

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Chris Pershing et al.
U.S. Patent No.: 9,135,737 Attorney Docket No.: 53317-0003IP1
Issue Date: September 15, 2015
Appl. Serial No.: 14/484,726
Filing Date: August 1, 2014
Title: CONCURRENT DISPLAY SYSTEMS AND METHODS FOR
AERIAL ROOF ESTIMATION

DECLARATION OF DR. DAVID FORSYTH

I, Dr. David Forsyth, declare that:

1. I am currently the Fulton-Watson-Copp Chair in Computer Science at the University of Illinois at Urbana-Champaign. I believe that my background and expertise qualify me as an expert in the technical issues in this matter. A brief summary of my qualifications is included below. My full Curriculum Vitae is attached to this Declaration as Appendix A.

2. My education began in Cape Town, South Africa. I was an undergraduate at the University of the Witwatersrand, Johannesburg, and I hold a Bachelor of Science (1984) and Master of Science in Electrical Engineering from that University. I was awarded the Diocesan College Rhodes Scholarship in 1984 to attend Oxford University. I hold a Master of Arts by special election from Oxford University and a Doctorate of Philosophy in Engineering Science from Balliol College, Oxford. I was appointed Fellow by Examination of Magdalen College, Oxford in 1989. I was then appointed Assistant Professor of Computer

Science at the University of Iowa in 1991; in 1994, I was promoted to Associate Professor of Computer Science, and went on leave of absence to take up an appointment as Assistant Professor of Computer Science at U.C. Berkeley. I was promoted to Associate Professor of Computer Science at U.C. Berkeley in 1996, and to Professor of Computer Science in 2002. I went on leave of absence from U.C. Berkeley to take up an appointment as Professor of Computer Science at the University of Illinois at Urbana-Champaign in 2004. I am currently the Fulton-Watson-Copp Chair in Computer Science at the University of Illinois at Urbana-Champaign.

3. I have studied Computer Vision since my final year as an undergraduate in 1984, when I engaged in an undergraduate project on the topic. My Ph.D. thesis treats a traditional problem in computer vision, known as "color constancy," and the paper that resulted from this work is still quite regularly cited. As a Fellow by Examination, I studied illumination and shading effects in vision, and geometric methods to recognize objects. I have published papers on a wide range of topics in computer vision, computer graphics, machine learning and human-computer interfaces. I have published about 160 refereed papers and 10 book chapters. I have published one textbook on computer vision in two editions and four languages, one research monograph, and two recent textbooks on machine

learning. I have edited six volumes of collected papers. A reasonably complete list of my publications is contained in my curriculum vitae in Appendix A.

4. In addition, I have occupied various leadership posts within my discipline. I was (or will be) program co-chair for the Institute of Electrical and Electronics Engineers ("IEEE") Conference on Computer Vision and Pattern Recognition ("CVPR") in 2000, 2011, 2018 and 2021, and for the European Conference on Computer Vision ("ECCV") in 2008. I was general co-chair for CVPR in 2006 and again held the position for CVPR 2015. I was general co-chair for the IEEE International Conference on Computer Vision in 2019. I am an Associate Editor of the International Journal of Computer Vision; of the Association for Computing Machinery ("ACM") Transactions on Graphics; and of the Journal of the ACM. I was the Editor in Chief of the IEEE Transactions on Pattern Analysis and Machine Intelligence ("TPAMI") for four years. TPAMI is a journal which receives approximately 1000 submissions per year, and which is usually seen as the leading journal in the discipline. I also served for three years on a committee of the National Research Council, convened to study methods to protect children from pornography and other inappropriate material on the internet.

5. Throughout my career I have received a variety of awards. In 1993, the Marr prize for Best Paper at the International Conference on Computer Vision was awarded to "Extracting Projective Structure from Single Perspective Views of

3D Point Sets," a paper I wrote with Charles A. Rothwell, Andrew Zisserman, and Joseph L. Mundy. In 2002, the award for Best Paper in Cognitive Computer Vision at the European Conference in Computer Vision was awarded to "Object recognition as machine translation: Learning a lexicon for a fixed image vocabulary," a paper I wrote with P. Duygulu, K. Barnard, and J.F.G. de Freitas. I was awarded an IEEE Technical Achievement Award in 2005 for my work on Computer Vision. I became an IEEE Fellow in 2009, and an ACM Fellow in 2014.

6. My work is extensively cited in computer vision literature, with 36,859 citations recorded by Google scholar in Dec 2019.

7. My appended CV lists all publications authored in the past 10 years, with perhaps a few exceptions that I have forgotten.

8. I have made extensive contributions to computer vision education. I am lead co-author of a widely used textbook in the discipline, "Computer Vision - A Modern Approach", which has appeared in two editions and four languages. I have written two other textbooks, and am the lead co-author of the computer vision chapter in the leading Artificial Intelligence textbook. I have trained 30 Ph.D. students. I have trained people who are very well known academics in computer vision. Tamara Berg is associate professor of computer science at the University of North Carolina at Chapel Hill. Ali Farhadi is associate professor of computer

science at the University of Washington. Deva Ramanan is a tenured professor of computer science at Carnegie Mellon University. Gang Wang was assistant professor of computer science at Nanyang Technological University in Singapore, and moved to become the senior lead in AI research at Alibaba. Zicheng Liao is a professor of computer science at Zhejiang University. Kobus Barnard is professor of computer science at University of Arizona. Each is seen as a young leader in the field.

9. Based on my above-described 35 years of experience in the field of computer vision and the acceptance of my publications and professional recognition by societies in my field, I believe that I am considered to be an expert in the field of computer vision (including image analysis).

10. My compensation in connection with this case is my normal rate of \$450 per hour. This compensation is not contingent upon my opinions or the outcome of this case.

11. In the last four years, I have acted as an expert and was deposed in the following matters: *Legend3D, Inc. v. Prime Focus Creative Services Canada Inc.*, IPR2016-00806; *Prime Focus Creative Services Canada Inc. v. Legend3D, Inc.*, IPR2016-01243; *Prime Focus Creative Services Canada Inc. v. Legend3D, Inc.*, IPR2016-01491; and *Kewazinga Corp. v. Microsoft Corporation*, 1:2018-cv-04500 (SDNY).

12. In writing this Declaration, I have considered the following: my own knowledge and experience, including my work experience in the field of communications networks; my experience in teaching those subjects; and my experience in working with others involved in those fields. In addition, I have analyzed the following publications and materials, in addition to other materials I cite in my declaration:

- NEARMAP-1001 U.S. Patent No. 9,135,737
- NEARMAP-1002 File History for U.S. Patent No. 9,135,737
- NEARMAP-1004 Heller et al., *The Site-Model Construction Component of the RADIUS Testbed System*, Proceedings: ARPA Image Understanding Workshop (1997) (“Heller”)
- NEARMAP-1005 Quam et al., *The Radius Common Development Environment*, RADIUS: Image Understanding for Imagery Intelligence, O. Firschein and T. Strat, eds. (1997) (“Quam”)
- NEARMAP-1006 U.S. Pub. No. 2006/0235611 (“Deaton”)
- NEARMAP-1010 *Xactware Solutions, Inc. v. Eagle View Technologies, Inc.*, IPR2016-00592, Paper 50 (P.T.A.B. August 25, 2017) (Final Written Decision)

- NEARMAP-1011 – *Xactware Solutions, Inc. v. Eagle View Technologies, Inc.*, IPR2016-00592, Paper 1 (P.T.A.B. February 8, 2016) (Petition)
- NEARMAP-1012 – *Xactware Solutions, Inc. v. Eagle View Technologies, Inc.*, IPR2016-00592, Paper 50 (P.T.A.B. August 25, 2017) (Patent Owner’s Response)
- NEARMAP-1013 – District Court Scheduling Order
- NEARMAP-1014 – Overview for Brian Theadore Stewart of DUtah (Lex Machina)
- NEARMAP-1015 – *Xactware Solutions, Inc. v. Eagle View Technologies, Inc.*, IPR2016-00592, Paper 33 (P.T.A.B. November 23, 2016) (Decision on Patent Owner’s Motion to Seal)
- NEARMAP-1019 to NEARMAP-1029 – Exhibits 2019 to 2029 from IP2016-00592
- NEARMAP-1030 – *Pictometry® Adopts the EagleView® Brand*, <https://www.eagleview.com/government/pictometry-adopts-eagleview-brand> (April 6, 2017)
- NEARMAP-1031 – *Pictometry® Roof Measurement Reports Now Available Through AccuLynx.com*, <https://www.prnewswire.com/news-releases/pictometry-roof-measurement-reports-now-available-through-acculynxcom-139984893.html> (Feb. 22, 2012)

- NEARMAP-1032 – *Pictometry Demonstrates Aerial Imagery Solutions at International Roofing Expo*, <https://www.businesswire.com/news/home/20110216006158/en/Pictometry-Demonstrates-Aerial-Imagery-Solutions-at-International-Roofing-Expo> (Feb. 16, 2011)
- NEARMAP-1033 – *What's imagery got to do with it?*, <https://www.professionalroofing.net/Articles/What-s-imagery-got-to-do-with-it--04-01-2012/2069> (Apr. 1, 2012)
- NEARMAP-1034 – *Oblique Imagery: The New Kids on the Block*, <https://geospatial-solutions.com/oblique-imagery-the-new-kids-on-the-block/> (July 2, 2013)
- NEARMAP-1035 – *Merger years in the making*, Rochester Business Journal, Vol. 28 No. 44 (Jan. 11, 2013)

I. THE '737 PATENT

A. Brief Description

13. The '737 patent, entitled “Concurrent Display Systems and Methods for Aerial Roof Estimation”, describes “a roof estimation system that provides a user interface configured to facilitate roof model generation based on one or more aerial images of a building roof.” NEARMAP-1001, Abstract.

14. Claim 1 is representative, and recites (reference numbers in bold are used to refer to the limitation in the analysis below):

1. **[1.0]** A computer-implemented method in a roof estimate report system including at least one processor and a memory coupled to the at least one processor, the method comprising:

[1.1] displaying, by the at least one processor of the roof estimate report system, a plurality of aerial images of a roof at the same time,

each of the aerial images providing a different view, taken from a different angle of the same roof;

[1.2] displaying, by the at least one processor of the roof estimate report system, respective line drawings representing features of the roof, the respective line drawings overlying a first and a second aerial image of the plurality of aerial images of the roof, the line drawing overlying the first aerial image of the roof having features in common with the line drawing overlying the second aerial image of the roof;

[1.3] in response to user input, changing, by the at least one processor of the roof estimate report system, the line drawing representing a feature of the roof that overlies the first aerial image of the roof;

[1.4] in response to the changing, making corresponding changes, by the at least one processor of the roof estimate report system, to the line drawing overlying the second aerial image; and

[1.5] generating and outputting a roof estimate report using a report generation engine, wherein the roof estimate report includes numerical values for corresponding slope, area, or lengths of edges of at least some of a plurality of planar roof sections of the roof, wherein the generated roof estimate report is provided for repair and/or constructing the roof structure of the building.

B. Prosecution History

15. The application that eventually issued as the '737 patent was filed on August 1, 2014, and claims priority (through a string of continuations) to a provisional application filed on October 31, 2008 (the "Critical Date"). On

December 30, 2014, the Examiner issued the only Office Action in this case, which rejected all claims as obvious. Applicant responded on June 1, 2015, stating that the Examiner had agreed to allow the case during an interview if “allowable subject matter from the parent application ... regarding generating and outputting a roof estimate report” was included in the claims, and amended the independent claims to recite the “generating and outputting a roof estimate report” limitations. NEARMAP-1002, 190-191. The Examiner subsequently issued a Notice of Allowance, and the patent issued on September 15, 2015.

C. Level of Ordinary Skill in the Art

16. A person of ordinary skill in the art at the time of the '737 patent (a “POSITA”) would have had at least a Bachelor’s Degree in an academic area emphasizing the design of electrical, computer, or software technologies, or a similar discipline, and at least two years of experience related to computerized image analysis and three-dimensional modeling. Superior education could compensate for a deficiency in work experience, and vice-versa.

D. Claim Construction under 37 C.F.R. §§ 42.104(b)(3)

17. I have been informed that all claim terms should be construed according to the *Phillips* standard. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005); 37 C.F.R. § 42.100. Besides the claim terms discussed below, in my opinion, based on the evidence presented herein and the prior art’s description of

the claimed elements being similar to that of the '737 patent specification, no formal claim constructions are necessary in this proceeding because “claim terms need only be construed to the extent necessary to resolve the controversy.”

Wellman, Inc. v. Eastman Chem. Co., 642 F.3d 1355, 1361 (Fed. Cir. 2011).

**1. “generating and outputting a roof estimate report...”
(independent claims 1, 12, 16, and 26)**

18. Independent claims 1, 12, 16, and 26 each recite a form of the following limitation:

generating and outputting a roof estimate report using a report generation engine, wherein the roof estimate report includes numerical values for corresponding slope, area, or lengths of edges of at least some of a plurality of planar roof sections of the roof, wherein the generated roof estimate report is provided for repair and/or constructing the roof structure of the building.

19. NEARMAP-1001, claim 1. These limitations are directed to generating printed matter that has no function or structural relation to the substrate on which it is printed or displayed. It is my understanding that limitations directed to such printed matter are entitled to no patentable weight. *See In re DiStefano*, 808 F.3d 845, 850 (Fed. Cir. 2015).

20. I have been informed by counsel that, in its Final Written Decision in a prior IPR challenge¹ to the '737 patent by a different petitioner, the Board considered these limitations, held that the “the detailed requirements as to the contents of the roof estimate report” recited in these limitations “are ***not entitled to patentable weight.***”² NEARMAP-1010, 18. Specifically, the Board reasoned that the “roof report is ***merely a printed description*** of the method’s output and it ***adds no functional or structural elements to the paper or computer screen on which the report appears.***” *Id.*, 17. In other words, the “the content of the information” in the generated report “does not modify or otherwise affect the underlying computer or paper, nor does it represent a new and non-obvious relationship with the substrate.” *Id.*, 17-18. “Thus, ***the claimed content of the information is not entitled to weight in the patentability analysis.***” *Id.*, 18 (citing *In re Ngai*, 367 F.3d 1336, 1338 (Fed. Cir. 2004); *Ex parte Nehls*, 88 USPQ2d 1883, 1887–90 (BPAI 2008) (precedential) (discussing non-functional descriptive material)). The Board explains that “what the content of the information, graphical or textual” in the generated roof estimate report “may convey to the human mind does not

¹ *Xactware Solutions, Inc. v. Eagle View Technologies, Inc.*, IPR2016-00592, (P.T.A.B. August 25, 2017).

² All emphasis added unless indicated otherwise.

change the functionality of the computer-implemented method and fails to distinguish over generating and displaying any graphical or textual information.” NEARMAP-1010, 18.

2. “transmitting roof measurement information” (claim 9)

21. Claim 9 recites “transmitting roof measurement information based . . . on the change of the line drawing.” NEARMAP-1001, claim 9. For the purposes of the present proceeding, this limitation should be interpreted broadly enough to encompass transmitting roof measurement information between components of the same computer system, consistent with the Board’s interpretation of the term in the prior IPR challenge to the ’737 patent. *See* NEARMAP-1010, 18-20. Notably, this claim term does not specify any particular source or destination for the transmission, thereby indicating that transmission within the same computer system is contemplated. *See id.* In addition, the ’737 patent’s specification contemplates this type of transmission. *See, e.g.,* NEARMAP-1001, 16:15–17, FIG. 8 (“Some portion of the contents, some of, or all of the components of the RES 810 may be stored on and/or transmitted over the other computer-readable media 805”); *see* NEARMAP-1010, 20. Accordingly, interpreting this claim term to encompass transmission of roof measurement information between components of the same computer system is proper because 1) it is consistent with the plain and ordinary meaning the term would have had to a POSITA; 2) it is consistent with

the '737 patent's specification; and 3) it is consistent with the Board's prior finding with respect to this term. *See, e.g.*, NEARMAP-1010, 18-20; NEARMAP-1001, 16:15–17, FIG. 8.

II. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. GROUND 1: Claims 1, 6, 7, 9, 10, 16, 17, 25, 26, and 34 are obvious over Heller in view of Quam

1. Overview of Heller

22. Heller describes various aspects of the “RADIUS” system, a software platform that enables the “creation of a 3-dimensional model that captures the basic geometry of [a] site under examination,” such as a house or a commercial building, based on analysis of one or more images of the site. NEARMAP-1004, 1. Heller describes that the “RADIUS Testbed System” (RTS) includes both “manual and semi-automatic tools for site model construction.” *Id.* “[M]anual techniques [are] those in which the 3-dimensional model of a feature is projected into one or more images and the operator adjusts the model to align it with what is seen in the images,” whereas “semi-automatic techniques [are] those which require an operator to provide an initial rough estimate of a feature’s position, size and topology and the system then refines or extends the model of the object using information extracted from the image(s).” *Id.*

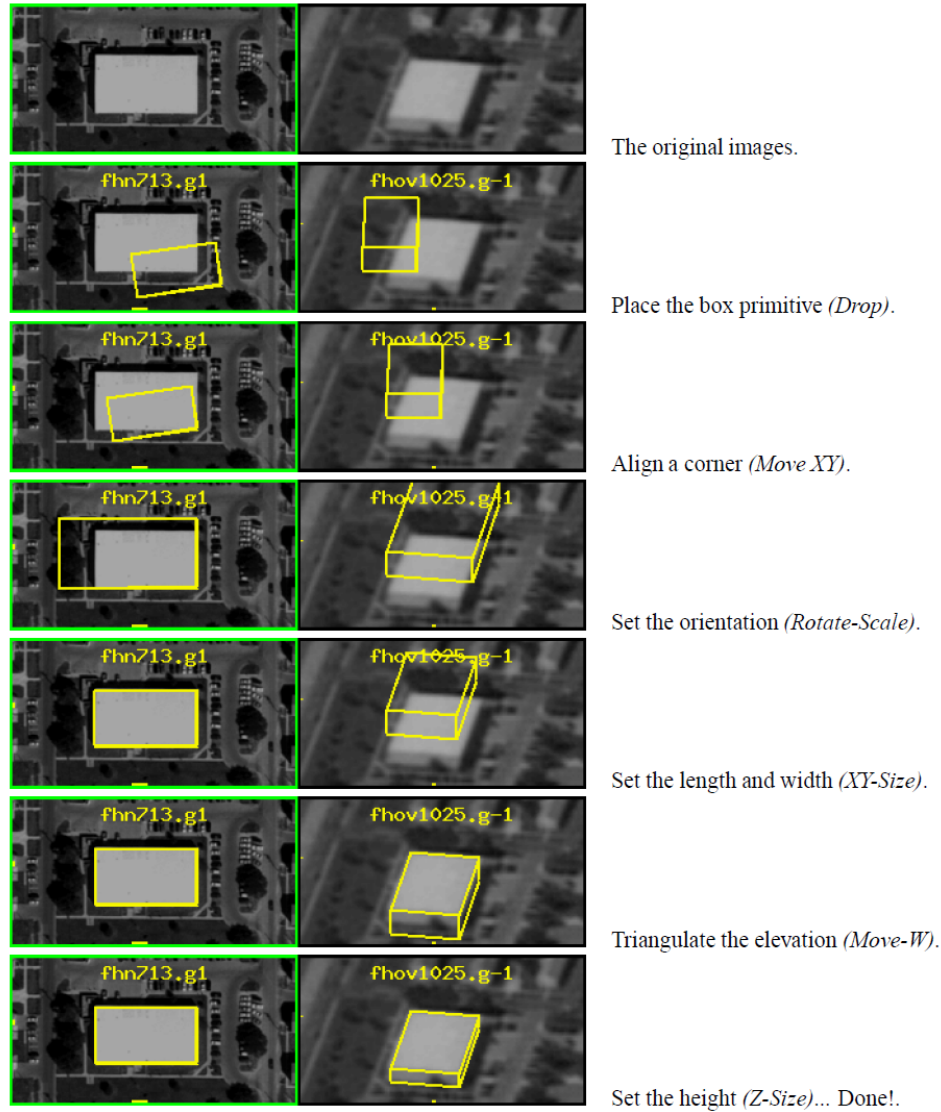
23. Heller describes a number of “primitive shapes” or “primitives” used to “model buildings and structures” in RTS. *Id.*, 3. “To add a structure, the model

builder” selects a shape to “approximate a structure found in the image, e.g., cylinders for towers, or rectangular wireframes for buildings.” *Id.* “The primitive shape is placed at the approximate position and orientation of the image feature to be modeled” and the “RADIUS Testbed System then adjusts the shape, placement, orientation, and size of the primitive to better fit the image.” *Id.*

24. Heller describes that “[m]ost buildings are modeled using the following primitives:

- Boxes which are simple rectangular solids.
- Houses which are boxes with sloped roofs. The system currently supports three kinds of roofs: gable, shed, or hip. The slope of the roof can be adjusted as well as the amount of overhang. [...]
- Extrusions which are a curve that typically defines the (flat) roof line which is extended to the ground to form the sides of the building.” *Id.*

25. FIG. 4 from Heller shows the steps to manually model a building using the Box primitive:



NEARMAP-1004, FIG. 4

26. As shown, a wireframe of the box primitive is overlaid on a pair of images showing different views of the building to be modeled. *Id.*, 4, FIG. 4. The user manipulates the wireframe model using various operations until the wireframe matches the outline of the building in both views. *See id.* Notably, a change made to the wireframe of one of the pair of images will be reflected in the wireframe overlaying the other image in the pair. *See id.*

2. Overview of Quam

27. Quam describes the “RADIUS Common Development Environment (RCDE),” a portion of the RADIUS platform that “provides the foundation for the RADIUS Testbed System” or “RTS” described in Heller. *See* NEARMAP-1005, 1; NEARMAP-1004, 1. The RCDE “provides a system to carry out interactive cartographic modeling of three-dimensional scenes from multiple images, as well as to provide an infrastructure to support the research in, and implementation of, image-understanding-based algorithms for this and other tasks.” NEARMAP-1005, 1.

28. Quam provides additional details on various aspects of the RADIUS platform described in Heller. *Id.* For example, Quam describes implementation and deployment details of the RADIUS platform, such as that it is implemented as “over 200,000 lines of Lisp/CLOS and 6,000 lines of C,” “runs on both SunMicrosystems and Silicon Graphics RISC-based workstations, under the UNIX operating system,” and “represents over 20 person years of continuous development of software environments for image understanding, cartographic feature extraction, and visualization at SRI’s Artificial Intelligence Center.” NEARMAP-1005, 2. Quam also describes the “image registration” process used in RADIUS, and provides descriptions and screenshots of the “Registration Tool” that “lead[s] the user through the necessary steps to register a new image, without

detailed knowledge of the intricacies of photogrammetry.” *Id.*, 14-15, FIGS. 8, 9, 10.

3. The combination of Heller and Quam

29. As previously discussed, Heller describes using the “RADIUS Testbed System” (RTS) to create three-dimensional models of buildings and other structures through the analysis of one or more images of the structures. NEARMAP-1004, 1. As also previously discussed, Quam describes the “RADIUS Common Development Environment (RCDE),” a portion of the RADIUS platform that “provides the foundation for the RADIUS Testbed System” or “RTS” described in Heller. NEARMAP-1005, 1. In the combination, Heller’s “RADIUS Testbed System” (RTS) is implemented using the advantageous implementation details and other information about the “RADIUS Common Development Environment (RCDE)” described by Quam, providing a beneficial implementation environment for the site modeling operations described in Heller. *See, e.g.*, NEARMAP-1004, 1; NEARMAP-1005, 1.

4. Reasons to combine Heller and Quam

30. A POSITA would have been motivated and found it obvious to implement Heller’s “RADIUS Testbed System (RTS)” using the implementation details and other information about the “RADIUS Common Development Environment (RCDE)” described by Quam, in order to benefit from Quam’s

advantageous implementation environment for the site modeling operations described in Heller. As previously discussed, Heller and Quam both describe portions of the “RADIUS” site modeling platform. *See* NEARMAP-1004, 1 (Heller describing the “RADIUS Testbed System (RTS)”); NEARMAP-1005, 1 (Quam describing the “RADIUS Common Development Environment (RCDE)”). Quam describes that the RCDE “*provides the foundation for the RADIUS Testbed System (RTS)*” described in Heller. NEARMAP-1005, 1. A POSITA reading Heller would have been motivated to determine practical implementation details of the system, regarding, for example, the computing hardware necessary to run the RADIUS Testbed System, technologies used to implement the system, as well as information on the tools provided by the system to perform common image analysis tasks such as image registration—all of which are not specified in Heller. *See, generally*, NEARMAP-1004. A POSITA would have been motivated to determine these additional implementation details for Heller’s system, for example, in order to assess the cost, impact, and desirability of implementing Heller’s system, and to define the operational capabilities of Heller’s system to render it suitable for use on particular projects or tasks. *See, e.g.*, NEARMAP-1004, 1, 4, 5, FIGS. 4-5; NEARMAP-1005, 1, 2, 14, 15, FIGS. 8, 9, 10.

31. Further, a POSITA would have found it obvious to modify Heller based on Quam’s teachings because doing so entails the use of known solutions to

improve similar systems and methods in the same way. Here, “when a patent ‘simply arranges old elements with each performing the same function it had been known to perform’ and yields no more than one would expect from such an arrangement, the combination is obvious.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). A POSITA would have recognized that applying Quam’s teachings to augment Heller would have led to predictable results without significantly altering or hindering the functions performed by Heller’s system.

32. In fact, a POSITA would have been motivated to incorporate the well-known techniques of Quam into Heller to achieve the predictable benefits described in Quam. *See, e.g.*, NEARMAP-1005, 1 (describing several benefits of the RCDE, including its “seamless integration and high level of interoperability between and among” different functions related to “modeling of three-dimensional scenes from multiple images.”), 34; NEARMAP-1006, [0009], [0012], [0013]. Indeed, a POSITA would have had a reasonable expectation of success incorporating Quam’s teachings into Heller, because Quam specifically teaches such incorporation. *See* NEARMAP-1005, 1 (Quam stating that the RCDE “provides the foundation for the RADIUS Testbed System (RTS)” described in Heller.).

33. Accordingly, for at least these reasons, augmenting Heller’s description with the teachings of Quam would have been routine and

straightforward to a POSITA, and it would have been clear that such a combination would predictably work and provide the expected results. *Id.*

5. Analysis

a) Claim 1

[1.0]: A computer-implemented method in a roof estimate report system including at least one processor and a memory coupled to the at least one processor, the method comprising:

34. To the extent the preamble is deemed a limitation, the Heller-Quam combination renders it obvious. In the combination, Heller describes “a suite of manual and semi-automatic tools for site-model construction” that are part of the “RADIUS Testbed System.” NEARMAP-1004, 1. Heller describes that the RADIUS Testbed System (also referred to as “RTS”) allows for the “***creation of a 3-dimensional model that captures the basic geometry of the site under examination***” based on analysis of one or more aerial images of the site. *Id.*, 1, Figure 5. Heller teaches that the RTS can model “[h]ouses” having “***three kinds of roofs: gable, shed, or hip***.” NEARMAP-1004, 3.

35. Also in the combination, Quam describes features of the “RADIUS Common Development Environment (RCDE),” which “provides the foundation for the RADIUS Testbed System” described in Heller. NEARMAP-1005, 1; NEARMAP-1004, 1. Quam describes the RADIUS system as an “an extensible, interactive, object-oriented, workstation-based image processing system” that “represents over 20 person years of continuous development of ***software***

environments for image understanding, cartographic feature extraction, and visualization at SRI's Artificial Intelligence Center.” NEARMAP-1005, 2. “The current implementation” of RADIUS “comprises over **200,000 lines of Lisp/CLOS** and **6,000 lines of C**,” which confirms that RADIUS is a software program. *See id.* Quam describes that RADIUS “runs on both SunMicrosystems and Silicon Graphics RISC-based workstations,” which indicates that the RADIUS software is executed by the processors of these workstations. *Id.*; *see also* 2, 5, 8, 10 (several references to computation, which indicates operations performed by a processor). Quam also makes clear that the RADIUS system utilizes “**memory**” when performing computations, such as using a “[t]iled memory layout for image storage.” NEARMAP-1005, 17; *see also* 4, 5, 8, 16.

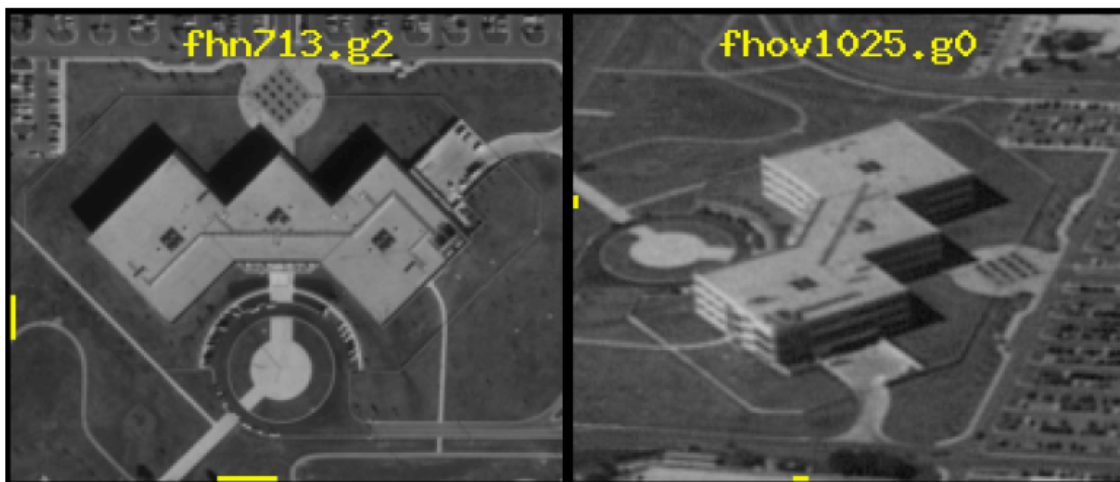
36. As described in greater detail below (*see* [1.5], *infra*), the combined system of Heller and Quam produces a roof estimate report.

37. Accordingly, the Heller-Quam combination renders obvious “computer-implemented method in a roof estimate report system including at least one processor and a memory coupled to the at least one processor.”

[1.1]: displaying, by the at least one processor of the roof estimate report system, a plurality of aerial images of a roof at the same time, each of the aerial images providing a different view, taken from a different angle of the same roof;

38. The Heller-Quam combination renders this limitation obvious. In the combination, Heller’s “Figure 5 shows the sequence of operations used in

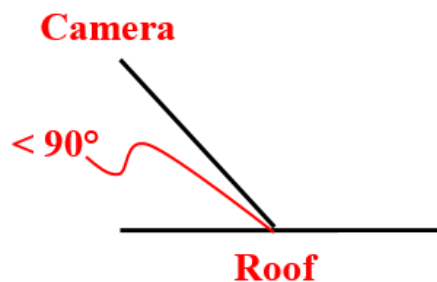
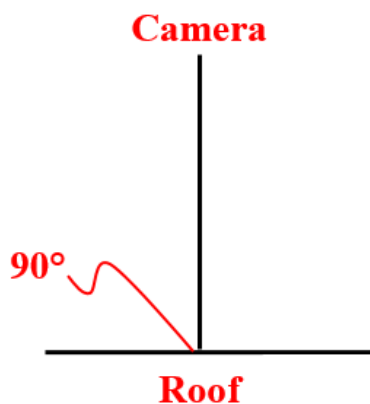
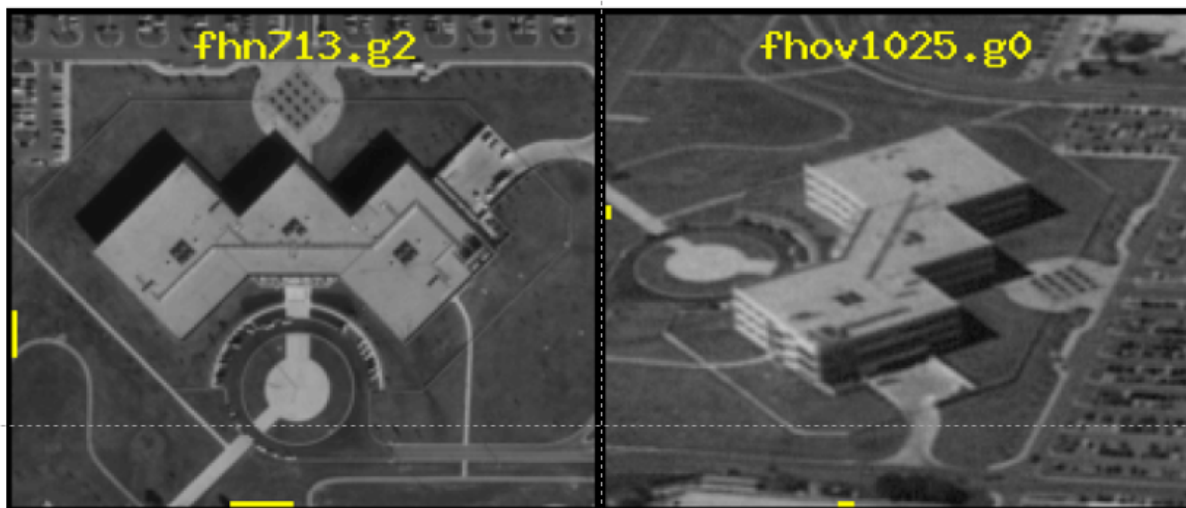
modeling a complex-shaped building with an extrusion primitive and the MBO” (Model-Based Optimization) “system” included in the RTS. NEARMAP-1004, 5. The following detail of Figure 5 is a screenshot of the RTS showing the original images before the modeling process begins. *See id.*, 6:



NEARMAP-1004, Detail of FIG. 5

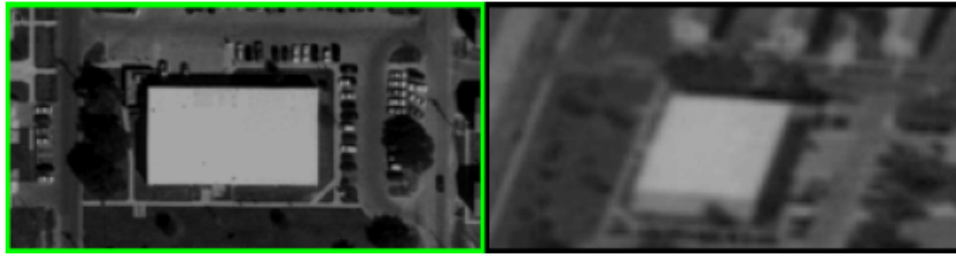
39. As shown in the figure, Heller teaches displaying two aerial images of the same roof (note the identical roof shape in both images), and that both images are displayed at the same time. NEARMAP-1004, 5, FIG. 5.

40. Heller further teaches that each displayed image provides a different view of the same roof taken at a different angle. As depicted in FIG. 5, the left image was taken from overhead at roughly a right angle relative to the roof. *Id.* The right image was taken from an acute angle, which is different from the angle of the left image. *See id.* The following annotated FIG. 5 from Heller illustrates the different angles for the two images:



NEARMAP-1004, Detail of FIG. 5 (annotated)

41. In addition, Heller describes another example of modeling a building with a simpler shape than that shown in FIG. 5. Similar to FIG. 5, the following detail of FIG. 4 of Heller shows two aerial images of the same roof, displayed at the same time, each taken from different angles and providing a different view:



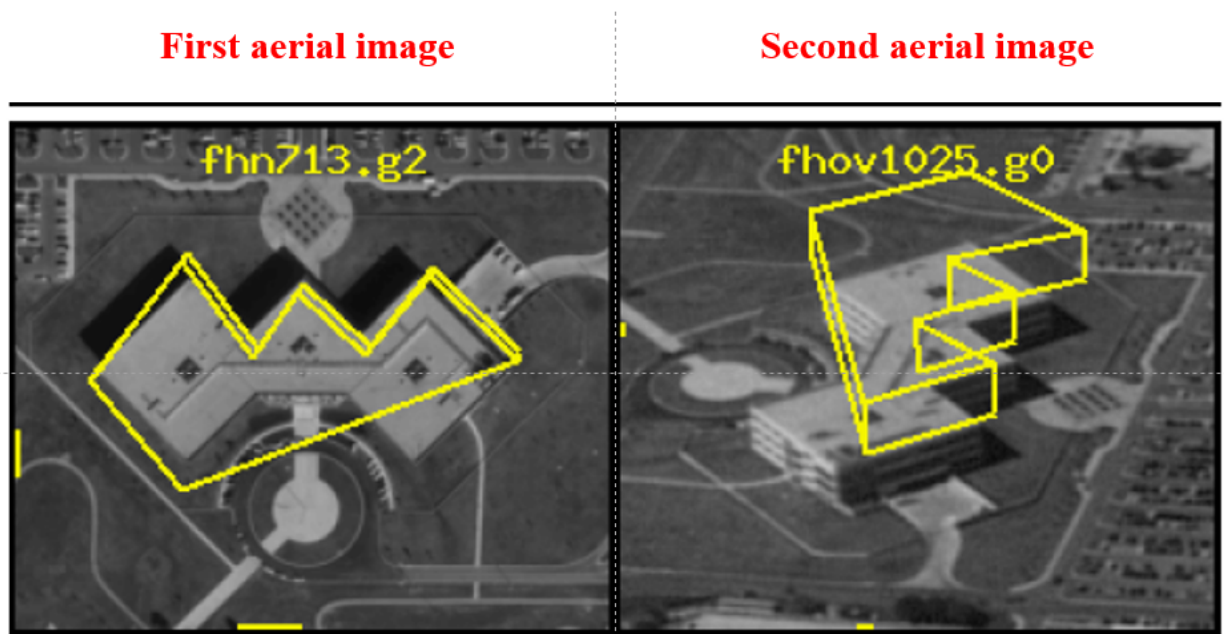
NEARMAP-1004, Detail of FIG. 4 (annotation in original)

42. Heller describes that the system performs the same basic operations to model “simple box objects” like the one shown in FIG. 4—which uses a “box primitive” as its base model—as it does to model “a complex-shaped building” like the one shown in FIG. 5—which uses an “extrusion primitive” as the base model. *See* NEARMAP-1004, 5 (“In the construction procedures for both simple box objects and extrusions, semi-automatic assistance can be invoked by a user using the Model-Based Optimization system.”) (“Modeling a building with a house primitive follows the same sequence of steps [as a box primitive], followed by setting the roof type (gabled, hip, shed), pitch, and overhang.”).

43. Accordingly, the Heller-Quam combination renders obvious “displaying, by the at least one processor of the roof estimate report system, a plurality of aerial images of a roof at the same time, each of the aerial images providing a different view, taken from a different angle of the same roof.”

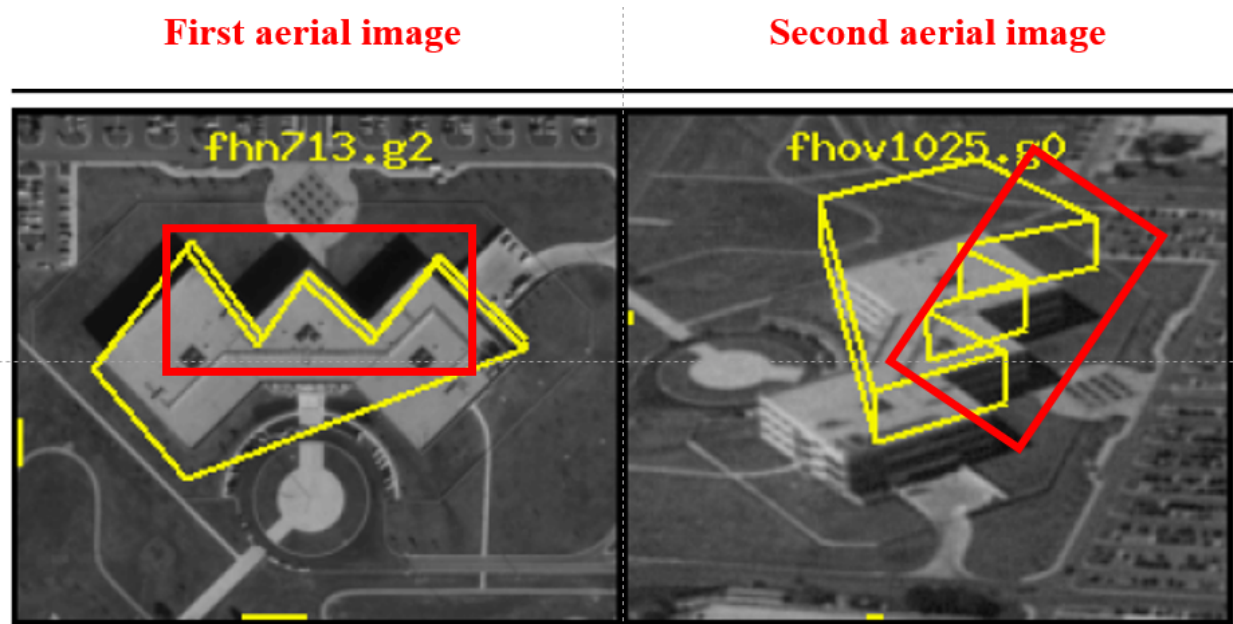
[1.2]: displaying, by the at least one processor of the roof estimate report system, respective line drawings representing features of the roof, the respective line drawings overlying a first and a second aerial image of the plurality of aerial images of the roof, the line drawing overlying the first aerial image of the roof having features in common with the line drawing overlying the second aerial image of the roof;

44. The Heller-Quam combination renders this limitation obvious. In the combination, the following annotated FIG. 5 from Heller depicts a first and second aerial image of the building roof, each overlaid with a yellow wireframe (*i.e.*, a “line drawing”). *See, e.g.*, NEARMAP-1004, 3 (“A shape is selected to approximate a structure found in the image, e.g., cylinders for towers, or rectangular wireframes for buildings. The primitive shape is placed at the approximate position and orientation of the image feature to be modeled.”):



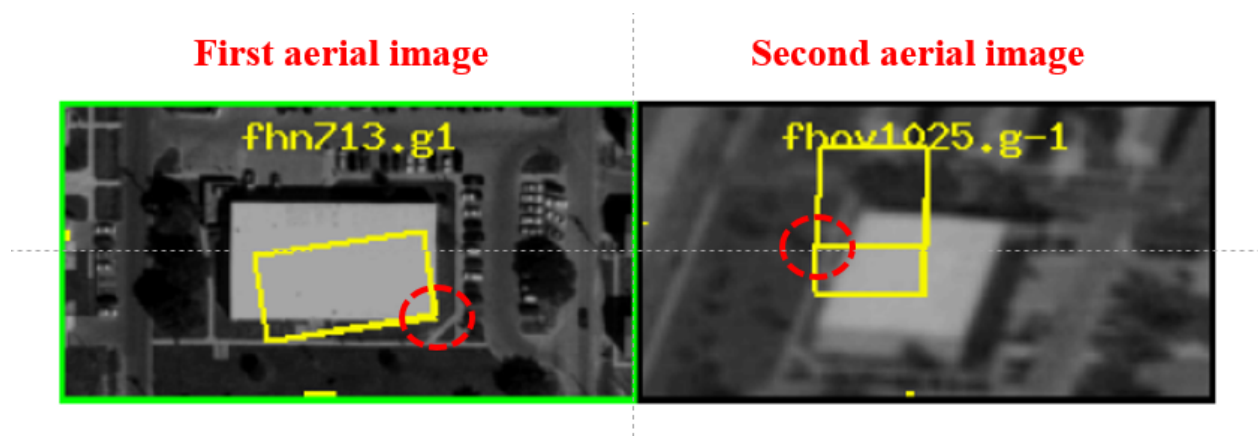
NEARMAP-1004, Detail of FIG. 5 (annotations in original)

45. As shown, the yellow line drawings overlaying the first and second images have “features in common” as the claim recites. For example, as shown in the following annotated FIG. 5, the “W” shape of the roof contour at the top of the first image is present in the yellow line drawings in both the first and second images. *See id.*:



NEARMAP-1004, Detail of FIG. 5 (annotated)

46. The simple “box” example from FIG. 4 of Heller similarly depicts a first and second aerial image of the building roof, each overlaid with a yellow wireframe (i.e., a “line drawing”). *Id.*, 5, FIG. 4. Like FIG. 5, the first and second aerial images of FIG. 4 also have “features in common,” such as the aligned corner denoted in red in both images below:



NEARMAP-1004, Detail of FIG. 4 (annotated)

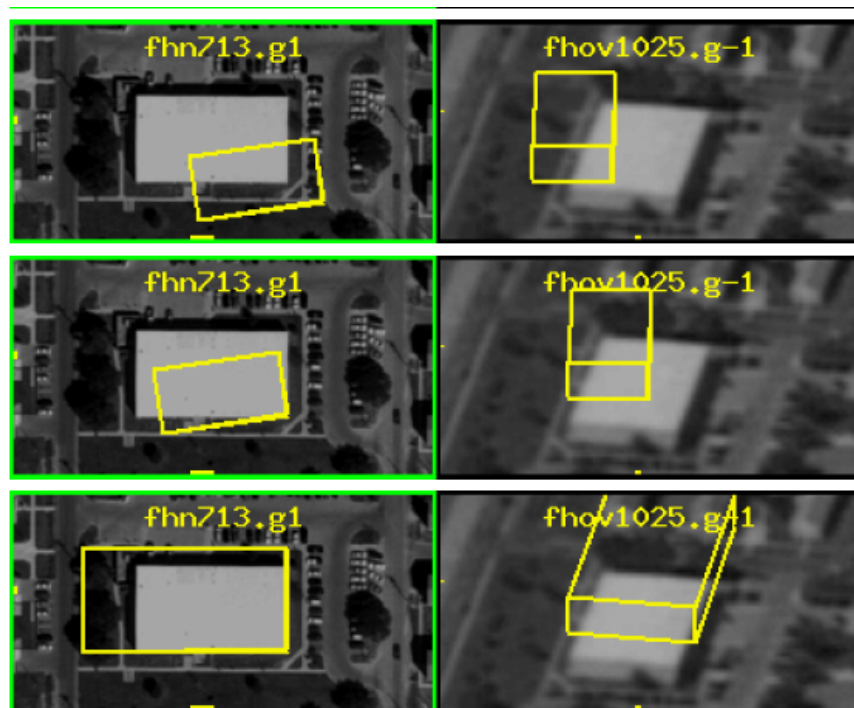
47. Accordingly, the Heller-Quam combination renders obvious “displaying, by the at least one processor of the roof estimate report system, respective line drawings representing features of the roof, the respective line drawings overlying a first and a second aerial image of the plurality of aerial images of the roof, the line drawing overlying the first aerial image of the roof having features in common with the line drawing overlying the second aerial image of the roof.”

[1.3]: in response to user input, changing, by the at least one processor of the roof estimate report system, the line drawing representing a feature of the roof that overlies the first aerial image of the roof;

48. The Heller-Quam combination renders this limitation obvious. In the combination, Heller describes the operations for modeling a structure with a simple shape using the “box primitive.” NEARMAP-1004, 4-5. Heller states that “[a]fter the primitive is added to the scene, ***the user grabs an upper corner of the object***”

(i.e., user input) “*and adjusts the pose and size of the box to match the building being modeled.*” *Id.*, 4; *see also* 1, note 2 (“we define manual techniques as those in which the 3-dimensional model of a feature is projected into one or more images and the operator adjusts the model to align it with what is seen in the images.”).

This operation is shown in the following detail of FIG. 4:



NEARMAP-1004, Detail of FIG. 4

49. The first row shows what is displayed “after the [box] primitive” (the yellow wireframe or “line drawing”) “is added to the scene.” *Id.*, 4. In the next two rows, the yellow line drawing is manipulated based on input from the user, such as the user “grab[bing]” with a mouse “an upper corner of the object and adjust[ing] the pose and size of the box to *match the building being modeled*”

(*i.e.*, “representing a feature of the roof”), *Id.*, 4. As described, the line drawing’s orientation with respect to each image (*i.e.*, its “pose”) changes from the first row of images to the second in response to user input. *See, e.g.*, NEARMAP-1004, 4, FIG. 4. In addition, the line drawing’s size with respect to each image changes from the second row of images to the third row, again in response to user input (e.g., the user “grabbing” and dragging a corner of the line drawing to change its size). *See, e.g.*, NEARMAP-1004, 4, FIG. 4.

50. As discussed above (*see* [1.1]), Heller describes that these same operations (e.g., grabbing a corner of the line drawing and resizing it) are also performed with respect to buildings with more complex shapes, like that shown in FIG. 5. NEARMAP-1004, 5, FIG. 5. As shown in the following annotated version of FIG. 5 from Heller, the user interacts with the overlaid line drawing to add vertices, making the shape of the line drawing more closely match the shape of the roof in the images. NEARMAP-1004, 5, FIG. 5:



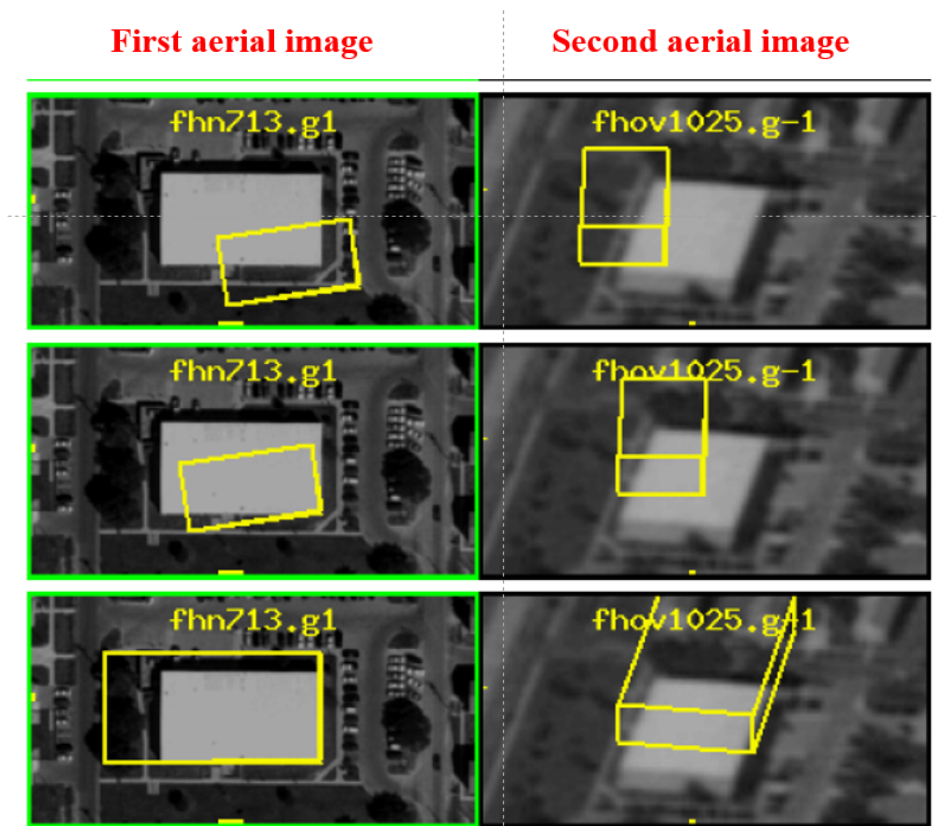
NEARMAP-1004, Detail of FIG. 5 (annotated)

51. Accordingly, the Heller-Quam combination renders obvious “in response to user input, changing, by the at least one processor of the roof estimate report system, the line drawing representing a feature of the roof that overlies the first aerial image of the roof.”

[1.4]: in response to the changing, making corresponding changes, by the at least one processor of the roof estimate report system, to the line drawing overlying the second aerial image; and

52. In the combination, Heller teaches that the line drawing overlying the second aerial image is updated in response to changes to the line drawing overlying

the first aerial image. *See* NEARMAP-1004, 2, 3, FIG. 4, FIG. 5. This operation is shown in the following detail of FIG. 4:



NEARMAP-1004, Detail of FIG. 4

53. As previously discussed (*see* [1.3]), the line drawing overlying the first aerial image changes position and size in response to user input. As shown in FIG. 4, the line drawing overlying the second image also changes position and size as we progress down from the top row. NEARMAP-1004, FIG. 4.

54. In Heller's FIG. 4, the changes in position and size of the line drawing in the second aerial image correspond to the changes to the line drawing in the first aerial image. For example, comparing the first row of images to the second row,

the line drawing on the first aerial image has been shifted up and to the left so that one of its corners aligns with a corner of the building in the image. The line drawing on the second aerial image has also been shifted, but in a different direction relative to the frame to account for the different view of the building shown in the second aerial image. Similarly, in the third row of the detail from FIG. 4 above, the line drawing over the second aerial image clearly becomes larger, just as the line drawing over the first aerial image does in the third row. *See, e.g., NEARMAP-1004, 2, 3* (“The results of the semi-automated site model construction are continuously displayed to the model builder.”), *4, 5* (“The Move W operation ***moves the box*** along the camera ray of the selected image and ***along the corresponding epipolar lines in the other images.***”), FIG. 4.

55. FIG. 5 from Heller depicts the same behavior. As discussed above (*see [1.3]*), FIG. 5 shows vertices being added to the line drawing overlying the first aerial image. As illustrated in the following annotated figure, the line drawing over the second aerial image is also changed to add these two vertices (denoted by red arrows). NEARMAP-1004, 5, FIG. 5:

First aerial image

Second aerial image



NEARMAP-1004, Detail of FIG. 5 (annotated)

56. Accordingly, the Heller-Quam combination renders obvious “in response to user input, changing, by the at least one processor of the roof estimate report system, the line drawing representing a feature of the roof that overlies the first aerial image of the roof.”

[1.5]: generating and outputting a roof estimate report using a report generation engine, wherein the roof estimate report includes numerical values for corresponding slope, area, or lengths of edges of at least some of a plurality of planar roof sections of the roof, wherein the generated roof estimate report is provided for repair and/or constructing the roof structure of the building.

57. As previously discussed, “the detailed requirements as to the contents of the roof estimate report” recited in these limitations “are not entitled to patentable weight.”³ NEARMAP-1010 (’592 FWD), 18. Specifically, “the content of the information” in the generated report “does not modify or otherwise affect the underlying computer or paper, nor does it represent a new and non-obvious relationship with the substrate,” and thus “***the claimed content of the information is not entitled to weight in the patentability analysis.***” *Id.*, 17-18.

58. Since the specific information content of the report described in the claim is not limiting, it follows that a showing of “generating and displaying any graphical or textual information” is sufficient to meet the claim. *Id.*, 18.

59. In the combination, Quam describes that “every entity represented in the RCDE has an associated local coordinate system” and are “tied together through a flexible and efficient network of coordinate transformations.” NEARMAP-1005, 1. “***This allows each type of data to be*** represented, manipulated, and ***displayed*** in the most convenient and precise form, without

³ All emphasis added unless indicated otherwise.

sacrificing functionality or generality, in addition to enabling the fusion of different types of geometric data.” *Id.*

60. Quam also teaches that “functionality can be exercised by using the mouse to click on an image being displayed by the RCDE,” which, in response, ***“displays both the image coordinates and apparent 3-D coordinates of the selected point.”*** *Id.*, 11.

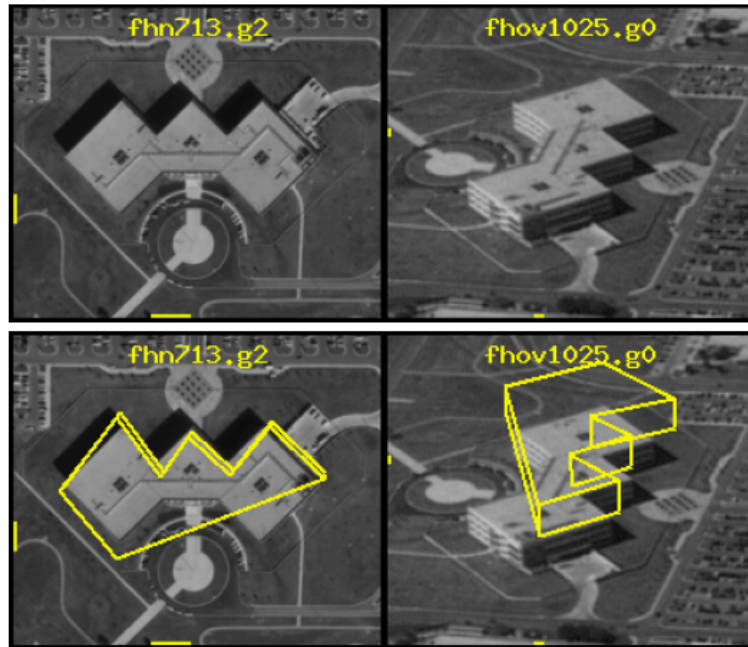
61. Quam further describes a “ContourMap” object that “displays a set of contours of constant elevation computed from a digital terrain model,” a “Map Grid” object that “displays lines of constant latitude and longitude or UTM coordinates,” and a “Text” object that “displays a string of text at a 3-D location in a site.” *Id.*, 8.

62. Any of these or the many other teachings in Quam and Heller of displaying data is sufficient to address the limitation in question. *See* NEARMAP-1010, 18. Accordingly, The Heller-Quam combination renders this limitation obvious.

b) Claim 6

[6.0]: The method of claim 1 wherein the displaying the respective line drawings includes initiating display of a line on the first and second image.

63. In the combination, Heller teaches displaying the yellow wireframe overlays (line drawings, *see* [1.2]) on the first and second aerial images, as shown in the following detail from FIG. 5:



NEARMAP-1004, Detail of FIG. 5

64. As shown in the figure, the first and second aerial images are first displayed without the line drawings overlayed, in the first row. In the second row, display of the overlaid line drawings is initiated (i.e., the overlay starts displaying) for both the first and second aerial images. See NEARMAP-1004, FIG. 5.

c) Claim 7

[7.0]: The method of claim 1 wherein the first image provides a substantially top plan view of the roof of the building,

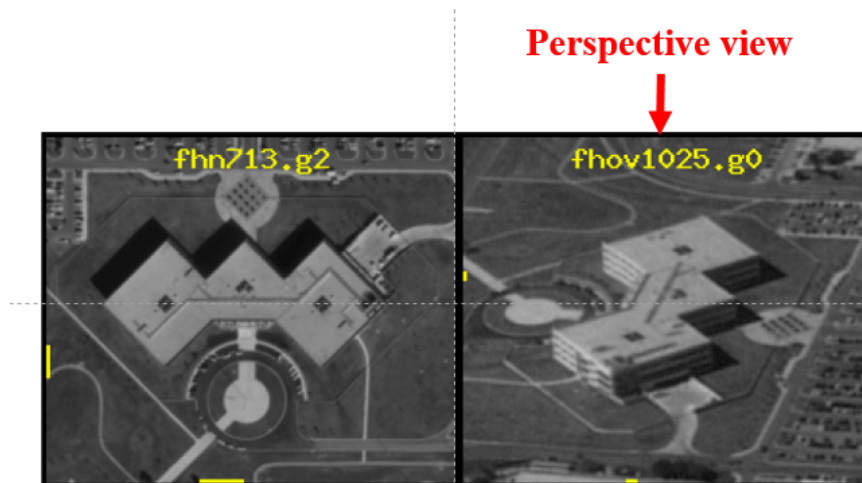
65. In the combination, Heller teaches that the first image provides a substantially top plan view of the roof of the building, as shown in FIG. 5:



NEARMAP-1004, Detail of FIG. 5 (annotated)

[7.1]: and wherein the second image provides a perspective view of the roof of the building.

66. In the combination, Heller teaches that the second image provides a perspective view of the roof of the building, as shown in FIG. 5:



NEARMAP-1004, Detail of FIG. 5 (annotated)

d) Claim 9

[9.0]: The method of claim 1 further comprising: transmitting roof measurement information based at least in part on the change of the line drawing representing a feature of the roof that overlies the first aerial image of the roof.

67. As previously discussed, for the purposes of the present proceeding, “transmitting roof measurement information” should be interpreted broadly enough to encompass transmitting roof measurement information between components of the same computer system, consistent with the Board’s interpretation of the term in the prior IPR challenge to the ’737 patent. *See* NEARMAP-1010, 18-20.

68. In the combination, Heller teaches “captur[ing] low level information from the RTS user interface about individual actions taken by the analyst.” NEARMAP-1004, 5. “Every mouse motion associated with making *adjustments to object parameters*, and every mouse click is *captured into an event history*.” *Id.* Heller describes that the event history captures “Object Adjustment Events,” which include an “Object ID” identifying the manipulated object, an “Adjustment type: (for example: vertex-xy, vertex-z, vertex-width, ...),” and a “Sequence of time deltas and mouse position deltas of the form: (delta-t dx dy).” *Id.*

69. A POSITA would have understood or at least found it obvious that the object adjustment events in the event history include roof measurement information. *See, e.g.,* NEARMAP-1004, 5. The object adjustment events represent, for example, the user adjusting the size of the wireframe overlays (the

line drawings, *see* [1.2]), because Heller refers to the wireframes as “objects.”

NEARMAP-1004, 4 (“After the primitive is added to the scene, the *user grabs an upper corner of the object* and adjusts the pose and size of the box to match the building[.]”). The “mouse-position deltas” in the event represent the movement of the mouse during the adjustment, which includes the starting and ending position of the mouse. *See, e.g.*, NEARMAP-1004, 5. The mouse movement during the adjustment represents the change in the size of the line drawing during the adjustment. *Id.* Because the line drawings are used to model the roof structure of a building (*see* [1.2]-[1.4]), a change in the size of the line drawing represents a change in the measurements of the roof represented by the model. *Id.* Thus, the object adjustment events in the event history include roof measurement information, and that information is transmitted to the event history when an adjustment to a wireframe is made (*i.e.*, based at least in part on the change of the line drawing). *See, e.g.*, [1.2]-[1.4]; NEARMAP-1004, 4, 5, FIG. 4, FIG. 5.

70. Accordingly, the Heller-Quam combination renders obvious “transmitting roof measurement information based at least in part on the change of the line drawing representing a feature of the roof that overlies the first aerial image of the roof.”

e) **Claim 10**

[10.0]: The method of claim 1 further comprising: displaying a marker operable to specify a point on an image;

71. In the combination, Quam describes that the “primary object used for image registration is the conjugate point” which “has both 2-D and 3-D components.” NEARMAP-1005, 14. “It is used to enter both image-to-ground correspondences (ground control points) and image-to-image correspondences (tie points) and to specify the a priori error estimates for these quantities.” *Id.* Quam describes that the “3-D component of the conjugate point is drawn as a “+”-shaped crosshair whose image overlay position is computed by projecting its 3-D coordinates through the image’s current camera model into the coordinate system of the image.” *Id.* “The 2-D component is drawn as *an “X”-shaped crosshair*” (a marker) “*whose image overlay position is set manually through mouse interactions*” (operable to specify a point on an image). *Id.*

[10.1]: receiving, via the marker, an indication of a point on the first aerial image; and

72. As previously discussed (*see* [10.0]), in the combination, Quam teaches a marker operable to specify a conjugate point on the first aerial image (“X’-shaped crosshair”). Quam describes that the “*image overlay position*” of the marker “*is set manually through mouse interactions.*” NEARMAP-1005, 14. The user manually setting the image overlay position of the marker—for example

by clicking the marker and dragging it to overlay a conjugate point in the first aerial image—provides an indication of a point in the first aerial image via the marker. *See, e.g.,* NEARMAP-1005, 4, 5, 14, FIG. 4, FIG. 5; [1.2]-[1.4].

[10.2]: registering, based on the received indication of the point, the aerial image to a reference grid corresponding to a three-dimensional model of the roof.

73. In the combination, Quam describes that “[i]mage registration is the process of determining and/or refining the internal and external parameters (e.g., position, orientation) of the sensor used to acquire the image.” NEARMAP-1005, 14 (in section “3.6 Image Registration”). Quam describes that the “***primary object used for image registration is the conjugate point,***” and that the “X-shaped crosshair” (the marker, *see* [10.1]) represents the “2-D component” of the conjugate point. NEARMAP-1005, 14. Quam describes that the “primary interface to” the registration “functionality” of RADIUS “is the Registration Tool.” *Id.* “The tool is designed to lead the user through the necessary steps to ***register a new image***, without detailed knowledge of the intricacies of photogrammetry.” *Id.*

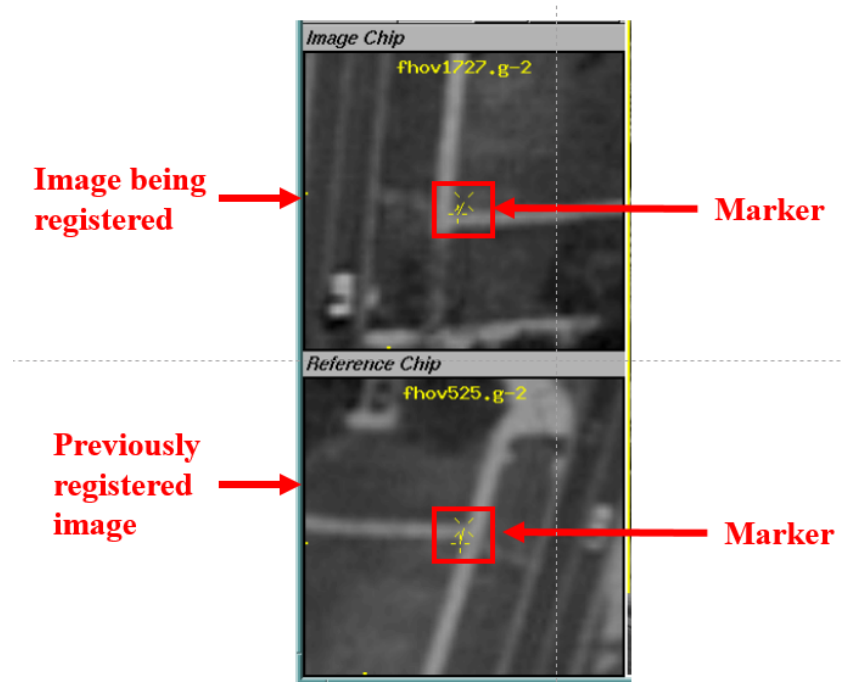
74. “The Registration Tool is shown in Figures 8, 9, and 10” of Quam. *Id.* “The main panel contains three image display panes” that “show the full image being operated on and enlarged views of the current conjugate point” which includes the “X-shaped crosshair” (the marker, *see* [10.1]) “on both the image being registered and a previously registered reference image.” *Id.* FIG. 8 from

Quam shows the Registration Tool registering an image based on the point in the image indicated by the marker (the X-shaped crosshair). NEARMAP-1005, 15:



NEARMAP-1005, FIG. 8

75. The following detail of FIG. 8 from Quam shows the two image panes at the bottom left of the figure, which display “enlarged views of the current conjugate point on both the image being registered and a previously registered reference image.” NEARMAP-1005, 15. An X-shaped crosshair is displayed on both images indicating the “current conjugate point.” *Id.*:



NEARMAP-1005, Detail of FIG. 8 (annotated)

76. Also in the combination, Quam teaches that RADIUS provides for “[r]egistration of multiple data sources, including stereographic or *multiple images*, terrain elevation models, and 3-D object models, *to the same world coordinate system*.” NEARMAP-1005, 5. A POSITA would have understood the “world coordinate system” described in Quam to be a “reference grid.” NEARMAP-1005, 5; *see also* 1 (“every entity represented in the RCDE has an associated local coordinate system.”), 5 (RADIUS provides “[r]egistration of local coordinate systems to Universal Transverse Mercator (UTM), latitude-longitude, and other cartographic coordinate representations.”), 8 (“Map Grid This object displays lines of constant latitude and longitude or UTM coordinates.”), FIG. 4.

77. Accordingly, The Heller-Quam combination renders this limitation obvious.

f) Claim 16

[16.0]: A non-transitory computer-readable storage medium, having computer executable instructions stored thereon that, when executed by at least one computer processor, cause the at least one processor to enable a computing system to generate a roof estimate report for a building having a roof, by performing a method comprising:

78. See [1.0].

[16.1]: overlaying a line drawing on corresponding locations of a roof feature of the roof on first and second aerial images of the roof, wherein the first aerial image provides a first view of the roof of the building and the second aerial image provides a second view of the roof of the building;

79. See [1.1], [1.2]

[16.2]: in response to changes in the line drawing overlaid on the first aerial image, displaying corresponding changes to the line drawing overlaid on the second aerial image; and

80. See [1.3], [1.4]

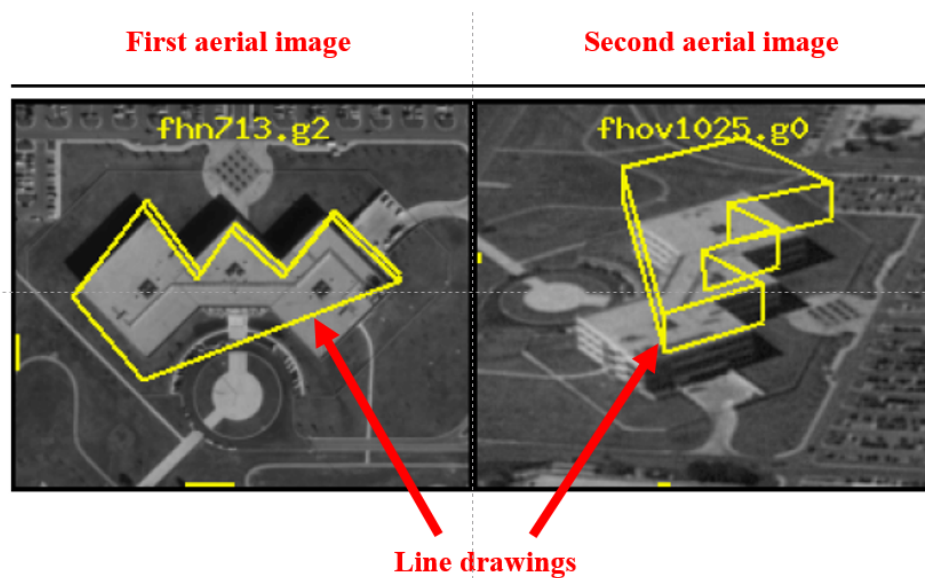
[16.3]: generate and output a roof estimate report using a report generation engine, wherein the roof estimate report includes numerical values for corresponding slope, area, or lengths of edges of at least some of a plurality of planar roof sections of the roof, wherein the generated roof estimate report is provided for repair and/or constructing the roof structure of the building.

81. See [1.5]

g) Claim 17

[17.0]: The non-transitory computer-readable storage medium of claim 16 wherein the method further comprises modifying a three-dimensional model of the roof by adding a planar roof section to the three-dimensional model.

82. In the combination, Heller describes that the “central component in the RADIUS model-supported image exploitation paradigm, is the creation of a **3-dimensional model** that captures the basic geometry of the site under examination.” NEARMAP-1004, 1. A POSITA would have understood that the yellow wireframes (line drawings) discussed with respect to limitations [1.2] to [1.4], and shown here in FIG. 5, are visual representations of Heller’s “3-dimensional models.” NEARMAP-1004, 1, 4, 5:



NEARMAP-1004, Detail of FIG. 5 (annotated)

83. Thus, Heller’s teaching of changing the line drawings based on user input, as discussed at [1.2]-[1.4], also modifies the three-dimensional model. *See, e.g.,* [1.2]-[1.4]; NEARMAP-1004, 4, 5, FIG. 4, FIG. 5.

84. Heller provides several examples of different types of base models (i.e., primitives) that can be used to model a building shown in the first and second aerial images, such as, for example, the “box primitive” used in FIG. 4, and the “extrusion primitive” used in FIG. 5. *See* NEARMAP-1004, 4, 5, FIG. 4, FIG. 5. In addition to these, Heller also describes a “house primitive” which it describes as a “box primitive” with a “sloped roof[.]” NEARMAP-1004, 4. Heller describes that “[m]odeling a building with a house primitive follows the same sequence of steps” taken to model a building with a box primitive “***followed by setting the roof type (gabled, hip, shed), pitch, and overhang.***” *Id.*, 5. Also in the combination, Quam teaches that “[h]ouses are boxes with ***one (shed), two (gable), or four (hip) sloping roof surfaces in place of the top face.***” NEARMAP-1005, 6. A POSITA would have understood or found it obvious for the house primitive to have the simplest type of roof—the “shed” type having a single “sloping roof surface” (planar roof section)—when first created. *See, e.g.,* NEARMAP-1004, 5; NEARMAP-1005, 6. Defaulting to the “shed” roof type is consistent with the modeling using a “house primitive follow[ing] the same sequence of [initial] steps” as modeling using a box primitive, because the “shed” roof type makes the added

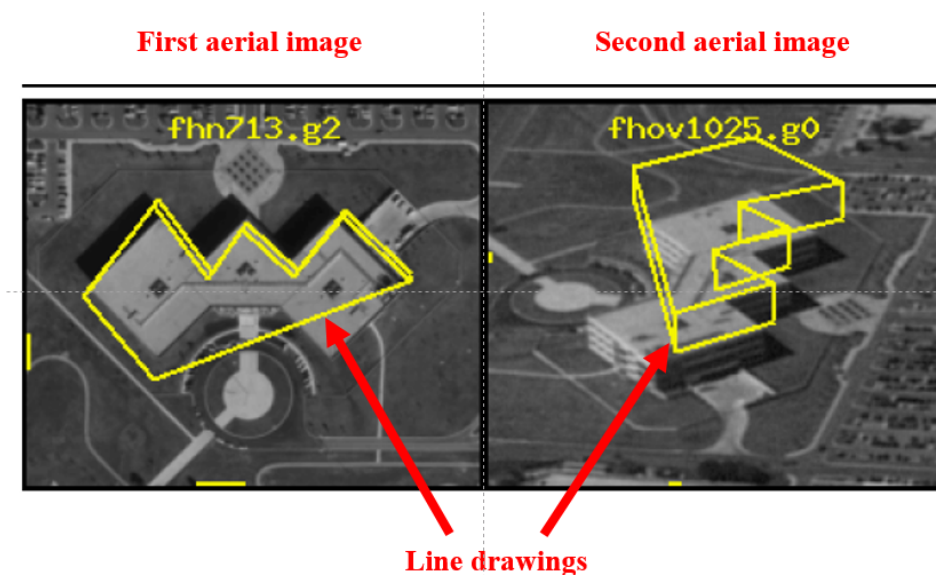
house primitive most similar to a box primitive, thereby making it easier to “follow[] the same sequence of steps” used with a box primitive. *Id.* In addition, a POSITA would have understood that “setting the roof type” to either to either “gable” or “hip” after “following the same sequence of steps” used with a box primitive would result in a particular number of “sloping roof surface[s]” being added to the existing “shed” roof having a single sloping roof surface” (planar roof section). *Id.* In particular, setting the roof type to “gable” would result in a single sloping roof surface (planar roof section) being added to the three dimensional model, bringing the total number of sloping roof surface to two. *Id.* Setting the roof type to “hip” would result in three additional sloping roof surfaces (planar roof sections) being added to the three dimensional model, bringing the total number of sloping roof surface to four. *Id.*

a) Claim 25

[25.0]: The non-transitory computer-readable storage medium of claim 16 wherein the method further comprises: modifying a three dimensional model of the roof based at least on the modification of the line drawing overlaid on the first aerial image.

85. In the combination, Heller describes that the “central component in the RADIUS model-supported image exploitation paradigm, is the creation of a **3-dimensional model** that captures the basic geometry of the site under examination.” NEARMAP-1004, 1. Heller describes that, in the RADIUS program, “***the 3-dimensional model of a feature is projected into one or more***

images and *the operator adjusts the model* to align it with [what] is seen in the images.” *Id.* A POSITA would have understood that the “3-dimensional models” Heller refers to are the yellow wireframes (line drawings) discussed with respect to limitations [1.2] to [1.4], and shown here in FIG. 5. NEARMAP-1004, 1, 4, 5:



NEARMAP-1004, Detail of FIG. 5 (annotated)

86. Thus, Heller’s teaching of changing the line drawings based on user input, as discussed at [1.2]-[1.4], also modifies the three-dimensional model. *See, e.g.,* [1.2]-[1.4]; NEARMAP-1004, 4, 5, FIG. 4, FIG. 5.

b) Claim 26

[26.0]: A computer-implemented method in a roof estimate report system including a computer system and a memory coupled to the computer system, the method comprising:

87. *See* [1.0].

[26.1]: changing, by the computer system of the roof estimate report system, a line in a first line drawing representing a feature of a roof that overlies a first aerial image of the roof;

88. See [1.1], [1.2], [1.3].

[26.2]: changing, by the computer system of the roof estimate report system, a line in a second line drawing that corresponds to the same feature in the first line drawing that was changed, the change in the second line drawing being made by the computer system in response to the change that was made in the first line drawing; and

89. See [1.4].

[26.3]: generating and outputting a roof estimate report using a report generation engine, wherein the roof estimate report includes numerical values for corresponding slope, area, or lengths of edges of at least some of a plurality of planar roof sections of the roof, wherein the generated roof estimate report is provided for repair and/or constructing the roof structure of the building.

90. See [1.5].

c) Claim 34

[34.0]: The method of claim 26 further comprising: displaying roof measurement information on the same display concurrently with the first line drawing being displayed.

91. As previously discussed (see [10.0]-[10.2]), in the combination, Quam describes registering an aerial image to a reference grid. Heller further describes a “**Map Grid**” that “**displays lines of constant latitude and longitude or UTM coordinates**” when added to a site model. NEARMAP-1005, 8. Displaying this “**Map Grid**” as an overlay, as taught by Quam, teaches displaying roof measurement information, because it allows the user to determine the area and

dimensions (i.e., measurements) of the building being modeled through comparison of the displayed model, in much the same way as placing a ruler next to an object enables measurement of the object by comparison to the ruler.

NEARMAP-1005, 8.

92. Accordingly, the Heller-Quam combination renders this limitation obvious.

B. GROUND 2: Claims 1, 6, 7, 9, 10, 16, 17, 25, 26, and 34 are obvious over Heller and Quam in view of Deaton

1. Overview of Deaton

93. Deaton describes “a roof inspection system” that generates and outputs various reports. NEARMAP-1006, [0010]. For example, Deaton describes a “project report” that “provides specification details and work items for repairing or replacing the infrastructure” (the roof) “in accordance with the conditions identified.” *Id.*, [0107]. The project report can include numerical values for “lengths (e.g. linear feet of metal flashing)” and “areas (e.g. square footage of roofing membrane)” associated with the roof. *Id.*

2. The combination of Heller, Quam, and Deaton

94. In the combination, the combined system of Heller and Quam is modified to produce a roof estimate report, as taught by Deaton, based on the site models described in Heller and Quam.

3. Reasons to combine Heller, Quam, and Deaton

95. A POSITA would have been motivated and found it obvious to modify the combined system of Heller and Quam to produce the roof estimate report described in Deaton. As described in the Deaton, the “project report...provides specification details and work items for repairing or replacing the infrastructure” (the roof) “in accordance with the conditions identified,” and including the production of such a report in the system resulting from the combination of Heller and Quam would advantageously enable the site models described in Heller and Quam to be utilized to plan and execute maintenance, repair, and new construction projects, thereby increasing the utility of the combined system. NEARMAP-1006, [0107].

96. Further, a POSITA would have found it obvious to modify the Heller-Quam combination based on Deaton’s teachings because doing so entails the use of known solutions to improve similar systems and methods in the same way. Here, “when a patent ‘simply arranges old elements with each performing the same function it had been known to perform’ and yields no more than one would expect from such an arrangement, the combination is obvious.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). A POSITA would have recognized that applying Deaton’s teachings to augment the Heller-Quam system would have led to

predictable results without significantly altering or hindering the functions performed by the Heller-Quam system.

97. In fact, a POSITA would have been motivated to incorporate the well-known techniques of Deaton into Heller-Quam to achieve the predictable benefits described in Deaton. *See, e.g.*, NEARMAP-1005, 34; NEARMAP-1006, [0009], [0012], [0013]. Indeed, a POSITA would have had a reasonable expectation of success incorporating Deaton’s teachings into Heller-Quam, because Deaton’s report is produced based on similar models to those in Heller-Quam. *See, e.g.*, NEARMAP-1006, [0070] (Deaton describing that “data collected representing these spatial relationships” between roof components “can assist in providing graphical models of a particular target”).

98. Accordingly, for at least these reasons, modifying the Heller-Quam system based on the teachings of Deaton would have been routine and straightforward to a POSITA, and it would have been clear that such a combination would predictably work and provide the expected results. *Id.*

4. Analysis

a) Claim 1

99. Limitations [1.0]-[1.4] are rendered obvious for the same reasons discussed in Ground 1, and the analysis of those limitations is hereby incorporated by reference.

[1.5]: generating and outputting a roof estimate report using a report generation engine, wherein the roof estimate report includes numerical values for corresponding slope, area, or lengths of edges of at least some of a plurality of planar roof sections of the roof, wherein the generated roof estimate report is provided for repair and/or constructing the roof structure of the building.

100. As previously discussed, “the detailed requirements as to the contents of the roof estimate report” recited in these limitations “***are not entitled to patentable weight.***” NEARMAP-1010 (’592 FWD), 18. However, to the extent this limitation is found to be entitled to patentable weight, it is nonetheless rendered obvious by the Heller-Quam-Deaton combination.

101. In the combination, Deaton describes “a roof inspection system” that generates and outputs various reports. NEARMAP-1006, [0010]. For example, Deaton describes a “project report” that “provides specification details and work items for repairing or replacing the infrastructure” (the roof) “in accordance with the conditions identified.” *Id.*, [0107]. The project report can include numerical values for “lengths (e.g. linear feet of metal flashing)” and “areas (e.g. square footage of roofing membrane)” associated with the roof. *Id.*

102. To the extent EagleView argues that Deaton produces its three-dimensional roof models based on on-site measurements of the roof using GPS rather than based on image analysis, a POSITA would understand that Deaton’s techniques for generating a roof estimate report based on a three-dimensional

model would operate in the same manner regardless of how the particular three-dimensional model was originally generated.

103. Accordingly, the Heller-Quam-Deaton combination renders this limitation obvious.

b) Claims 6, 7, 9, and 10

104. Claims 6, 7, 9, and 10 are obvious for the same reasons discussed in the analysis of Ground 1, which is hereby incorporated by reference.

c) Claim 16

105. Limitations [16.0]-[16.2] are rendered obvious for the same reasons discussed in Ground 1, and the analysis of those limitations is hereby incorporated by reference.

[16.3]: generate and output a roof estimate report using a report generation engine, wherein the roof estimate report includes numerical values for corresponding slope, area, or lengths of edges of at least some of a plurality of planar roof sections of the roof, wherein the generated roof estimate report is provided for repair and/or constructing the roof structure of the building.

106. See [1.5]

d) Claims 17 and 25

107. Claims 17 and 25 are obvious for the same reasons discussed in the analysis of Ground 1, which is hereby incorporated by reference.

e) Claim 26

108. Limitations [16.0]-[16.2] are rendered obvious for the same reasons discussed in Ground 1, and the analysis of those limitations is hereby incorporated by reference.

[26.3]: generating and outputting a roof estimate report using a report generation engine, wherein the roof estimate report includes numerical values for corresponding slope, area, or lengths of edges of at least some of a plurality of planar roof sections of the roof, wherein the generated roof estimate report is provided for repair and/or constructing the roof structure of the building.

109. See [1.5].

f) Claim 34

110. Claim 34 is obvious for the same reasons discussed in the analysis of Ground 1, which is hereby incorporated by reference.

III. SECONDARY CONSIDERATIONS OF NONOBVIOUSNESS

111. The Board has “cautioned petitioners in prior proceedings that petitions may be denied if they do not address known evidence of secondary considerations.” See, e.g., *Stryker v. KFX*, IPR2019-00817, Paper at 28-29 (P.T.A.B. September 16, 2019). Consistent with this guidance, the sections below address secondary considerations arguments and evidence presented by Patent Owner in IPR2016-00592—an IPR challenge to the ’737 patent brought by petitioner Xactware (the “Xactware IPR”). See *id.* In summary, the publicly

available evidence from the Xactware IPR is insufficient to establish a nexus between the Challenged Claims and the evidence of secondary considerations.

A. Patent Owner previously presented evidence of secondary considerations for the '737 patent

112. In the Xactware IPR, Patent Owner presented arguments and evidence related to secondary considerations of non-obviousness. *See* NEARMAP-1012, 49-71. The Board “considered” the petitioner’s “evidence and arguments about the asserted prior art’s teachings and the reasons why one skilled in the art would combine them,” and “also weighed the objective indicia of non-obviousness presented by Patent Owner.” NEARMAP-1010, 34; *see also* 26-35. The Board noted that it found “certain aspects of” the petitioner’s “obviousness allegations to be at best a close call.” *Id.*, 34. The Board also faulted the petitioner for failing to present any evidence to rebut Patent Owner’s positions on secondary considerations. *Id.*, 29-34. The Board ultimately found that “objective indicia of non-obviousness” were “decisive” in the case, and that the petitioner had not shown any of the challenged claims⁴ to be unpatentable. *Id.*, 34-36.

113. Patent Owner filed most of this material under seal in the Xactware IPR. *See* NEARMAP-1015, 6. Thus, many of the arguments (especially those

⁴ The prior IPR challenged claims 1, 9, 10, 16, 19, 22, 25–28, 31, and 34–36.

related to the “nexus” requirement) in the publicly available documents are heavily redacted, and several exhibits (again those related to “nexus”) are sealed with no version available to the public. *See, e.g.*, NEARMAP-1012, 52-65 (showing redactions, and citing to, *e.g.*, the “Bajaj Declaration” (Exhibit 2031), which is unavailable). As a result, I am unable to fully evaluate and address Patent Owner’s contentions and evidence regarding secondary considerations from the prior IPR. *See id.*

B. The redacted materials from the Xactware IPR are insufficient to establish a nexus between the evidence of secondary considerations and the Challenged Claims

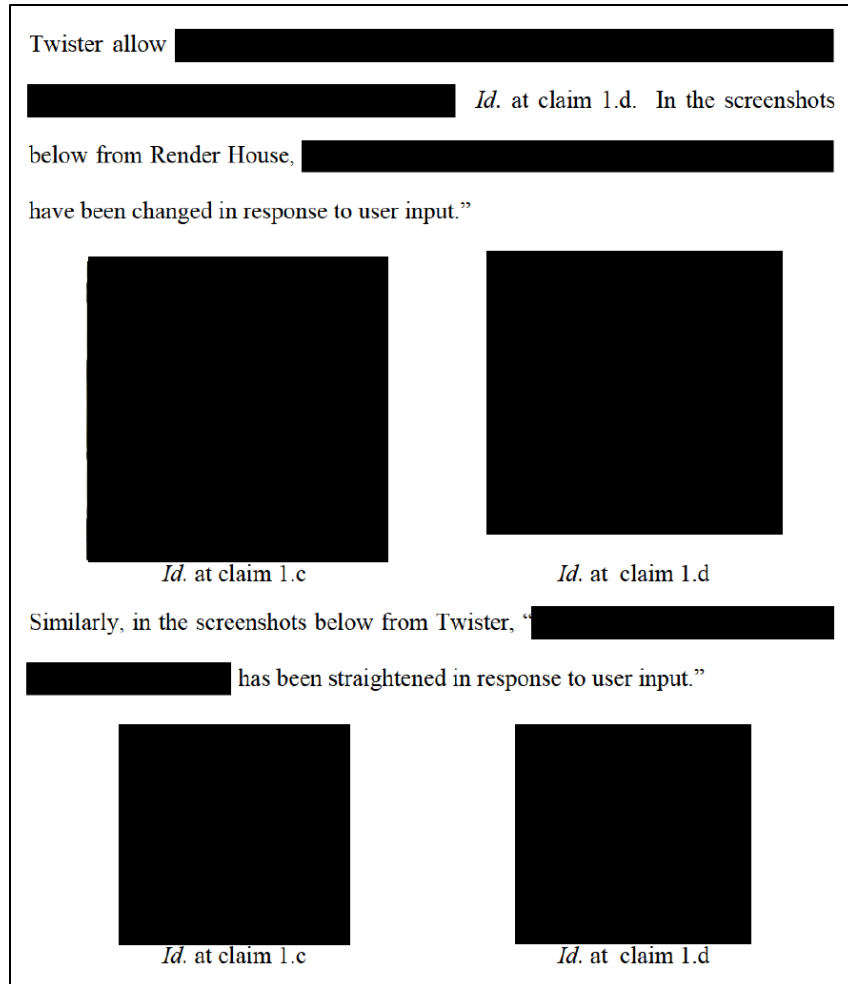
114. I have been informed by counsel that “[f]or objective indicia of nonobviousness to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention.” *Lectrosonics Inc. v. Zaxcom*, IPR2018-00129, Paper 33 at 31 (P.T.A.B. Jan. 24, 2020) (precedential) (hereinafter “*Lectrosonics*”) (citing *ClassCo, Inc., v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016)). “[T]here is no nexus unless the evidence presented is reasonably commensurate with the scope of the claims.” *Lectrosonics*, 32 (quoting *Rambus Inc. v. Rea*, 731 F.3d 1248, 1257 (Fed. Cir. 2013)) (internal quotes omitted).

115. The publicly available Xactware IPR materials are insufficient to establish the required nexus. As noted above, in the case, Patent Owner filed its

secondary considerations evidence under seal. *See* NEARMAP-1015, 6. Patent Owner presented evidence purporting to show commercial success and industry praise related to two of its software products: Twister and Render House.

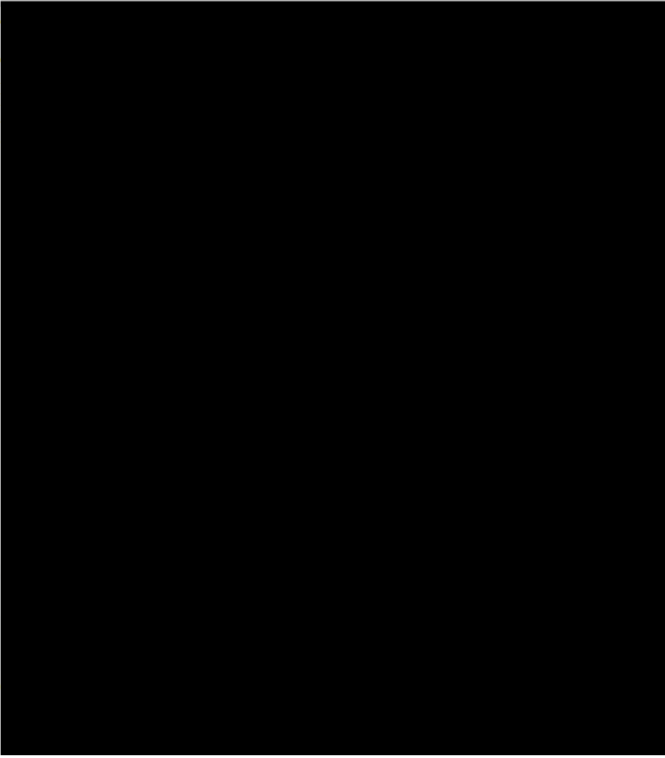
NEARMAP-1012, 50-51. Patent Owner also presented evidence describing the operation of the Twister and Render House products, which it attempted to map to the claims of the '737 patent to establish a nexus between the alleged commercial success and industry praise, and the claimed invention. *See id.*, 52-66.

116. In the Xactware IPR, Patent Owner filed its Patent Owner Response and the evidence describing the operation of Twister and Render House under seal. *See* #SealMotion, 6. All quotations and discussions of the operation of Twister and Render House are redacted in the publicly available version of the Patent Owner Response. *See* NEARMAP-1012, 52-66. For example, page 54 from the Response is typical:



NEARMAP-1012, Detail of p. 54

117. The supporting expert declaration of Dr. Bajaj is similarly redacted, as shown below:

Claim Terms in U.S. Patent 9,135,737	<u>Patent Owner's Twister and Render House Products¹</u>
Claim 1 [1.a]: A computer- implemented method in a roof estimate report system including at least one processor and a memory coupled to the at least one processor, the method comprising:	

IPR2016-00592, Ex. 2008, Detail of p. 43

118. Much of the redacted material is from Exhibit 2007 (“Reference Guide: Twister, 10/1 5/2008 (EV000144)”) and Exhibit 2030 (“Reference Guide: For Measuring Technicians, 10/15/2008 (EV000236)”). *See* NEARMAP-1012, v-vii (Exhibit List). No public version of either exhibit is available.

119. The publicly available materials in the Xactware IPR are insufficient to establish the required nexus between the evidence of secondary considerations and the Challenged Claims. The available exhibits do not provide any information on the operations of the Twister and Render House products, and the arguments in

the Patent Owner Response do not explain how those products are alleged to embody the Challenged Claims. *See* NEARMAP-1012, 52-66.

120. It is my understanding that without an established nexus between the evidence and the challenged claims, the evidence of commercial success and industry praise presented by Patent Owner in the Xactware IPR⁵ is irrelevant to the present proceeding, and thus should not be considered at this stage of the present proceeding. *See Lectrosonics*, 31; *ClassCo*, 838 F.3d at 1220.

C. The publicly available evidence of industry praise and commercial success is not tied to the Challenged Claims

121. It is my understanding that the lack of evidence or explanation of a nexus between the secondary considerations evidence and the Challenged Claims should end the inquiry into secondary considerations at this stage of the proceeding. *See Lectrosonics*, 31-32. However, to the extent the Board continues its inquiry, the industry praise and commercial success described in the publicly available evidence (*see* NEARMAP-1019 – NEARMAP-1029) results from factors other than the purported invention embodied by the Challenged Claims of the '737 patent.

⁵ Exhibits 2019-2029 in IPR2016-00592.

122. Similar to the evidence and arguments related to nexus, much of Patent Owner’s evidence of commercial success—specifically its revenue numbers—are redacted from the Patent Owner’s Response and the referenced Exhibits (2012 through 2015) are sealed. *See* NEARMAP-1012, 67 (note 2) (“Revenue data comes from the gross revenue from roof reports found in Patent Owner’s financial records. Exs. 2012 at 3; 2013 at 7; 2014 at 6; 2015 at 12.”), 68 (redacted discussion of revenue growth). Patent Owner attributes whatever commercial success is shown in these confidential materials to the “Render House and Twister products,” which allegedly “embody the claimed invention of the ’737 Patent to create roof reports that are then transmitted to customers.” *Id.*, 66. Patent Owner’s simplistic (and self-serving) analysis proclaims that its “success is directly tied to the” ’737 patent, a conclusion which strains credulity. *Id.*

1. Patent Owner ties its commercial success and industry praise to more accurate roof measurements

123. Patent Owner states that the “inventiveness of [its] process generates *more consistently accurate roof measurements* than could be achieved using older methods.” NEARMAP-1012, 66. Patent Owner similarly ties much of its industry praise to increased accuracy, stating again, without explanation, that “a feature of the patented invention is the *increased accuracy of roof measurements* by modifying and displaying line drawings overlaid over aerial images of the roof.” NEARMAP-1012, 70 (citing NEARMAP-1001, claim 1). “Not surprisingly,”

Patent Owner continues, “*the industry praises the accuracy of Patent Owner’s roof reports*, which is a direct result of the innovative features.” *Id.* Patent Owner reproduces several quotes praising the accuracy of its reports, and simply concludes, without explanation, that this is a result of the claimed techniques. *Id.* One particularly hyperbolic bit of praise states that its system “produced *more precise estimates than workers with tape measurers.*” *Id.*, 71.

124. But Patent Owner provides no explanation of how its claimed techniques lead to more accurate measurements, and the claims do not describe any feature as resulting in increased accuracy. *See, e.g.*, NEARMAP-1001, claim 1. And, as explained below, several other factors (e.g., quality of user input, resolution of the aerial images) contribute to any increase in accuracy more than any of the operations recited in the Challenged Claims.

2. Higher resolution aerial images lead to more accurate reports

125. One factor that would affect the accuracy of the measurements is the resolution of the “first and second aerial images.” *See, e.g.*, NEARMAP-1001, claim 1. Any measurements of the roof features in the Challenged Claims are produced based on the first and second aerial images, and the maximum accuracy of the roof measurements is thus limited by the resolution of these aerial images. *See, e.g.*, NEARMAP-1030, 1 (Eagle View reports are “derived from Pictometry

imagery.”). Notably, the Challenged Claims do not recite any limitations related to capturing the first and second aerial images. *See id.*

126. Patent Owner recognized the importance of “high-resolution imagery” to its commercial success when it merged with “Pictometry International Corp.” (hereinafter “Pictometry”) in 2013. *See* NEARMAP-1030, 1. In a 2017 press release, Patent Owner described Pictometry as “a leading provider of aerial imagery and the originator of technology for aerial oblique image capture.” *Id.* Others in the industry similarly recognized Pictometry as “*the expert in high resolution aerial imagery*” as early as 2012—noting that it “produces imagery that is among the highest quality, highest resolution imagery in the world.” NEARMAP-1031, 1-2; NEARMAP-1032, 1 (Pictometry uses “high resolution aerial images to accurately obtain roof measurements”); NEARMAP-1033, 3 (“For the past decade, Pictometry International Corp., Rochester, N.Y., has used its fleet of more than 60 aircraft to systematically collect intelligent imagery of locations around the world.”); NEARMAP-1034, 2 (“Pictometry has been the dominant force in oblique imagery capture for more than a decade, thanks partially to patents and surrounding technology the company has developed.”).

127. Patent Owner described its “aerial roof measurements and property data reports” as being “*derived from Pictometry imagery*.” *See* NEARMAP-1030, 1. In that same 2017 press release, Patent Owner described “Pictometry imagery”

as “*a core offering*,” touting its “fleet of 115 aircraft” as allowing it to offer “more coverage and third-party integrations than any other aerial imagery provider.” *See id.*, 2. From these statements, and from its decision to merge with Pictometry, it is clear that Patent Owner recognized the contribution of “high-resolution imagery,” which is not covered by the Challenged Claims, to its commercial success. *See, e.g., NEARMAP-1030, 1-2.*

128. Accordingly, the increased accuracy of the roof reports Patent Owner alleges were responsible for its commercial success resulted from the use of higher resolution aerial images, and not the systems and methods recited in the Challenged Claims. *See, e.g., NEARMAP-1030, 1-2.*

3. The techniques recited in the Challenged Claims are not responsible for the increased accuracy of the reports

129. As explained above, Patent Owner does not explain how anything recited in the Challenged Claims would lead to more accurate roof reports. *See NEARMAP-1012, 66-71.* To the extent Patent Owner argues that the claimed “line drawings representing features of the roof” are initially placed more accurately than prior systems, the claims require “changing” the line drawings “in response to user input.” *See, e.g., NEARMAP-1001, claim 1.* Thus, the ultimate accuracy of the roof measurement depends on the quality of the input from the individual user, and not on anything covered by the Challenged Claims.

4. Additional factors contributed to Patent Owner's alleged success

130. Patent Owner does not acknowledge or examine the contributions of any additional factors besides the techniques claimed in the '737 patent to its alleged commercial success and industry praise. *See* NEARMAP-1012, 66-71. In addition to the factors discussed above, strategic business decisions undoubtedly contributed to Patent Owner's alleged success.

131. For example, as discussed above, in 2013 Patent Owner made the strategic business decision to merge with Pictometry. *See* NEARMAP-1030, 1; NEARMAP-1035, 1-2. This merger gave it control over the "high resolution aerial oblique imagery" its roof estimate reports are "derived from," which undoubtedly contributed to Patent Owner's commercial success. *See* NEARMAP-1030, 1 ("Patent Owner's "aerial roof measurements and property data reports" are "derived from Pictometry imagery"); NEARMAP-1031, 2 ("Pictometry ... specializes in the capture of high resolution aerial oblique imagery. Using its patented capture technology, Pictometry produces imagery that is among the highest quality, highest resolution imagery in the world.").

132. The merger with Pictometry also eliminated a clear competitor to Patent Owner's roof estimate reports. A press release from 2012 describes Pictometry as providing "the most precise and comprehensive roof measurement

reports on the market today,” and as having “the best coverage in the industry.”

NEARMAP-1031, 1. The release continues:

Pictometry creates highly accurate Roof Measurement Reports with data derived from Pictometry imagery. Pictometry imagery is captured using a patented process that geo-references images, attributing a latitude/longitude coordinate to each pixel and enables users to make highly accurate remote measurements of structures and land features including area, height, distance, elevation, bearing, pitch and more – directly on imagery.

Id., 2. Patent Owner’s merger with Pictometry thus eliminated a clear competitor from the roof estimate report market, and therefore undoubtedly contributed to Patent Owner’s alleged commercial success. *See id.*

133. Other business factors also contributed to Patent Owner’s alleged success. Much of Patent Owner’s alleged commercial success is likely due to its business relationships (e.g., with the insurance companies that use its reports), as well as efforts in the areas of marketing, sales, customer support, and other areas that are commonly necessary to operate a profitable business.

IV. Legal Principles

A. Anticipation

134. I have been informed that a patent claim is invalid as anticipated under 35 U.S.C. § 102 if each and every element of a claim, as properly construed, is found either explicitly or inherently in a single prior art reference. Under the

principles of inherency, if the prior art necessarily functions in accordance with, or includes the claimed limitations, it anticipates.

135. I have been informed that a claim is invalid under 35 U.S.C. § 102(a) if the claimed invention was known or used by others in the U.S., or was patented or published anywhere, before the applicant's invention. I further have been informed that a claim is invalid under 35 U.S.C. § 102(b) if the invention was patented or published anywhere, or was in public use, on sale, or offered for sale in this country, more than one year prior to the earliest effective filing date of the patent application (*i.e.*, the Critical Date). And a claim is invalid, as I have been informed, under 35 U.S.C. § 102(e), if an invention described by that claim was described in a U.S. patent granted on an application for a patent by another that was filed in the U.S. before the date of invention for such a claim.

B. Obviousness

136. I have been informed that a patent claim is invalid as "obvious" under 35 U.S.C. § 103 in light of one or more prior art references if it would have been obvious to a POSITA, taking into account (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so called "secondary considerations" of non-obviousness, which include: (i) "long felt need" for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results

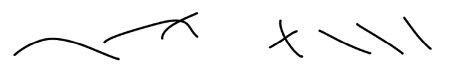
of the claimed invention, and (iv) “copying” of the claimed invention by others. For purposes of my analysis above and because I know of no indication from the patent owner or others to the contrary, I have applied the Critical Date as the date of invention in my obviousness analyses, although in many cases the same analysis would hold true even at an earlier time than the Critical Date.

137. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. To be obvious in light of a single prior art reference or multiple prior art references, there must be a reason to modify the single prior art reference, or combine two or more references, in order to achieve the claimed invention. This reason may come from a teaching, suggestion, or motivation to combine, or may come from the reference or references themselves, the knowledge or “common sense” of one skilled in the art, or from the nature of the problem to be solved, and may be explicit or implicit from the prior art as a whole. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

I currently hold the opinions set expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare 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 the Title 18 of the United States Code.

Dated: 21 Mar 2022

By: 
Dr. David A. Forsyth

APPENDIX A

Curriculum Vitae:

D.A. Forsyth

Birth

2 May, 1963, Cape Town, South Africa.

Degrees

1. B.Sc., Electrical Engineering, U. of the Witwatersrand, Johannesburg, 1984
2. B.Sc., Electrical Engineering, U. of the Witwatersrand, Johannesburg, 1986
3. M.A., (procedural degree), Oxford University, 1989
4. D.Phil., Oxford University, 1989

Appointments

1. Fellow, Magdalen College, Oxford, Jan. 1989-Jan. 1992
2. Assistant Professor, Dept. of Computer Science, U. of Iowa, Sept. 1991-Jul. 1994
3. Associate Professor, Dept. of Computer Science, U. of Iowa, July 1994-Jul. 1996
4. Assistant Professor, Dept. of Computer Science, U. of California, Berkeley, Jul. 1994-Jun. 1996
5. Associate Professor, Dept. of Computer Science, U. of California, Berkeley, Jul. 1996-Jun. 2002
6. Full Professor, Dept. of Computer Science, U. of California, Berkeley, Jul. 2002-Jun 2006
7. Full Professor, Dept. of Computer Science, U. of Illinois, Aug. 2004-Present
8. Fulton Watson Copp Chair in Computer Science, U. of Illinois, May 2014-Present

Honors and Awards

1. Diocesan College Rhodes Scholar, 1985
2. National Science Foundation Research Initiation Award, 1992
3. National Science Foundation Young Investigator Award, 1992
4. Marr Prize, Best Paper at 1993 ICCV, 1993
5. Best Paper in Cognitive Computer Vision, ECCV, 2002
6. Okawa Foundation Fellowship, 2003
7. IEEE Technical Achievement Award, 2006
8. IEEE Fellow, 2009
9. ACM Fellow, 2014

Consulting Activities

1. Consultant, intellectual property law firm, 65 hours billed, 1998-99
2. Consultant on retainer, FujiFilm Software CA, 2001-2006
3. Consultant, venture capital firm, 3 hours billed, 2002
4. Consultant, intellectual property law firm, 13 hours billed, 2003
5. Consultant, State's attorney's general, 1 hour, 2006
6. Technical Advisor, Euclid Media, 2007-2008
7. Technical Advisor, Animate-me, 2007-2008, helped them get NSF SBIR award.
8. Technical Advisor, Snap-and-buy, 2007-2008
9. Technical Advisor, Luminous, 2015-present, helped them get NSF SBIR award.
10. Technical Advisor, Depix, 2020-present
11. Technical Advisor, Revery.ai, 2020-present
12. Consultant, Foley+Lardner, 2009-2010
including reading and report preparation, 10 hours deposition, attendance at trial, about 4 hours direct examination at trial, about 2 hours cross examination at trial. Matter was 337-TA-680 in the ITC
13. Consultant, Sheridan and Ross (IP law firm), 2012-2013;
including reading, search and report preparation; district court case number 6:11-cv-00494
14. Consultant, Fish and Richardson, 2014-2015
including reading and report preparation, deposition in IPR invalidity, deposition on non-infringement, presenting to district court judge on technical tutorial. Matter was IpLearn-Focus, LLC vs Microsoft Corp, district court case number 3:14-cv-00151-JD. IPR's were IPR2015-00095; IPR2015-00096; IPR2015-00097.
15. Consultant, Irell and Manella, 2016-2018
including reading, search and report preparation; 3 full day depositions; IPR petitions; *Legend3D, Inc. v. Prime Focus Creative Services Canada Inc.*, IPR2016-00806; *Prime Focus Creative Services Canada Inc. v. Legend3D, Inc.*, IPR2016-01243; and *Prime Focus Creative Services Canada Inc. v. Legend3D, Inc.*, IPR2016-01491.
16. Consultant, Klarquist Sparkman, 2019-current
Including reading, search and report preparation for invalidity and non-infringement, for district court matter. 1 full day deposition. *Kewazinga Corp. v. Microsoft Corporation*, Southern District of New York, 1:2018-cv-04500 (SDNY)
17. Consultant, Scientific Advice to Apple, 2021
18. Consultant, Kerr, Russell and Weber,
2020-current, *Innovision vs Autis*: engaged, but no actual work done and no income., 2021
19. Consultant, Oblon, 2021,
Eagle View v. Nearmap, advice on some prior art. 2021
21. Consultant, Tensegrity Law group, 2021
22. Consultant, Quinn Emmanuel, 2021

Graduated PhD Students

1. C.A. Rothwell (co advised with A. Zisserman)
2. J.Haddon
3. F.S.Cho
4. S.J. Chenney
5. S.Ioffe
6. P.Duygulu (co-advised)
7. O.Arikan
8. D.Ramanan
9. T.Berg (nee Miller)
10. J.Edwards
11. R.White
12. L.Ikemoto
13. N.Loeff
14. A.Farhadi
15. D.Tran
16. A.Sorokin
17. G.Wang
18. V.Hedau (joint with D. Hoiem)
19. B.Jones (joint with B. Bailey)
20. R.Sodhi (joint with B. Bailey)
21. K.Karsch
22. A.Sadeghi
23. Z.Liao
24. S. Singh
25. D. Tsatsoulis
26. J. Liu
27. J. Rock
28. A. Deshpande
29. M. Vasileva
30. D. Roberts (joint with M. Golparvar Fard)

Editorial Boards

1. Associate Editor, IEEE Trans. Multimedia
2. Editorial Board, Int. J. Computer Vision
3. Associate Editor, IEEE Trans Pattern Analysis and Machine Intelligence, 2 terms
4. Associate Editor, J. ACM, since 2011
5. Associate Editor, ACM Transactions on Graphics, since 2011

6. Editor in Chief, IEEE Trans. Pattern Analysis and Machine Intelligence, 2013-2017

Service and Administration

1. Committee member, U.C. Berkeley Committee on Admissions, Enrollment and Preparatory Education, 1995-2001 (Dealt with the University's response to the UC Regents order on affirmative action; established now well-known new admission policy for UC Berkeley, currently being taken up by other UC campuses).
2. Committee member, U.C. Berkeley Rhodes and Marshall Scholarship Committee, 1999-2003.
3. Member, National Research Council Committee on Tools and Strategies for Protecting Kids from Pornography and Their Applicability to Other Inappropriate Internet Content. (3 years of hearings, both closed and public, and an extensive report that was very well received by the popular press)
4. Founder and Member, Executive Committee of the Board, Berkeley Foundation for Opportunity in Information Technology. (Foundation seeks to ensure that Demographics of California University Computer Science Departments reflects that of the state, by helping targeted schoolchildren improve their understanding of science and their college application packets; by offering scholarships; and by various other means.)
5. Program Co-Chair: ECCV2008, CVPR 2000, CVPR2011, CVPR2018, CVPR2021
(Note: For vision conferences, program chairs cannot submit papers; PC is a major administrative task; CVPR2018 had approx. 5000 submissions and CVPR 2021 had approx. 7000 submissions)
6. General Co-Chair: CVPR2006, CVPR2015, ICCV2019
7. Associate Department Chair, UIUC CS Department, 2011-2015
8. Adjunct Professor, TTIC, 2015-ongoing
9. Scientific Advisory Board, Allen Institute for Artificial Intelligence, 2015-to date
10. Scientific Advisory Board, KAUST Visual Computing Institute, 2016-ongoing
11. Scientific Advisory Board, Baidu Research, 2017-ongoing
12. Editor in Chief, IEEE Trans. Pattern Analysis and Machine Intelligence, 2013-2017
13. Committee member, UIUC Senate Committee on Student Discipline, 2017-present
14. Ombud, CVPR, 2018-present
15. Member, 8'th Senate review commission, UIUC 2018-2019
16. Chair, UIUC Senate committee for Academic Freedom and Tenure, 2020-present
17. Technical Advisory board, Depix, 2019-present
18. Scientific advisor, Revery.ai, 2020-present
19. Moderator for Computer Vision, ArXiv, 2017(?)-present

20. Chair, search committee for EIC IEEE TPAMI, 2021

US Patents

1. US 9330500 B2 Inserting objects into content, Kevin Karsch, Varsha Chandrashekhhar Hedau, David A. Forsyth, Derek Hoiem
2. US 8842118 B1 Automated image replacement using deformation and illumination estimation, Ryan White, David Forsyth
3. US 9,471,967, Relighting Fragments For Insertion Into Content, Kevin Karsch, Zicheng Liao, David Forsyth,

Publications

Authored books

1. Forsyth, D.A. and Ponce, J., *Computer Vision: A Modern Approach*, Prentice-Hall, 2002.
2. Forsyth, D.A. and Ponce, J., *Computer Vision: A Modern Approach*, 2002. Chinese Language Edition
3. Forsyth, D.A. and Ponce, J., *Computer Vision: A Modern Approach*, 2002. Russian Language Edition
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