art item supposedly lacks one or more elements of an asserted claim. In other words, Avidbots contends that each charted prior art item can be combined with other charted prior art items if a particular prior art item lacks or does not explicitly disclose an element or feature of an asserted claim. To the extent Avidbots contends that any one or more prior art references in a combination disclose an element of an Asserted Claim as set forth in Avidbots's respective claim charts attached hereto, Avidbots reserves the right to rely on any one or more of such references, whether alone or in combination, as disclosing or rendering obvious that particular claim limitation.

Specifically, Avidbots asserts that any one of the below combinations would render the Asserted Claims of the '539 patent obvious under Section 103:

- any two charted patent prior art references;
- any two charted non-patent literature prior art references;
- any two charted system prior art references; or
- any combination of one or two charted patent prior art references, any one or two charted non-patent literature prior art references, and/or any one or two charted system prior art references, to a maximum of five references per combination.

**a. Level of Ordinary Skill in the Art**

A person of ordinary skill in the art at the time of the earliest effective filing date of the '539 Patent would have had a Bachelor's degree or higher in electrical or computer engineering (or equivalent discipline) and at least two years' experience in research, design and/or development of autonomous robotics and/or robotic mapping/navigation and/or mechanical engineering and/or a related field. Additional education could substitute for experience, and vice versa.

**b. Scope and Content of the Prior Art**

The background state of the art includes that which is set forth in the patent, the file history, and the prior art references disclosed herein. For example, the '539 Patent generally relates to route planning via the use of sensors to learn and detect things about the environment. In some embodiments, these routes are planned by autonomous robots. *See* '539 Patent, Abstract. As shown by the prior references disclosed herein and by those set forth in the '539 Patent and file history, autonomous robotic route planning, including the use of sensors to gather data on the environment and update a route, was well-known as the asserted priority date of the '539 Patent.

**c. Motivations to Combine Prior Art**

A person of ordinary skill in the art would have been motivated to combine the above identified prior art items according to the combinations listed in Section III.C.3. A person of skill in the art would have been motivated to combine these references according to these categories because the references teach and/or suggest that a person of skill do so. For example, each of the charted non-patent literature provides background information on robotic navigation, including on the use of attractive and repulsive forces and/or potential fields, which were well-known in the art. *See, e.g.*, Nieuwenhuisen at 293; Fajen at 23 (explaining that potential field methods arise from calculating attractive and repulsive forces). Each of the charted non-patent literature also discloses innovative robots that autonomously navigate spaces. To the extent that any charted patent does

not disclose the use of attractive and repulsive forces and/or potential fields, the patent instructs and/or suggests that a POSITA could use any available method, including potential fields, to enable autonomous navigation. *See, e.g.*, Guldner at 9:41–47; Eade at 27:45–67. Further, any elements claimed in the Asserted Claims would have been obvious to a person of ordinary skill in the art and predictable solutions resulting from routine optimization. Certain of these rationales are discussed more specifically below. The fact that others are not discussed more specifically should not be interpreted as an admission or concession that it does not apply. To the contrary, the discussion below simply provides more explanation of these specific rationales to exemplar combinations.

As set forth below, it would have been obvious to a person of ordinary skill in the art to combine the teachings of similar prior art references to render the Asserted Claims obvious. The references identified in the exemplary combinations set forth below are analogous prior art and for at least the reasons set forth below, a person of ordinary skill in the art would have had reasons for combining them. The various teachings, suggestions, and/or reasons to modify any of the references and/or to combine any two or more references come from various sources, including the prior art (specific and as a whole), common knowledge, common sense, predictability, expectations, industry trends, design incentives or need, market demand or pressure, market forces, the nature of the problem faced, and/or the knowledge possessed by one of ordinary skill in the art.

Furthermore, to the extent that Plaintiff argues any modification of a base reference is required to meet the claim elements, such modification was routine and predictable, within the skill of a person of ordinary skill in the art, and a person of ordinary skill in the art would have had a reasonable expectation of success in making such a combination.

The following are exemplary motivations to combine:

- For the Asserted Claims of the '539 Patent, to the extent the references charted in any of Exhibits B1–B11 do not disclose a "compute repulsive forces from a point on an object onto the plurality of points of the respective pose, the object being on the map," it would have been obvious to combine the charted references according to the combinations listed in Section III.C.3. A person of skill in the art would be motivated to combine these references because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. As of the asserted priority date of the '539 Patent, the commercial and academic interest in autonomous robotics—particularly as applied to floor cleaners—was substantial motivation to improve robotic mapping, navigation, and object avoidance. *See, e.g.*, Section III.C.1.c. A person of skill in the art would have been motivated to combine various teachings on autonomous mapping, navigation, and floor cleaners, including as it related to object detection and avoidance. A person of skill in the art working on robotic floor cleaners would have known that others were also developing techniques for robotic navigation, object avoidance, and route planning, and would have been motivated to research those systems and techniques. Furthermore, a person of skill would have attempted many techniques and systems to determine what would yield the best results, including by looking at other research and development in the field. A person of skill would also understand that the art contained many methods which accomplish substantially similar results, and would have therefore would have understood that disclosure of one method discloses all methods that could reasonably be substituted for the chosen method. Additionally, a person of skill in the art would have had a reasonable expectation of success, as others in the art had already succeeded in disclosing this limitation. *See, e.g.*, Section III.C.1.c. These combinations would have also been obvious to try given that there were a finite number of identified, predictable solutions in the prior art, and there would have been a reasonable expectation of success to simply implement one prior art solution with concepts from prior art in the same field. Moreover, these combinations would have been the result of applying known techniques to a known method—that was ready for improvement—to yield predictable results.

- For the Asserted Claims of the '539 Patent, to the extent the references charted in any of Exhibits B1–B11 do not disclose a "the repulsive forces from the point on the object prevent the robot from colliding with the object," it would have been obvious to combine the charted references according to the combinations listed in Section III.C.3. A person of skill in the art would be motivated to combine these references because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. As of the asserted priority date of the '539 Patent, the commercial and academic interest in autonomous robotics—particularly as applied to floor cleaners—was substantial motivation to improve robotic mapping, navigation, and object avoidance. *See, e.g.*, Section III.C.1.c. A person of skill in the art would have been motivated to combine various teachings on autonomous mapping, navigation, and floor cleaners, including as it related to object detection and avoidance. A person of skill in the art working on robotic floor cleaners would have known that others were also developing techniques for robotic navigation, object avoidance, and route planning, and would have been motivated to

research those systems and techniques. Furthermore, a person of skill would have attempted many techniques and systems to determine what would yield the best results, including by looking at other research and development in the field. A person of skill would also understand that the art contained many methods which accomplish substantially similar results, and would have therefore would have understood that disclosure of one method discloses all methods that could reasonably be substituted for the chosen method. Additionally, a person of skill in the art would have had a reasonable expectation of success, as others in the art had already succeeded in disclosing this limitation. *See, e.g.*, Section III.C.1.c. These combinations would have also been obvious to try given that there were a finite number of identified, predictable solutions in the prior art, and there would have been a reasonable expectation of success to simply implement one prior art solution with concepts from prior art in the same field. Moreover, these combinations would have been the result of applying known techniques to a known method—that was ready for improvement—to yield predictable results.

- For the Asserted Claims of the '539 Patent, to the extent the references charted in any of Exhibits B1–B11 do not disclose a performance of "interpolation," it would have been obvious to combine the charted references according to the combinations listed in Section III.C.3. A person of skill in the art would be motivated to combine these references because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. As of the asserted priority date of the '539 Patent, the commercial and academic interest in autonomous robotics—particularly as applied to floor cleaners—was substantial motivation to improve robotic mapping, navigation, and object avoidance. *See, e.g.*, Section III.C.1.c. A person of skill in the art would have been motivated to combine various teachings on autonomous mapping, navigation, and floor cleaners, including as it related to object detection and avoidance. A person of skill in the art working on robotic floor cleaners would have known that others were also developing techniques for robotic navigation, object avoidance, and route planning, and would have been motivated to research those systems and techniques. Furthermore, a person of skill would have attempted many techniques and systems to determine what would yield the best results, including by looking at other research and development in the field. A person of skill would also understand that the art contained many methods which accomplish substantially similar results, and would have therefore would have understood that disclosure of one method discloses all methods that could reasonably be substituted for the chosen method. Additionally, a person of skill in the art would have had a reasonable expectation of success, as others in the art had already succeeded in disclosing this limitation. *See, e.g.*, Section III.C.1.c. These combinations would have also been obvious to try given that there were a finite number of identified, predictable solutions in the prior art, and there would have been a reasonable expectation of success to simply implement one prior art solution with concepts from prior art in the same field. Moreover, these combinations would have been the result of applying known techniques to a known method—that was ready for improvement—to yield predictable results.

- For the Asserted Claims of the '539 Patent, to the extent the references charted in any of Exhibits B1–B11 do not disclose a "the controller is further configured to execute the computer readable instructions to, reposition the respective pose and a subsequent

respective pose in response to the repulsive forces on each point of the plurality of points," it would have been obvious to combine the charted references according to the combinations listed in Section III.C.3. A person of skill in the art would be motivated to combine these references because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. As of the asserted priority date of the '539 Patent, the commercial and academic interest in autonomous robotics—particularly as applied to floor cleaners—was substantial motivation to improve robotic mapping, navigation, and object avoidance. *See, e.g.*, Section III.C.1.c. A person of skill in the art would have been motivated to combine various teachings on autonomous mapping, navigation, and floor cleaners, including as it related to object detection and avoidance. A person of skill in the art working on robotic floor cleaners would have known that others were also developing techniques for robotic navigation, object avoidance, and route planning, and would have been motivated to research those systems and techniques. Furthermore, a person of skill would have attempted many techniques and systems to determine what would yield the best results, including by looking at other research and development in the field. A person of skill would also understand that the art contained many methods which accomplish substantially similar results, and would have therefore would have understood that disclosure of one method discloses all methods that could reasonably be substituted for the chosen method. Additionally, a person of skill in the art would have had a reasonable expectation of success, as others in the art had already succeeded in disclosing this limitation. *See, e.g.*, Section III.C.1.c. These combinations would have also been obvious to try given that there were a finite number of identified, predictable solutions in the prior art, and there would have been a reasonable expectation of success to simply implement one prior art solution with concepts from prior art in the same field. Moreover, these combinations would have been the result of applying known techniques to a known method—that was ready for improvement—to yield predictable results.

- For the Asserted Claims of the '539 Patent, to the extent the references charted in any of Exhibits B1–B11 do not disclose a "respective pose corresponds to a footprint of the robot, the footprint configured to be adjustable between a small footprint and a large footprint, the small footprint having a high likelihood of collision with the object, and the large footprint having a low likelihood of collision with the object, the footprint of the robot configured to be dynamically reshaped," it would have been obvious to combine the charted references according to the combinations listed in Section III.C.3. A person of skill in the art would be motivated to combine these references because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. As of the asserted priority date of the '539 Patent, the commercial and academic interest in autonomous robotics—particularly as applied to floor cleaners—was substantial motivation to improve robotic mapping, navigation, and object avoidance. *See, e.g.*, Section III.C.1.c. A person of skill in the art would have been motivated to combine various teachings on autonomous mapping, navigation, and floor cleaners, including as it related to object detection and avoidance. A person of skill in the art working on robotic floor cleaners would have known that others were also developing techniques for robotic navigation, object avoidance, and route planning, and would have been motivated to research those systems and techniques. Furthermore, a person of skill would have

attempted many techniques and systems to determine what would yield the best results, including by looking at other research and development in the field. A person of skill would also understand that the art contained many methods which accomplish substantially similar results, and would have therefore would have understood that disclosure of one method discloses all methods that could reasonably be substituted for the chosen method. Additionally, a person of skill in the art would have had a reasonable expectation of success, as others in the art had already succeeded in disclosing this limitation. *See, e.g.*, Section III.C.1.c. These combinations would have also been obvious to try given that there were a finite number of identified, predictable solutions in the prior art, and there would have been a reasonable expectation of success to simply implement one prior art solution with concepts from prior art in the same field. Moreover, these combinations would have been the result of applying known techniques to a known method—that was ready for improvement—to yield predictable results.

- For the Asserted Claims of the '539 Patent, to the extent the references charted in any of Exhibits B1–B11 do not disclose a "repulsive forces from the object [being] uniform on the respective pose," it would have been obvious to combine the charted references according to the combinations listed in Section III.C.3. A person of skill in the art would be motivated to combine these references because they each disclose features related to robotic mapping and route planning, and/or relate to autonomous robotic floor cleaners. As of the asserted priority date of the '539 Patent, the commercial and academic interest in autonomous robotics—particularly as applied to floor cleaners—was substantial motivation to improve robotic mapping, navigation, and object avoidance. *See, e.g.*, Section III.C.1.c. A person of skill in the art would have been motivated to combine various teachings on autonomous mapping, navigation, and floor cleaners, including as it related to object detection and avoidance. A person of skill in the art working on robotic floor cleaners would have known that others were also developing techniques for robotic navigation, object avoidance, and route planning, and would have been motivated to research those systems and techniques. Furthermore, a person of skill would have attempted many techniques and systems to determine what would yield the best results, including by looking at other research and development in the field. A person of skill would also understand that the art contained many methods which accomplish substantially similar results, and would have therefore would have understood that disclosure of one method discloses all methods that could reasonably be substituted for the chosen method. Additionally, a person of skill in the art would have had a reasonable expectation of success, as others in the art had already succeeded in disclosing this limitation. *See, e.g.*, Section III.C.1.c. These combinations would have also been obvious to try given that there were a finite number of identified, predictable solutions in the prior art, and there would have been a reasonable expectation of success to simply implement one prior art solution with concepts from prior art in the same field. Moreover, these combinations would have been the result of applying known techniques to a known method—that was ready for improvement—to yield predictable results.

**d. Secondary Considerations of Non-Obviousness**

A patentee bears the burden of production with respect to evidence of secondary considerations of non-obviousness. *ZUP, LLC v. Nash Mfg., Inc.*, 896 F.3d 1365, 1373 (Fed. Cir. 2018). As of the date of these Initial Non-Infringement and Invalidity Contentions, Plaintiff has not identified any evidence of secondary considerations. Avidbots reserves the right to present additional evidence and argument regarding secondary considerations of non-obviousness to the extent Plaintiff purports to identify any such evidence. In any event, as shown in these Initial Non-Infringement and Invalidity Contentions, other companies and individuals described, built, and/or patented the exact same concepts in the '539 Patent before Plaintiff ever did—often many years before. Even where others' invention(s) occurred around the same time as the '539 Patent, such simultaneous invention demonstrates the obviousness of the '539 Patent.

**4. Priority Date**

U.S. Application No. 16/011,499 (hereinafter, "the '499 application"), which led to the '539 Patent, was filed on June 18, 2018. The '499 application purports to be a continuation of and claim priority to the '612 application, which was filed on November 2, 2016. Plaintiff asserts that the '539 Patent is entitled to a priority date based on the '612 application, but Plaintiff has the burden of proof. To the extent that Plaintiff fails to carry this burden, Avidbots reserves the right to update its contentions with additional prior art reflective of the actual priority date ascribable to the '539 Patent.

## D. Prior Art Invalidity of U.S. Patent No. 10,379,325

### 1. Identification of Prior Art[20]

Avidbots identifies the following prior art now known to Avidbots that anticipates or render obvious one or more of the Asserted Claims of the '325 Patent. Each of the following patents, publications, systems, and products is prior art under at least 35 U.S.C. §§ 102(a)(1) or (2), as applicable. Avidbots's reliance on each prior art reference below includes the reference itself, anything incorporated by the reference, and any testimony by those with knowledge of the reference, such as named authors and inventors.

#### a. Patents and Patent Publications

| Patent / Publication No. | First Named Inventor | Date of Issue / Publication |
|---|---|---|
| U.S. Patent No. 7,170,252 | Akira Maeki | Jan. 30, 2007 |
| U.S. Patent No. 8,903,589 | Boris Sofman | Dec. 2, 2014 |
| U.S. Patent No. 8,954,191 | Dong Hoon Yi | Feb. 10, 2015 |
| U.S. Patent No. 9,233,472 | Colin Angle | Jan. 12, 2016 |
| U.S. Patent No. 9,286,810 | Ethan Eade | Mar. 15, 2016 |
| U.S. Patent No. 9,304,001 | Soon Yong Park | Apr. 5, 2016 |
| U.S. Patent No. 9,400,501 | Mark Schnittman | Jul. 26, 2016 |
| U.S. Patent No. 9,404,756 | Phillip Fong | Aug. 2, 2016 |
| U.S. Patent No. 9,519,289 | Mario Munich | Dec. 13, 2016 / May 26, 2016 |
| U.S. Patent No. 9,534,899 | Jens-Steffen Gutmann | Jan. 3, 2017 / May 30, 2013 |
| U.S. Patent No. 9,538,892 | Phillip Fong | Jan. 10, 2017 / Apr. 10, 2014 |
| U.S. Patent No. 9,864,377 | Bruce Welty | Jan. 9, 2018 / Apr. 1, 2016 (filed) |
| U.S. Patent No. 9,952,053 | Phillip Fong | Apr. 24, 2018 / Aug. 1, 2016 (filed) |
| U.S. Patent No. 10,093,021 | Aliakbar Aghamohammadi | Oct. 9, 2018 / Jun. 24, 2016 (filed) |
| U.S. Patent No. 10,209,063 | Peter Elving Anderson-Sprecher | Feb. 19, 2019 / Oct. 3, 2015 (filed) |

[20] *See supra* note 3.

| Patent / Publication No. | First Named Inventor | Date of Issue / Publication |
|---|---|---|
| U.S. Patent No. 10,667,664 | Faizan Sheikh | Jun. 2, 2020 / Oct. 27, 2016 |
| U.S. Patent Pub. 2008/0294338 | Nakju Doh | Nov. 27, 2008 |
| U.S. Patent Pub. 2012/0121161 | Ethan Eade | May 17, 2012 |

**b. Printed Publications**

| Citation | Publication Date |
|---|---|
| Stachness et al., *Springer Handbook of Robotics, Chapter 46: Simultaneous Localization and Mapping*, Springer (2d ed.) | Jun. 26, 2016 |
| Peter Biber and Wolfgang Straßer, *nScan-Matching: Simultaneous Matching of Multiple Scans and Application to SLAM*, Proceedings 2006 IEEE International Conference on Robotics and Automation, 2006 | 2006 |
| Lu and Milios, *Globally Consistent Range Scan Alignment for Environment Mapping*, Autonomous robots, 4 Autonomous robots 333–49 (1997) | 1997 |
| Francisco Amoros et al., *Global Appearance Applied to Visual Map Building and Path Estimation Using Multiscale Analysis*, Hindawi Publishing Corporation, Mathematical Problems in Engineering, Vol. 2014 Article ID 365417 | Jul. 22, 2014 |
| Khalid Yousif et al., *An Overview to Visual Odometry and Visual SLAM: Applications to Mobile Robotics,* Intell. Ind. Syst. Vol. 1, 289 | Nov. 13, 2015 |
| Richard Szeliski, *Image Alignment and Stitching: A Tutorial*, Foundations and Trends in Computer Vol. 2 | 2006 |
| Wolfgang Hess et al., *Real-time loop closure in 2D LIDAR SLAM*, 2016 IEEE Internation Conference on Robotics and Automation | May 16–21, 2016 |
| Giorgio Grisetti, et al, *A Tutorial on Graph-Based SLAM*, 2 IEEE Intelligent Transportation Systems Magazine 31 | Feb. 4, 2011 |
| Edwin B. Olson, *Robust and Efficient Robotic Mapping*, Massachusetts Institute of Technology | 2008 |
| Giorgio Grisetti, et al, *Nonlinear Constraint Network Optimization for Efficient Map Learning*, 10 IEEE Transactions on Intelligent Transportation Systems 428 | Sep., 2009 |
| Edwin Olson, et al, *Fast Iterative Alignment of Pose Graphs with Poor Initial Estimates*, Proceedings of the 2006 IEE Conference on Robotics and Automation | May, 2006 |
| John Folkesson and Henrik I. Christensen, *Closing the Loop with Graphical SLAM*, 23 IEEE Transactions on Robotics 731 | Aug., 2007 |
| Carlos Estrada, et al, *Hierarchical SLAM: Real-Time Accurate Mapping of Large Environments*, 21 IEEE Transactions on Robotics 588 | Aug., 2005 |
| Tim Bailey and Hugh Durrant-Whyte, *Simultaneous Localization and Mapping (SLAM): Part II*, IEEE Robotics & Optimization Magazine | Sep. 2006 |