

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SHENZHEN JIMUYIDA TECHNOLOGY CO., LTD.,
Petitioner,

v.

ARTEC EUROPE S.à r.l.,
Patent Owner.

Case IPR2023-01148
U.S. Patent No. 7,768,656

**DECLARATION OF DAVE AIKENS IN SUPPORT OF
PATENT OWNER'S PRELIMINARY RESPONSE
TO PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 7,768,656**

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TABLE OF EXHIBITS – PETITIONER

Exhibit No.	Description
1001	U.S. Patent No. 7,768,656
1002	File History of U.S. Application No. 11/846,494
1003	Declaration of Mohit Gupta in Support of Petition for Inter Partes Review of U.S. Patent No.
1004	U.S. Pat. Appl. No. 2004/0005092 (“Tomasi”)
1005	WO 2007/059780 (“Vinther”)
1006	Vuylsteke and Oosterlinck, “Range Image Acquisition with a Single Binary-Encoded Light Pattern,” <i>IEEE Transactions on Pattern Analysis and Machine Intelligence</i> , Vol. 12, No. 2, February 1990 (“Vuylsteke”)
1007	Battle, et al, “Recent Progress in Coded Structured Light as a Technique to Solve the Correspondence Problem: a Survey,” <i>Pattern Recognition</i> , Vol. 31, No. 7, pp. 963-982
1008	Salvi, et al., “Pattern codification strategies in structured light systems,” <i>Pattern Recognition</i> 37 (2004) 827 – 849
1009	Salvi, et al., “An overview of the advantages and constraints of coded pattern projection techniques for autonomous navigation,” <i>Proceedings of the 1997 IEEE/RSJ International Conference on Intelligent Robot and Systems. Innovative Robotics for Real-World Applications. IROS '97</i> , Grenoble, France, 1997, pp. 1264-1271 vol.3

TABLE OF EXHIBITS – PATENT OWNER

Exhibit No.	Description
2001	Declaration of Dave Aikens
2002	Dave Aikens CV

I, Dave Aikens, declare as follows:

I. INTRODUCTION & QUALIFICATIONS

A. Engagement

1. I have been retained on behalf of Artec Europe S.à r.l. (“Artec” or “Patent Owner” or “PO”) to prepare a declaration in support of the Patent Owner’s Preliminary Response to Shenzhen Jimuyida Technology Co., Ltd.’s (“Petitioner”) petition for *inter partes* review of claims 1-4, 6-15, and 17-22 of U.S. Patent No. 7,768,656 (the “’656 patent”). I am being compensated at an hourly rate of \$400 for my time working in this matter. My compensation is not contingent on my findings or the outcome of this proceeding. I have no financial interest in the ’656 Patent, Petitioners, Patent Owner, or the outcome of this matter.

2. Patent Owner has asked me to offer opinions regarding the ’656 Patent, including the patentability of claims 1-4, 6-15, and 17-22 (which I may refer to subsequently as the “Challenged Claims”) in view of the prior art identified and discussed in the Petition and the accompanying exhibits. This declaration sets forth the opinions I have reached to date regarding these matters. For convenience, the precise language of the challenged claims is attached to this declaration as Appendix A.

3. This declaration briefly outlines my background and qualifications to provide my opinion, describes the technology at issue and background of the art,

identifies materials I reviewed to prepare this declaration, and sets forth my understanding of the patent claims and my analysis regarding the application of the patent claims of the prior art provided to me. I reserve the right to supplement my opinions in the future, to clarify responses where appropriate, and to take into account new information as it becomes available to me. I further reserve the right to address additional deficiencies that are not discussed in this declaration in response to any institution of *inter partes* review and nothing in this declaration should be taken as a waiver of any argument or agreement with any of Petitioner's positions.

B. BACKGROUND AND QUALIFICATIONS

4. I am an expert in the field of optics, optical engineering, and optical systems development with extensive understanding of optical design. In formulating my opinions, I have relied upon my training, knowledge, and experience in the relevant art. My detailed Curriculum Vitae (CV) including my technical/educational qualifications as well as publications/patents and work experience etc. is included as **Exhibit 2002**. Also, following is a brief summary of my relevant qualifications and professional experience.

5. I received my Master of Science in Optical Engineering in 1984 and my Bachelor of Science in Optical Engineering in 1983.

6. In 2007, I founded Savvy Optics Corp. I am the current President of the company. My company's mission is to facilitate commerce in the optics industry by offering products and services aimed at reducing confusion, conflict, and waste in optical specifications and drawings. Savvy Optics Corp. is a globally recognized source of innovative and practical lens design, forensic physics and expert witness work, cost reductions through supply selection and specifications management, and educational services.

7. I am currently using ZEMAX for optical design and modeling, but I am facile with OSLO and Code V as well. Areas of specialization include precision optics for space applications, reconnaissance, industrial metrology, UV and IR systems, mobile devices, non-imaging systems for medical devices, laser telecom, architectural and industrial lighting, and optics requiring extremely tight flatness, waviness, roughness, and surface imperfection tolerances.

8. For nearly 40 years, I have been working, teaching, or researching in the field of optical devices.

9. I am a named inventor on 18 US patents and pending patent applications, including patents concerning various advanced optical systems, optical metrology (US7154607; US6879449; US6862090; US6587282), an imaging range finder (US4916536), a compact imaging spectrometer (US6744505), and fabrication of an optical component (US6099389).

10. I teach lens design through a year-long, company funded mentorship program. I have been running classes continuously since 2018, and currently have 18 students at various points in the 48-week program. I regularly teach at conferences and courses arranged by SPIE (The International Society for Optical Engineering, formerly Society of Photo-Optical Instrumentation Engineers). In 2017, I was named a fellow for SPIE, and in 2021 I was honored to receive the prestigious A. E. Conrady award for contributions in optical design and engineering. According to the bylaws of SPIE, the SPIE Board of Directors may confer the grade of a Fellow on member who has distinguished themselves through a clear demonstration of outstanding technical contributions in the field of optics and photonics that sets them apart from their peers.

11. I am also Chair of the American Technical Advisory Group to ISO TC172 and designated Leader of American Standards Council Task Force 2 for Surface Imperfections.

C. Information Considered

12. My opinions are based on a review of the materials of record in this proceeding, including the '656 patent and all exhibits submitted by Petitioner and Patent Owner or otherwise referenced or cited in those submissions. In reaching my opinions, I have relied upon my general knowledge and experience in the field and also considered the viewpoint of a person having ordinary skill ("POSITA" or

“skilled artisan”) in the art at the time of the filing date of the ’656 Patent, *i.e.*, August 2007. As explained below, I am familiar with the level of a person having ordinary skill in the art regarding the technology at issue at that time.

II. LEVEL OF ORDINARY SKILL IN THE ART

13. Petitioner proposed the following level of ordinary skill:

A person of ordinary skill in the art (‘POSITA’) as of the claimed priority date of the ’656 would have had a bachelor’s degree in computer systems, computer science, or the equivalent thereof, and at least two years of experience with 3D scanning or related technology. More education can supplement practical experience, and vice-versa.

Petition at 15.

14. I considered several factors in reviewing Petitioner’s proposed level of skill of a person having ordinary skill in the art of the ’656 patent in August 2007, including the types of problems encountered in the art, the solutions to those problems, the pace of innovation in the field, the sophistication of the technology, and the education level of active workers in the field.

15. In my opinion, in addition to the degrees articulated in Petitioner’s level of ordinary skill in the art, a POSITA could have alternatively held a bachelor’s degree in optics, optical engineering, optical science, electrical engineering, physics, or mathematics and that broader experience with optical

measurement or scanning systems would similarly suffice because these degrees and experience provide similar training and background that could be utilized and employed by a person in the relevant field. Therefore, a POSITA as of the August 2007 purported priority date of the '656 patent would have had: a bachelor's degree in computer systems, computer science, optics, optical engineering, optical science, electrical engineering, physics, or mathematics or the equivalent thereof, and at least two years of experience with optical measurement or scanning systems, 3D scanning, or related technology.

16. I qualify as a POSITA, regardless of whether Petitioner's or the above level of ordinary of skill is applied in this proceeding, and did so as of August 2007.

II. LEGAL STANDARDS

17. I am not a lawyer and have not been asked to offer my opinion on the law. Counsel has informed me of the applicable legal standards, as set forth below. I have applied these legal standards in my analysis.

A. Invalidity

18. It is my understanding that, under the patent laws, a claim of an issued patent is invalid if it does not cover eligible subject matter, is not novel, and/or obvious in light of what came before, and/or if the patent fails to meet the formal requirements of written description, enablement, and definiteness.

19. I further understand that what came before, for the purposes of determining whether the claimed invention is novel and nonobvious, is referred to as “prior art.” The claims of a patent are invalid if they are anticipated by the prior art (*i.e.*, are not novel) and/or are obvious in light of the prior art.

20. I have been informed that, for purposes of determining whether a patent or patent application is prior art to a claimed invention, the patent or patent application is considered to be effectively filed (i) as of the actual filing date of the patent or application, or (ii) if the patent or application includes a claim of priority to or benefit of an earlier filing date, then as of the filing date of the earliest such application that describes the claimed invention.

B. Anticipation

21. I understand that “anticipation” is a question of fact and that for a reference to anticipate a claimed invention it must disclose (either explicitly or inherently) each and every element set forth in the claim for that invention. I further understand that the requirement of strict identity between the claim and the reference is not met if a single element or limitation required by the claim is missing from the applied reference.

22. It is further my understanding that a disclosure in a prior art reference must be arranged in the same way as in the claims such that different embodiments and/or disclosures in a reference cannot be combined for purposes of anticipation if

they were not arranged in that way in the reference. In other words, every limitation of a claim must identically appear in a single prior art reference and be arranged in the same way as the challenged claim for the reference to anticipate a claim.

23. It is my understanding that (among other reasons) a patent claim is invalid if the claimed invention was patented, described in a printed publication, or in public use, on sale, or otherwise available to the public before the effective filing date of the claimed invention. I understand there are exceptions to this rule, which include, for example, that a disclosure made 1 year or less before the effective filing date of a claimed invention shall not be prior art to the claimed invention if:

- the disclosure was made by the inventor or joint inventor or by another who obtained the subject matter disclosed directly or indirectly from the inventor or a joint inventor; or
- the subject matter disclosed had, before such disclosure, been publicly disclosed by the inventor or a joint inventor or another who obtained a subject matter disclosed directly or indirectly from the inventor or a joint inventor.

24. I further understand that an element is disclosed inherently in a prior art reference if it is necessarily present in the prior art reference.

C. Obviousness

25. I understand that a claimed invention is unpatentable if the differences between the invention and the prior art are such that the subject matter of the claim as a whole would have been obvious at the effective filing date to a person having ordinary skill in the art to which the subject matter pertains (*i.e.*, a POSITA).

26. It is my understanding that obviousness is a question of law based on underlying factual issues including (1) the scope and content of the prior art, (2) the differences between the prior art and the challenged claims, (3) the level of ordinary skill in the pertinent art, and (4) the existence of secondary considerations such as commercial success, long-felt but unresolved needs, failure of others, copying, industry praise, etc.

27. It is also my understanding that I should first determine the scope and content of the prior art, then consider the differences, if any, between the prior art and each challenged claim; and that in doing so, although it is proper to consider differences between the claimed invention and the prior art, I should not focus on only the differences, because the test is whether the claimed invention as a whole would be obvious over all of the prior art. It is also my understanding that, in evaluating validity, each claim of the patent must be considered separately and in its entirety.

28. It is my understanding that the next step is to determine the level of ordinary skill in the art to which the claimed invention pertains at the time the invention was made.

29. It is my understanding that a person of ordinary skill in the art is presumed to have knowledge of the relevant prior art at the time of the claimed invention; and that if I find that the available prior art shows, discloses, teaches or suggests each of the elements of the challenged claims, I should determine whether a POSITA would have a reason to combine or coordinate these elements in the same manner as the challenged claim.

30. I understand that an obviousness evaluation can be based on a combination of multiple prior art references.

31. I understand that for a single reference or a combination of references to render obvious the claimed invention, a POSITA must have been able to arrive at the claimed invention by altering or combining the applied reference or references.

32. It is my understanding that a patent claim composed of several elements is not proven obvious merely by demonstrating that each of its elements was independently known in the art. Rather, obviousness would arise only where it is determined that the claimed invention implemented a predictable variation of

prior art elements or amounts to nothing more than the predictable use of prior art elements according to their established functions.

33. I understand that the prior art references themselves may provide an explicit suggestion, motivation, or reason to combine, but that the suggestion to combine may also arise from the state of the prior art generally.

34. It is my understanding that obviousness analyses can often be improperly distorted by hindsight bias. Hindsight bias can arise when an obviousness evaluation is influenced by the fact that the patented invention has already explained and demonstrated the solution to the problem and has already made clear the benefits of the claimed invention. My understanding is that once a problem has been solved, the solution may thereafter seem obvious in hindsight once the solution is already known. To avoid applying improper hindsight bias while conducting an obviousness evaluation, I should consider only what was known before the invention and cast my mind back to the time of the inventions before the patent at issue existed and consider whether the invention as a whole would have been obvious to a person of ordinary skill in the art, taking into consideration any interrelated teachings of the prior art, the effects of demands known to the marketplace, and the background knowledge possessed by a person having ordinary skill in the art.

35. In sum, my understanding is that prior art teachings are properly combined where a POSITA having the understanding and knowledge reflected in the prior art and confronted by the problem facing the inventor would have been led to make the combination of elements recited in the claims. Under this analysis, the prior art references themselves, or any need or problem known in the field of endeavor at the time of the invention, can provide a reason for combining the elements of multiple prior art references in the claimed manner.

D. Claim Construction

36. I also understand that a claim may express an element of a claim as means for performing a specified function without reciting the structure for performing that function. This type of claim limitation is referred to as a means-plus-function limitation. I understand that when a claim limitation recites a generic “means” or uses another generic term for implementing a given function, special narrowing rules apply to further limit the protection granted by the claim to cover only the specific structures disclosed in the patent specification and their equivalents.

III. OVERVIEW OF THE '656 PATENT & PROSECUTION HISTORY

37. The '656 patent is directed to a novel system for three dimensional (3D) measurement of shapes of material objects using non-contact structured light triangulation. I have reproduced Figures 1 and 13 of the '656 patent below:

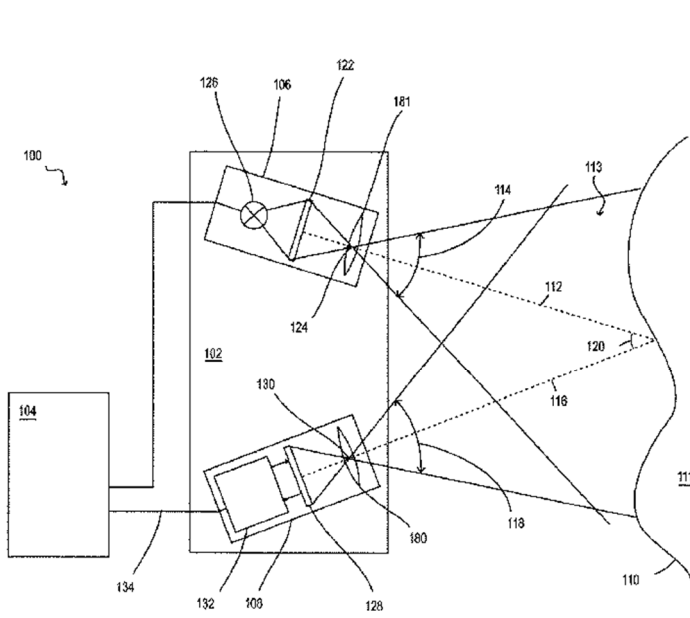


Fig. 1

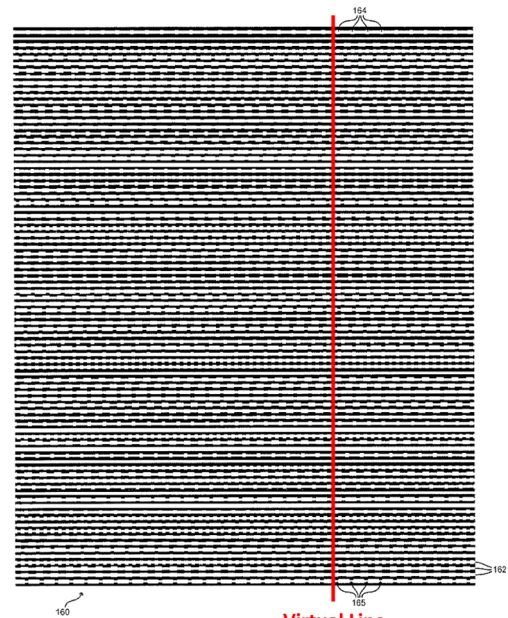


Fig. 13

Ex. 1001 ('656 patent), Fig. 1

Ex. 1001, Fig. 13¹

38. As shown above, the '656 patent discloses a system that includes a light projector for projecting a structured light pattern onto the surface of any object and a camera (with certain components) for capturing an image of the structured light pattern acting on the surface of the object. *See* Ex. 1001 at 3:30-47. The '656 patent further discloses a computing device for determining the 3D measurement of the surface shape of the illuminated object through a triangulation algorithm employed based on a calculated correspondence between the projected structured light and the captured image. *See* Ex. 1001 at 3:49-56, 4:49-5:2. The

¹ Emphasis, coloration, and annotations added throughout unless otherwise noted.

structured light includes coded elements that lie within planes passing through vertices of the central projection areas of both the projector and the camera, where such planes also pass through the space of the object being measured. *See* Ex. 1001 at 1:46-61. This arrangement allows a correspondence between the coded elements in the structured light and the captured image to be easily identified by restricting the number of directions in which the structured light can be deformed to one known direction, thereby providing a system and method of quickly and accurately obtaining the 3D measurement of the surface shape of objects using a non-contact structured-light triangulation methodology. *Id.*

39. During prosecution, claim 1 was amended to include “a light projector,” and “a device for capturing an image,” as well as other changes. I note that in an office action response, Applicant stated that:

Applicants disclose a system and method where groups of coded elements of the structured light are located along virtual lines that are defined on the surface of the projector slide by a plurality of virtual planes. Each of such virtual planes must pass through both the vertex of the projector lens and the vertex of the camera lens. Furthermore, when the structured light is reflected on the object and the image is captured by the camera, the coded elements are found in the image only along virtual lines that are defined by the same exact virtual planes on the surface of the object and

in the camera regardless of the shape of the surface. Thus, although the relative location of the coded elements from the same group of elements may change in the image reflected on the object and captured by the camera, all coded elements from the same group of elements will nevertheless be found along one virtual line defined as stated above, regardless of the shape of the object. Therefore, the foregoing principles make it easier to establish a direct correspondence between coded elements in the structured light pattern and the images of the coded elements as they are reflected on the surface of the object and captured by the camera and, thereby, establish a direct correspondence between points in the structured light pattern and the images. Once such direct correspondence is established, the shape of the object may be calculated using a triangulation method and the information regarding how the relative locations of the points are affected by the shape of the object.

Ex. 1002 at 138.

40. An examiner's Amendment was entered with the Interview Summary dated March 11, 2010, in which claim 1 was amended to recite "one parameter and, where said at least one parameter defines a spatial or temporal distribution of an amplitude or a wavelength of said structured light." Ex. 1002 at 155-158.

IV. CLAIM CONSTRUCTION: STRUCTURE ASSOCIATED WITH “A DEVICE FOR CAPTURING AN IMAGE”

41. I have been asked to consider whether “a device...compris[ing] a device lens characterized by a device lens vertex” that is recited in claims 1 and 12 is sufficient structure to perform the function of “capturing an image of said structured light pattern reflected on said object.”

42. In my opinion, the structure recited in the claim— “a lens characterized by a device lens vertex” —is insufficient structure to perform the function. A lens with a lens vertex on its own is not capable of performing the function of “capturing an image.” A POSITA would recognize that an image may pass through a lens, but the POSITA would know that a lens by itself cannot capture the image. Additional features and functionality would be needed to actually “capture” the image. There are many ways in which an image could be captured—for example through film or digitally using different approaches and device structures.

43. Upon review of the specification as to the structure associated with the “device for capturing an image,” the specification describes the structure associated with the claimed device as follows:

The optical unit 102 includes a camera 108 or other image detecting device for capturing an image of the structured light 113 acting on the surface 110 of the object 111. In one or more embodiments, the **camera 108 includes a lens 180 having a vertex 130, a matrix radiation receiver 128 and a camera driver 132.** The lens 180 forms the image on the surface of the matrix radiation receiver 128. The camera driver 132 functions as an electronic signal management and processing unit which controls operation of the matrix radiation receiver 128 and can convert the image captured by the receiver 128 to another format (e.g., VGA, bmp, jpeg, etc., as desired or required before the captured image is transferred to the camera output 134.

Ex. 1001 at 3:30-42. The specification does not describe different or additional structure associated with the “camera 108” or any other “device for capturing an image.”

44. It is my opinion that a POSITA would have recognized that the specification explains that the “lens 180 forms the image on the surface of the matrix radiation receiver 128,” and that the “camera driver 132” operates with the

matrix radiation receiver to capture the image. This statement alone would indicate to a POSITA that the “lens” is not “capturing” the image, instead it acts to direct or otherwise “forms the image” on another component — for example, a matrix radiation receiver. A POSITA would further recognize that another component — for example, a “camera driver” — is disclosed as being involved in the process to actually “capture” the image. Therefore, a POSITA would recognize that the “lens characterized by a device lens vertex” recited in the claims assists in the operation to form an image and is required by the claim, but the recitation of a “lens...[with a] lens vertex” is insufficient structure to perform the recited function. As such, a POSITA would understand that the structure that is disclosed for the claimed “device” is: a camera including a lens having a vertex, a matrix radiation receiver and a camera driver.

45. As a result, it is my understanding that, the “device for” term here must be interpreted as a means-plus-function limitation as follows:

Function: capturing an image of said structured light pattern reflected on said object;

Structure: camera including a lens having a vertex, a matrix radiation receiver, and a camera driver, and equivalents thereto.

V. THE PURPORTED MOTIVATIONS TO COMBINE THE REFERENCES ARE DEFICIENT

46. I note that the Petition asserts that all three references—Tomasi, Vinther, and Vuylsteke—disclose all eight limitations of the independent claims. Petition at 26-48, 77-86. It is unclear which aspects of the claim Petitioner asserts is missing from one reference and that is satisfied by another reference.

47. **Ground 1**: Petitioner’s arguments as to why a POSITA would have purportedly combined Tomasi and Vinther is reproduced below:

POSITA would have had a motivation and a reasonable expectation of success in modifying Tomasi with Vinther’s teachings by using, **for example**, Vinther’s specific structured light pattern, which is very similar to the one disclosed in the ‘656. ... It was well understood to a POSITA at the time of the invention to look to other 3D scanning implementations for guidance in how to implement such a system. ... Modifying Tomasi with Vinther’s teachings would have been a straightforward application of those teachings in a manner that advantageously **improves the efficiency** of a 3D scanning system.

Petition at 25-26.

48. Petitioner’s main reason why a POSITA would have modified Tomasi in view of Vinther is that “[i]t was well understood to a POSITA at the time of the

invention to look to other 3D scanning implementations for guidance in how to implement such a system.” *Id.* But Petitioner asserts Tomasi’s system already discloses “structured light patterns.” Petition at 27-29. Based on my review, the Petition does not explain why a POSITA would view Tomasi’s patterns as being insufficient or why Vinther’s light patterns are preferable.

49. I have seen no indication in the Petition that explains why a POSITA would look to other 3D implementations outside of Tomasi to implement other light patterns or components or aspects of Vinther, as Petitioner suggests. In fact, the only reason apparently given for the proposed combination is that a POSITA would have found that a combination of Tomasi and Vinther would “advantageously improv[e] the efficiency of a 3D scanning system.” Petition at 26. In my opinion, this is an assertion without appropriate support because Petitioner and its expert do not provide any explanation of how efficiency would have been purportedly improved over what is taught in Tomasi.

50. **Ground 2:** Petitioner’s argument as to why it would have purportedly been obvious to combine Tomasi, Vinther, and Vuylsteke is reproduced below:

In light of the above teachings, a POSITA would have had a motivation and a reasonable expectation of success in modifying Tomasi with Vinther’s teachings by using, **for example**, Vuylsteke’s grouping of coded light symbols within the structured light pattern. As previously

discussed in section IX.A, Tomasi and Vinther teach using structured light patterns having varying coded bits that can be grouped. EX1004, [0035], EX1005, 7:18-19. Vuylsteke also discloses coded elements that can be grouped. Indeed, it was also well understood for a designer of a system at the time of the invention to look to other 3D scanning implementations for guidance. See, e.g., section IX.A.2. Modifying Tomasi in view of Vinther with Vuylsteke's teachings would have been a straightforward application of those teachings in a manner that advantageously **improves the efficiency** of a 3D scanning system. EX1003, ¶¶57-63.

Petition at 76-77.

51. Petitioner asserts that Vuylsteke could be combined with Tomasi and Vinther because Vuylsteke discloses “grouping of coded light symbols within the structured light pattern.” Petitioner, however, also states that both Tomasi and Vinther disclose the coded light symbols and groupings as claims. *See id.* (“As previously discussed in section IX.A, **Tomasi and Vinther teach using structured light patterns having varying coded bits that can be grouped. Vuylsteke also discloses coded elements that can be grouped.**”) (citations omitted).

52. Petitioner again asserts that a POSITA would “look to other 3D scanning implementations” and that the combination would purportedly “advantageously improve[] the efficiency of a 3D scanning system.” *Id.* Like with Ground 1, I see no indication in the Petition that explains why a POSITA would look to other 3D implementations outside of Tomasi and/or Vinther to implement other groupings of coded light symbols as purportedly disclosed by Vuylsteke, as Petitioner suggests. Indeed, aside from the conclusory statements on this point, Petitioner does articulate a reason why a POSITA would have been motivated to combine Tomasi and/or Vinther with Vuylsteke's disclosure. This is particularly true in my opinion because Petitioner has asserted that all three of these references disclose all aspects of the claim.

VI. THE PETITION DOES NOT SHOW THAT TOMASI IN VIEW OF VINTHER AND/OR VUYLSKETE RENDERS OBVIOUS MULTIPLE ELEMENTS OF THE INDEPENDENT CLAIMS

A. Limitation 1.B & 12.B - The Petition does not show that the cited references render obvious “a device for capturing an image”

53. As discussed above, it is my understanding that the phrase “**a device for capturing an image** of said structured light pattern reflected on said object” must be interpreted as a means-plus-function limitation and that the corresponding structure that must be disclosed to perform the recited function is: **a camera having a lens with a vertex, a matrix radiation receiver, and a camera driver, and equivalents thereof**. Petitioner does not show how Tomasi, Vinther,

Vuylskete, or a combination thereof renders obvious this structure (or its equivalent).

54. *Tomasi and Vinther*. The Petition states that both Tomasi and Vinther disclose “a camera for capturing images,” and that Tomasi’s camera “include[es] a lens having an optical center (lens vertex)” and that Vinther’s camera “compris[es] a lens with a focal point (lens vertex).” See Petition at 31, 33. The Petition does not assert that Tomasi and/or Vinther discloses a matrix radiation receiver, camera driver, or their equivalents. I further note that the citations to Tomasi and Vinther do not reference a matrix radiation receiver and camera driver.

55. A POSITA would have understood that it would not have been inherent that a camera necessarily includes a matrix radiation receiver and camera driver. A camera may process and capture images in many different ways and a camera need not include a matrix radiation receiver and camera driver to capture images. Indeed, the very term “camera” is a shortened version of the term “camera obscura” that literally translates from latin as “dark chamber,” indicating what we now call a “pinhole camera,” an imaging device that predates modern photography by 1000 years or more. In the last 180 years there have been many methods for creating an image that do not require any matrix radiation receiver or camera driver at all, such as photographic film or vidicon sensors. If Tomasi or Vinther disclose this element, there is no evidence of it in the Petition.

56. *Vuylsteke*. The Petition states that: “Vuylsteke discloses a camera for capturing images. [Vuylsteke] further describes that the focal length is designed to match that of the projector optics.” Petition at 79. The Petition again does not explain how this text discloses a matrix radiation receiver and camera driver, or their equivalents. I note that the Petition’s citations to Vuylsteke do not reference any matrix radiation receiver or camera driver.

57. To the extent it is found that Vuylsteke does include the required structure and that the Petition has identified those elements, in my opinion the Petition does not articulate why a POSITA would have combined Tomasi in view of Vinther and Vuylsteke such that the combined system would include a camera with a matrix radiation receiver and camera driver.

B. Limitation 1.D & 12.D - The Petition does not show that the cited references render obvious “a spatial or temporal distribution of an amplitude or a wavelength of said structured light”

58. Claims 1 and 12 recite “wherein said slide pattern comprises a plurality of coded elements, where each of said coded elements is characterized by at least one parameter and, where said at least one parameter defines **a spatial or temporal distribution of an amplitude or a wavelength of said structured light.**”

59. *Tomasi in view of Vinther*. For Tomasi, the Petition reproduces Figure 6 and paragraphs 35, 89, and 90 and concludes that each of Tomasi’s “grid

point[s] [are] characterized by parameters including color defining a spatial distribution of wavelength, and/or size defining a spatial distribution of amplitude.” *See* Petition at 36. For Vinther, the Petition reproduces Figures 4 and 5, 6:4-5, and 7:18-27 of Vinther and concludes that each of Vinther’s “line[s] [are] characterized by parameters including line width or intensity defining a spatial distribution of amplitude.” *See* Petition at 37.

60. I note that none of Petitioner’s quoted or cited portions of Tomasi or Vinther recite either “amplitude” or “wavelength.” I further note that I could not find any such recitation in Tomasi or Vinther. In my opinion, Petitioner does not explain why the cited text from Tomasi and Vinther disclose a spatial or temporal distribution of an amplitude or a wavelength of said structured light. It is also my opinion that Petitioner does not explain why a POSITA would have been motivated to modify Tomasi in view of Vinther in such a way that would render obvious this limitation.

61. ***Vuylsteke***. The Petition states that “Vuylsteke discloses that it was known to use a slide pattern with varying wavelength” and quotes Vuylsteke’s discussion of a prior art system that Vuylsteke refers to as “Tajima.” A POSITA would have recognized that Vuylsteke describes Tajima as disclosing “gradually increasing wavelength,” but would have further understood that Vuylsteke disparages Tajima by identifying several problems with Tajima’s system that

Vuylsteke's system attempts to solve. Ex. 1006 at 148. For example, Vuylsteke explains that "acceptable range accuracy" using Tajima's system can be difficult to achieve, and that "it is not obvious [how] to deal with the effects of mutual illumination from nearby reflecting surfaces" caused by Tajima's system. *Id.* A POSITA would not have been motivated to implement Tajima's system of "gradually increasing wavelength" into Tomasi or Vinther's system when Vuylsteke disparages this system.

62. Petitioner also asserts that Vuylsteke discloses "varying amplitude" through Vuylsteke's use of grid points. *See* Petition at 80-81 (quoting Ex. 1006 at 150, Figs. 2-3). The identified disclosure states that "every grid point is individually marked with a bright or a dark spot." *Id.* But a POSITA reviewing the cited disclosures would recognize that this disclosure refers to making a certain grid point either bright or dark (*see* Ex. 1006 at Fig. 3), and the Petition does not explain why this would constitute a variation in amplitude of the grid points.

C. Limitations 1.F-1.G & 12.F-12G - The Petition does not show that the cited references render obvious a "virtual line" or "coded elements" along the virtual line

63. Claims 1 and 12 recite: "a first slide virtual line and a second slide virtual line are defined on said slide surface" and that "said coded elements of said first group are located along said first virtual line and said coded elements of said second group are located along said second virtual line."

64. ***First and Second Virtual Lines.*** For Tomasi, Petitioner asserts that Tomasi’s purported “epipolar line pairs define virtual lines on the slide surface.” Petition at 43 (quoting Ex. 1004 ¶ 60 (“[A]ny point on a given epipolar line in the projector plane 322 must map onto the corresponding epipolar line in the camera plane 324.”)). However, the Petition does not explain why Tomasi’s “epipolar line,” or any other line, teaches the claimed “virtual lines.” I note the Petition also does not explain how these purported epipolar lines are “defined on said slide surface,” as claimed.

65. For Vinther, Petitioner cites Figures 4-7, 7:15-35, and 8:21-25 and states:

Vinther discloses using multiple virtual lines to resolve the correspondence between points of the slide pattern and points in the captured image. **Vinther** discloses defining virtual lines on the slide pattern. These virtual lines relate to planes inherent in the epipolar geometry (called epipolar planes) that exists between the projector and the camera.

Petition at 44-45.

66. Vinther never once recites “epipolar” or “polar” and Petitioner fails to explain why Vinther allegedly discloses epipolar geometry and planes. Additionally, Petitioner does not explain how disclosures of epipolar geometry and

planes constitute a disclosure of the claimed “virtual lines.” The Petition also does not explain how these purported epipolar lines are “defined on said slide surface,” as claimed.

67. For Vuylsteke, Petitioner asserts that:

“Vuylsteke discloses light sheets (planes) projected through the projector lens vertex, and virtual planes passing through the projector lens vertex and the camera lens vertex. The structured light pattern is designed in a grid-like fashion such that defined rows and columns intersect with the light sheets.”

Petition at 82. The Petition here also does not explain how the purported “light sheets” and “virtual planes” result in a first and second “virtual line” and why any such virtual line would be “defined on said slide surface,” as claimed.

68. ***First and Second Coded Element Groups along the respective First and Second Virtual Lines.*** Claim [1.G] requires that the “first group [of coded elements] are located along said first virtual line” and the “second group [of coded elements] are located along said second virtual line.” Petitioner does not explain or show how each of the purported first and second virtual lines in Tomasi or Vinther include the corresponding claimed first and second groups of coded elements along those lines.

69. For Tomasi, Petitioner concludes that “Tomasi discloses groups of coded elements located along each of the epipolar lines that are inherent in the epipolar geometry.” Petition at 46. For Vinther, Petitioner concludes that “Vinther discloses multiple virtual lines passing through groups of coded elements.”

70. Petitioner’s conclusory statements and blank citations to portions of Tomasi or Vinther do not explain how Tomasi or Vinther disclose a first group of coded elements along a first virtual line and a second group of coded elements along a second virtual line.

71. For Vuylsteke, the Petition includes a variety of miscellaneous statements including that Vuylsteke discloses “groups of coded elements located along varying virtual lines,” “how triangulation with structured light involves the intersection of lines and planes,” “how codebits exist within the context of columns and planes,” “groups of coded elements, containing at least two coded elements,” and “how coded elements exist in the context of a grid topology.” Petition at 84-86. But, again, none of these unsupported conclusions show or even allege that a first group of coded elements is located on a first virtual line or that a second group of coded elements is located on a second virtual line. For example, Petitioner’s assertion that “groups of coded elements located along varying virtual lines” — even if accepted as true — merely states that “varying virtual lines” include “groups of coded elements.” But this does constitute an assertion that a first virtual

line includes a first grouping and that a second virtual line includes a second grouping, as required by the claims.

72. Tomasi in view of Vinther and/or Vuylsteke. The Petition does not explain *how* the proposed combined system of Tomasi in view of Vinther and/or Vuylsteke would have incorporated Vinther and/or Vuylsteke’s coded elements and/or virtual line(s) *or why* a POSITA would have been motivated to do so.

D. Limitation 1.A & 12.A - The Petition does not show that Tomasi in view of Vinther renders obvious “a projector lens characterized by a projector lens vertex”

73. Claims 1 and 12 recite a “light projector comprises a light source, a slide with a slide pattern located on a slide surface, and *a projector lens characterized by a projector lens vertex.*” Petitioner fails to show that Tomasi, Vinther, or Tomasi in view of Vinther discloses or otherwise renders obvious “a projector lens characterized by a projector lens vertex.”

74. **Tomasi**. The Petition reproduces paragraphs 4, 34, 36 and 59 of Tomasi and concludes that Tomasi’s “projector optical center” discloses the claimed “projector lens vertex.” Petition at 27-29. Tomasi’s quoted text references a “projector optical center 302,” but the text does not mention any “projector lens” as required by the claims. Indeed, none of the cited paragraphs recite a “lens” at all. A POSITA would have understood that a projector may have an optical center without necessarily having an optical lens. Projectors come in

many forms, not all of which involve lenses. One common form of projector is a reflective mirror, for example. Such a projector may have an optical center, but would not have a projector lens with a lens vertex. Other types of projectors include combinations of mirrors, or entirely eccentric lenses with no actual lens vertex. In any event, if Tomasi includes this claim element, there is no evidence of this in the Petition.

75. ***Vinther***. The Petition reproduces several block quotes from Vinther and states that Vinther’s “projector optical center” discloses the claimed “projector lens vertex.” *See* Petition at 29-31. *First*, Vinther does not recite an “optical center” and it is unclear what aspect or portion of Vinther Petitioner is purportedly identifying. *Second*, the Petition’s only citation mentioning a projector lens (Petition at 30 (citing 2:1-2)) is from the “Background of Invention” and the Petition does not explain why this text purportedly discloses the claimed “projector lens vertex.” *Finally*, the Petition again does not explain why Vinther’s reference to a “projector lens” discloses or renders obvious the claimed projector lens having “a projector lens vertex.” A POSITA would understand that not all projector lenses include a lens vertex. For example, one such system would be a projector with a non-symmetric lens as discussed above. It is not uncommon to use highly eccentric optical systems with no intrinsic axis or vertex in, for example, heads-up

displays. Once again, if Vinther discloses this claim element, there is no evidence to this effect in the Petition.

76. *Tomasi in view of Vinther.* As discussed above, the Petition does not explain how either Tomasi or Vinther discloses “a projector lens characterized by a projector lens vertex.” The Petition also does not explain why a POSITA would have been motivated to modify Tomasi in view of Vinther to render obvious this limitation.

VII. CONCLUSION

77. For the above reasons, it is my opinion that the claims of the '656 Patent are not rendered obvious in view of the grounds presented by Petitioner.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the results of these proceedings.

Executed on October 23rd, 2023 in Chester, Connecticut.



Dave Aikens

APPENDIX A: CHALLENGED CLAIM CHART

1. [1. PREAMBLE]	A system for the 3D measurement of the shape of a material object, comprising:
[1.A]	a light projector for projecting a structured light pattern onto a surface of said object, wherein said light projector comprises a light source, a slide with a slide pattern located on a slide surface, and a projector lens characterized by a projector lens vertex;
[1.B]	a device for capturing an image of said structured light pattern reflected on said object, wherein said device for capturing an image comprises a device lens characterized by a device lens vertex; and
[1.C]	a computing device for determining a measurement relating to the shape of said object using a triangulation algorithm based on a correspondence between points in said slide pattern and said image, and
[1.D]	wherein said slide pattern comprises a plurality of coded elements, where each of said coded elements is characterized by at least one parameter and, where said at least one parameter defines a spatial or temporal distribution of an amplitude or a wavelength of said structured light; and
[1.E]	wherein said coded elements are assigned to one of at least first group or second group, each of which first group and second group comprising at least two of said coded elements, and
[1.F]	wherein at least a first slide virtual line and a second slide virtual line are defined on said slide surface, where said first slide virtual line is defined by an intersection between said slide surface and a first plane passing through said projector lens vertex and through said device lens vertex, and said second slide virtual line is defined by an intersection between said slide surface and a second plane passing through said projector lens vertex and through said device lens vertex,

[1.G]	wherein said coded elements of said first group are located along said first virtual line and said coded elements of said second group are located along said second virtual line.
2	The system of claim 1, wherein each of said coded elements having at least three points that do not lie on a straight line.
3	The system of claim 1, wherein at least first object virtual line and second object virtual line are defined on the surface of said object, where said first object virtual line is defined by an intersection between said surface of said object and said first plane and where said second object virtual line is defined by an intersection between said surface of said object and said second plane.
4	The system of claim 1, wherein the light projector is further characterized by a central optical axis, further wherein the light projector and the device for capturing an image are arranged such that a line extending between the projector vertex and the device vertex is perpendicular to the central optical axis of the light projector.
6	The system of claim 1, wherein the light projector is characterized by a projector central optical axis and wherein the device for capturing an image is characterized by a device central optical axis, further wherein the light projector and the device for capturing an image are arranged such that a line extending between the projector vertex and the device vertex is not perpendicular to either the projector optical axis or the device optical axis.
7	The system of claim 1, wherein the light projector projects structured light in a wavelengths selected from optical, visible and infrared wavelengths.
8	The system of claim 1, wherein the light projector is a flashlight source.
9	The system of claim 1, wherein the structured light pattern comprises a plurality of coded elements that can be variably grouped together such that all of the coded elements in each group form a unique sequence relative to the sequences of coded elements in adjacent groups of coded elements.

10	The system of claim 1, wherein the computing device determines a three-dimensional shape of the surface of said object.
11	The system of claim 1, wherein said at least one parameter defines a shape, size, or color or a change thereof in time for at least one of said coded elements.
12. [12.PREAMBLE]	A method for the 3D measurement of the shape of a material object, comprising:
[12.A]	projecting a structured light pattern from a light projector onto a surface of an object, wherein the light projector comprises a light source, a slide with a slide pattern located on a slide surface, and a projector lens characterized by a projector lens vertex;
[12.B]	capturing an image of the structured light pattern reflected on the surface of the object with a device for capturing an image, wherein said device for capturing an image comprises a device lens characterized by a device lens vertex;
[12.C]	determining a measurement relating to the surface of the object using a triangulation algorithm based on a correspondence between points in said slide pattern and said image, and
[12.D]	wherein said slide pattern comprises a plurality of coded elements, where each of said coded elements is characterized by at least one parameter and, where said at least one parameter defines a spatial or temporal distribution of an amplitude or a wavelength of said structured light, and
[12.E]	wherein said coded elements are assigned to one of at least first group or second group, each of which first group and second group comprising at least two of said coded elements, and
[12.F]	wherein at least a first slide virtual line and a second slide virtual line are defined on said slide surface, where said first slide virtual line is defined by an intersection between said slide surface and a first plane passing through said projector lens vertex and through said device lens vertex, and said

	second slide virtual line is defined by an intersection between said slide surface and a second plane passing through said projector lens vertex and through said device lens vertex, and
[12.G]	wherein said coded elements of said first group are located along said first virtual line and said coded elements of said second group are located along said second virtual line.
13	The method of claim 12, wherein each of said coded elements having at least three points that do not lie on a straight line.
14	The method of claim 12, wherein at least first object virtual line and second object virtual line are defined on said surface of said object, where said first object virtual line is defined by an intersection between said surface of said object and said first plane and where said second object virtual line is defined by an intersection between said surface of said object and said second plane.
15	The method of claim 12, wherein the light projector is further characterized by a central optical axis, further comprising arranging the light projector and the device for capturing an image such that a line extending between the light projector vertex and the device vertex is perpendicular to the central optical axis of the light projector.
17	The method of claim 12, wherein the light projector is characterized by a projector central optical axis and wherein the device for capturing an image is characterized by a device central optical axis, further comprising arranging the light projector and the device for capturing an image such that a line extending between the projector vertex and the device vertex is not perpendicular to either the projector central optical axis or the device central optical axis.
18	The method of claim 12, further comprising projecting structured light in a wavelengths selected from optical, visible and infrared wavelengths.
19	The method of claim 12, further comprising projecting the structured light from a flashlight source.

20	The method of claim 12, wherein the structured light pattern comprises a plurality of coded elements that can be variably grouped together such that all of the coded elements in each group form a unique sequence relative to the sequences of coded elements in adjacent groups of coded elements.
21	The method of claim 12, further comprising determining a three-dimensional shape of the surface of said object.
22	The method of claim 1, wherein said at least one parameter defines a shape, size, or color or a change thereof in time for at least one of said coded elements.