

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

XACTWARE SOLUTIONS, INC.
Petitioner

v.

EAGLE VIEW TECHNOLOGIES, INC.
Patent Owner

Case No. IPR2016-00590

Patent No. 8,818,770

DECLARATION OF DR. CHANDRAJIT L. BAJAJ

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I, Chandrajit L. Bajaj, PhD, of Austin, Texas declare that:

I. ASSIGNMENT

1. I have been retained by counsel for Eagle View Technologies, Inc. (“Eagle View” or “Patent Owner”). I understand that the Patent Trial and Appeal Board (“PTAB” or “Board”) has instituted an *inter partes* review (“IPR”) of Eagle View’s U.S. Patent No. 8,818,770 (the “’770 patent”) based on a petition filed by Xactware Solutions, Inc. (“Xactware” or “Petitioner”).

2. I have been asked to opine on the subject of validity of claims 1, 10, 11, 14, and 19 in light of the grounds at issue in this *inter partes* review:

Ground	Reference(s)	Basis (35 U.S.C.)	Claims Being Reviewed
1	Avrahami and AppliCad	§ 103(a) obvious	1, 11, and 14
3	Avrahami, AppliCad, and Abhyanker	§ 103(a) obvious	10 and 19

3. In forming my opinions as set forth in this declaration, I have relied upon my education, research, training, and experience in the area of computer science, mathematics, image processing, and visualization. I have also relied on my review and analysis of the art and information provided to me in connection with this case.

4. I am being compensated for my work as an expert with respect to this *inter partes* review, but my compensation is not contingent in any way on the content of my opinions or the outcome of this proceeding.

II. QUALIFICATIONS

5. My curriculum vitae (“CV”) is attached hereto as Exhibit 2009 and provides an accurate identification of my background and experience.

6. I am currently employed as a Professor of Computer Science at the University of Texas at Austin (“UT Austin”). I currently hold the Computational Applied Mathematics endowed Chair in Visualization. I am also the Director of the Computational Visualization Center at UT Austin, which has been funded by the National Institutes of Health, the National Science Foundation, the Department of Energy, and the Department of Defense. The center personnel include fifteen researchers, scientists, post-graduate students, and staff.

7. I have a Bachelor of Technology degree in Electrical Engineering, which I obtained from the Indian Institute of Technology in Delhi (IITD) in 1980. I also have a Master of Science degree and a Doctorate in Computer Science from Cornell University in 1983 and 1984, respectively.

8. Prior to my employment at the University of Texas, I was an assistant professor, then associate professor, and finally professor of Computer Sciences at Purdue University (Purdue) from 1984 until I resigned in 1997 and transferred to UT. During this time, I was also the Director of Image Analysis and Visualization Center at Purdue University. I was a visiting associate professor of Computer

Science at Cornell University from 1990–1991. I have also been invited for collaborative visits by several academic institutions, and have presented numerous keynote presentations worldwide. I have been an editorial member of the SIAM Journal on Imaging Sciences, and the ACM Transactions on Graphics, and continue my editorial role for ACM Computing Surveys and the International Journal of Computational Geometry and Applications.

9. I have spent the better part of my career, both at Purdue and UT, researching, designing, teaching and using computer systems to model, simulate and visualize natural and synthetic objects combining computational image and geometry processing. I am knowledgeable about and have much experience in both the hardware and software, including algorithms, used for capturing, analyzing, and displaying interactive imagery.

10. In the 1970s, while majoring in Electrical Engineering at Indian Institute of Technology with a minor in Computer Sciences, I was intimately involved in the design and fabrication of microprocessor-controlled circuits including the development of microprocessor controller software. In the 1980s, while at Cornell University, these past experiences led to research in computational geometry, processing and optimization. In the early 1990s, I created 3D collaborative multimedia software environments which were fully navigable for

multi-person computer gaming and simulation. In 1994, I co-authored a technical paper entitled “Shastra: Multimedia Collaborative Design Environment,” V.

Anupam, C. Bajaj (1994). IEEE Multimedia, 1(2):39-49. The need for increasing computer graphics display realism without sacrificing interactivity led me also to explore image processing techniques such as texture mapping with data compression, such as described in my publication “Compression-Based 3D Texture Mapping for Real-Time Rendering,” C. Bajaj, I. Ihm, S. Park (2000). Graphical Models, 62(6):391-410 and “3D RGB Image Compression for Interactive Applications,” C. Bajaj, I. Ihm, S. Park (2001). ACM Transactions on Graphics, 20(1):10-38.

11. In the mid-2000s, I began to create spatially-realistic 3D graphical environments of nature’s molecules and cells with a combination of different types of acquired and reconstructed imagery within which a user may explore, query, and learn. My publication titled “From Voxel Maps to Models” that appeared in an Oxford University Press book called “Imaging Life: Biological Systems from Atoms to Tissues,” is an example of my research in computational imaging. Over the course of my career, I have participated in the design and use of several computer systems spanning handhelds, laptops, graphics workstations to PC/Linux clusters as well as very large memory supercomputers for capturing, modeling and

displaying virtual and scientific phenomena. My experience with computer modeling and displaying computer graphics imagery encompasses many fields, such as interactive games, molecular, biomedical and industrial diagnostics, oil and gas exploration, geology, cosmology, and military industries.

12. During this time at UT Austin, I also designed and implemented scalable solutions for inverse problems in microscopy; spectroscopy; biomedical imaging; constructing spatially realistic and hierarchical 3D models; development of search/scoring engines for predicting energetically favorable multi-molecular and cellular complexes; and statistical analysis and interrogative visualization of neuronal form-function. Additionally, I have courtesy appointments and supervise M.S and Ph.D. students from several UT departments, including, biomedical and electrical engineering, neurobiology, and mathematics. I currently serve on the editorial boards for the International Journal of Computational Geometry and Applications, and the ACM Computing Surveys. Much of my work involves issues relating to interactive image processing, 3D modeling, bio-informatics, computer graphics and computational visualization. Examples of my publications, including peer-reviewed publications, are listed in my CV.

13. As set forth in my CV, I have authored approximately 150 peer-reviewed journal articles, 33 book chapters (which were also peer reviewed), and 142 peer-reviewed conference publications.

14. I have written and edited four books, on topics ranging from image processing, geometric modeling and visualization techniques, to algebraic geometry and its applications. I have given 165 invited speaker keynote presentations. I am a Fellow of the American Association for the Advancement of Science, a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), a Fellow of the Society of Industrial and Applied Mathematics (SIAM), and also a Fellow of the Association of Computing Machinery (also known as ACM), which is the world's largest education and scientific computing society. ACM Fellow is ACM's most prestigious member grade and recognizes the top 1% of ACM members for their outstanding accomplishments in computing and information technology and/or outstanding service to ACM and the larger computing community.

III. MATERIALS CONSIDERED

15. The materials I considered include the '770 Patent, the '770 patent's file history, the Petition from Xactware for *inter partes* review (Paper 7) (as far as it is relevant to the instituted grounds), the Harold Schuch Declaration in support

of the Petition (Ex. 1008) (as far as it is relevant to the instituted grounds), the Patent Trial and Appeal Board (“PTAB”) decision to institute *inter partes* review (Paper 12), and the Patent Owners’ Preliminary Response (Paper 8).

16. I also considered the following materials that I refer to and that I cite in this declaration:

- a) An article by Avrahami, et al., “Extraction of 3D Spatial Polygons Based on the Overlapping Criterion for Roof Extraction from Aerial Images” (“Avrahami”) (Ex. 1003);
- b) A user guide by AppliCad Ltd. entitled “Product Bulletin - November 2002: Key Features of our Roofing Software” (“AppliCad”) (Ex. 1004); and
- c) U.S. Patent Publication U.S. 2007/0220174 A1 to Abhyanker, September 20, 2007 (“Abhyanker”) (Ex. 1006).

17. In addition, I have drawn on my experience and knowledge, as discussed above and described more fully in my CV, in the areas of image processing, interactive 3D modeling, computer graphics and visualization.

IV. PERSON OF ORDINARY SKILL IN THE ART

18. It is my understanding that a person of ordinary skill in the art (“POSITA”) at the time of the effective filing date of the application that led to the ’770 patent is someone with a bachelor’s degree or higher in computer science, computer engineering, computer vision or visualization, physics, or an equivalent

educational background, or someone having at least 5 years of industry experience in software development.

V. SUMMARY OF U.S. PATENT NO. 8,209,770

19. The '770 patent issued on August 26, 2014, from Application No. 13/438,288, which was filed on April 3, 2012. Ex. 1001 ('770 patent) at Cover. That application is a continuation of Application No. 12/467,244, which was filed on May 15, 2009. The '770 patent is also related to Provisional Application No. 61/197,094, which was filed on October 31, 2008.

20. The '770 patent is directed to “user interface systems and methods for roof estimation.” Ex. 1001 at Abstract. To accomplish this, it also includes “a user interface configured to facilitate roof model generation based on one or more aerial images of a building roof.” *Id.* at Abstract. Once a three-dimensional model of a roof has been created, a roof report based on that model is created that may include roof measurement information, such as “one or more plan (top-down) views of the model, annotated with numerical values for the slope, area, and/or lengths of the edges of at least some of the plurality of planar roof sections of the model of the roof.” *Id.* at 6:36–42. “The report may also include information about total area of the roof, identification and measurement of ridges and/or valleys

of the roof, and/or different elevation views rendered from the 3D model.” *Id.* at 6:42–46.

21. The inventions of the ’770 patent are useful in a variety of roof estimation contexts, whether it be for a roof contractor to repair or replace a roof, or to install solar energy panels. *Id.* at 1:25–34, 53–59. In such contexts, the accuracy of the three-dimensional model generated and in turn the resulting roof report are important considerations in evaluating the ultimate usefulness of a roof estimation procedure that relies on aerial images instead of in-person physical measurements of the roof.

22. To that end, the ’770 patent includes displaying a first and second aerial image of a roof during the process of roof estimation. *Id.* at 22:33–38. It also includes a first visual marker that is movable by a user as part of a user interface and a second visual marker that is displayed based on that movement. *Id.* at claims 1, 19; *see also id.* at 9:54–61. Figures 6A–6C. For example, Claim 1 recites a “first visual marker that is moveable by a user,” “moving the first visual marker with respect to the first aerial image of the roof structure to a first location in response to input from the user” and thereafter “displaying a location of a second visual marker on the roof structure of the building in the second aerial image of the roof structure based on an indication received from the stored data in

the memory of the first location on the displayed first aerial image to which the user had moved the first visual marker.” *Id.* at claim 1.

23. One advantage of being able to move a marker in one image and have it correspondingly move in the other image is that it provides to the user “feedback regarding the accuracy of the roof model, the image registration, etc.” *Id.* at 3:39–41. For example, if a tree is blocking part of a roof in one view, it may not be possible to perform a specific task from that perspective. In another example, a marker may appear to be set correctly in one image, but not in another. Thus, for example in the model generation context, the claimed invention permits “the operator ... [to] switch between various images of the building of the roof 407, making refinements to the 3D model . . . in whichever image is more convenient and/or provides a more suitable perspective/view of the model.” *Id.* at 14:57–61.

VI. CLAIM INTERPRETATION

24. I understand that claims in an IPR are given their broadest reasonable interpretation in light of the specification as it would be interpreted by one of ordinary skill in the art.

25. I understand that petitioner has proposed the following interpretations for terms with respect to this IPR.

- A. **“displaying a location of a second visual marker on the roof structure of the building in the second aerial image of the roof structure based on an indication received from the stored data in the memory of the first location on the displayed first aerial image to which the user had moved the first visual marker” (claim 1) and “display the location of a second visual marker corresponding to the first visual marker on the roof structure of the building in the second aerial image of the roof structure based on the indication received of the location on the displayed first aerial image to which the user had moved the first visual marker” (claim 19)”**

26. I disagree with Petitioner’s construction of these terms to mean “a second visual marker is displayed on the roof structure of the building in the second aerial image at the same location as the first visual marker in the first aerial image.” Paper 7 (Petition) at 6, 8. This definition is overly broad because it does not account for the fact that, pursuant to the plain language of the claims, the claimed marker must have the capability of being moved from one location to another. For example, with respect to claim 1, the plain language states that the marker is “movable” and includes the step of “moving” the first visual marker. With respect to claim 10, the plain language states that the location of the marker is indicated “as a result of the detection of movement” of a marker.

27. Furthermore, Petitioners construction is at odds with how a person of ordinary skill would understand the claims in light of the specification of the ’770 patent. The specification specifically contemplates that a marker is not simply

placed, but can be moved from one location to the next, or adjusted to the location of the user's choosing. Ex. 1001 at 9:54–10:40, 12:1–9, 13:17–25 (“Here, the operator has moved the marker 520 to a position in which the spine of the marker 20 is substantially aligned with the ridge line of the roof 407.”). Accordingly, Petitioner's definition is not appropriate because it is overly broad and I do not believe that this term needs further clarification.

VII. PETITIONER'S PROPOSED GROUNDS DO NOT SHOW THE CLAIMS OF THE '770 PATENT ARE UNPATENTABLE

A. Background On Asserted References

1. Avrahami

28. Avrahami discloses a study to test an algorithm “for semi-automatic 3D spatial polygon extraction from a pair of colored aerial images with a known external model solution.” Ex. 1003 at Abstract. To achieve its goal, the algorithm assumes that the two images are significantly overlapping. *Id.* at 43. The proposed algorithm requires minimal user-input in that the operator needs only to “point at every distinct planar part of the roof in the left image space,” after which time the algorithm is fully automatic. *Id.* at Abstract. The reference presents the algorithm, an experiment where the algorithm was applied, and results comparing the accuracy of the semi-automatic algorithm compared to a manual approach.

29. One computation relied upon by Avrahami is the use of epipolar geometry. Epipolar geometry is a way to describe the geometric relationships of two perspective views or images of a scene. These views may be acquired simultaneously as in a stereo rig (like with your own eyes or a pair of binoculars), or acquired sequentially, for example, by a camera moving relative to the scene. These two situations are geometrically equivalent. When two cameras view a 3D scene from two distinct positions, there are a number of geometric relations between the 3D points and their projections onto the 2D images that lead to linear relationships between the same image points in two different images (i.e., a homologous pair of points). Each view has an associated camera matrix, P and P' , where P' indicates entities associated with the second view. A 3-space point X is imaged as $x = PX$ in the first view, and $x' = P'X$ in the second. Image points x and x' are “homologous” because they are the image of the same 3-space point X .

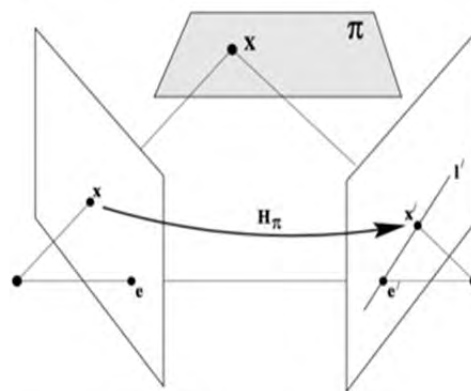


Fig. 9.5. A point x in one image is transferred via the plane π to a matching point x' in the second image. The epipolar line through x' is obtained by joining x' to the epipole e' . In symbols one may write $x' = H_\pi x$ and $l' = [e']_x x' = [e']_x H_\pi x = Fx$ where $F = [e']_x H_\pi$ is the fundamental matrix.

Figure excerpted from Chapter 9 of Multiview geometry in Computer Vision, 2nd ed., Richard Hartley, Andrew Zisserman, Cambridge Univ. Press, 2000, 2003.

30. Figure 2 below “illustrates a flowchart of the proposed algorithm.” Ex. 1003 at 46. The algorithm is broken up into three main stages once it is given a pair of colored aerial images: (1) “[m]anual pointing - seed points (in 2D) to the centre area (in a typical radiometric point) of each roof plane in the left image space”; (2) an “automatic process for extraction of the roof planes for each seed point”; and (3) the “[t]opology between the planes is built, the planes are intersected and the outcome is a 3D roof.” *Id.* at 46. In the below diagram, the steps within the bracketed “For 1:n” loop comprise the second stage of the algorithm and are carried out once for each “seed point” selected in the first step. *Id.* at 46.

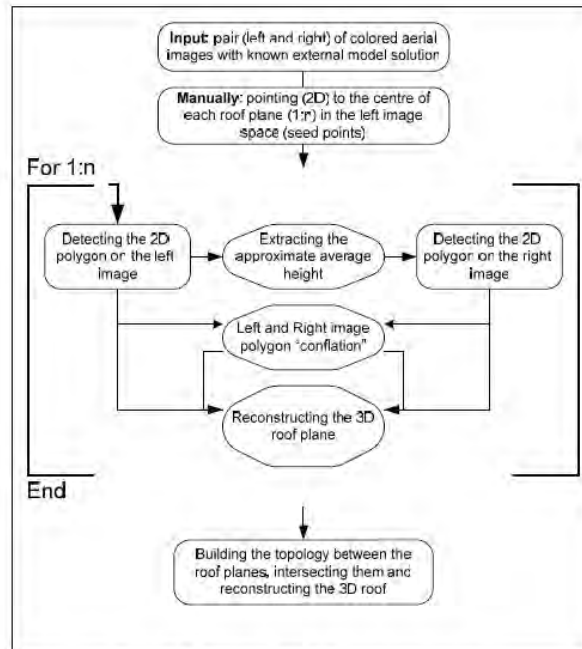


Figure 2. Flowchart of the roof extraction

Id. at 46.

31. The first step of the algorithm is for a user or operator to point to the center of each individual roof plane of the subject roof in an image (called the “left” image). Ex. 1003 at 44, 46. The algorithm disclosed by Avrahami does not require the user to perform any tasks on the right image, and does not disclose even showing that image to the user. This “seed point” is utilized by the algorithm as a starting point to search for the bounds of a particular roof plane section, though the indication of the “seed point” itself does not tell the algorithm where the bounds of the roof reside. This step is the only manual aspect of the algorithm and all other steps are fully automatic. *Id.* at 43 (“1) manual pointing to the center of a well-defined area in the left image space by the operator. This stage defines the

algorithm as semi-automatic and ***from here on the process is fully automatic.***") (emphasis added). At the time the "seed point" is input by the user, the algorithm has not yet started and there are no lines or polygons that have been created.

32. The second step of the algorithm is to automatically extract individual roof planes for each "seed point" selected by the user. Ex. 1003 at 46. This second step involves a series of five sub-steps (i) - (v), explained below, that are carried out only once for each area to be extracted. *Id.* at 44-46 (Sections 3.1 to 3.5). At the end of the second step, the algorithm of Avrahami has not yet created an integrated model of the subject roof, but rather has only incrementally created individual polygons that have yet to be fit together.

33. Sub-step (i) involves determining the 2D bounds of the roof area based on the initial "seed point" in the left image, because the selection of a "seed point" itself does not provide information regarding any bounding lines or points of the roof. Ex. 1003 at 44 (Section 3.1). In order to accomplish that task, a "flood fill" operator is utilized to find the bounds of the area. *Id.* at 44. However, as discussed below, in some situations the "flood fill" operator fails to distinguish between two adjacent roof planes and includes multiple roof planes in the 2D polygon that is extracted. *Id.* at 46 (Figure 1).

34. Sub-step (ii) involves automatically estimating the height of the points of the bounding 2D polygon in the left image space. Ex. 1003 at 44 (Section 3.2). This involves a couple of independent procedures. For each vertex of the left image polygon, the algorithm finds the homologous points in the right image space via an Area Based Matching algorithm (ABM). *Id.* at 44-45. Based on the epipolar geometry relationships between two images, an approximate average height is calculated by using the MEDIAN of the heights obtained from determining the optimal match using ABM. *Id.*

35. Sub-step (iii) involves repeating sub-step (i) to determine the bounds of the roof section in the right image space. Ex. 1003 at 45 (Section 3.3). A suitably chosen 2D transformation based on epipolar geometry is used to transfer the initial “seed point” of the left image to corresponding homologous point in the right image space. *Id.* The “flood” fill operation previously discussed in sub-step (i) above is then performed. *Id.* Because this operation is performed independently in the right and left image spaces, the 2D polygons created in the left and right images may be mismatched and not have the same number of points. *See Id.* at 46 (Figure 1).

36. Sub-step (iv) involves “left and right polygon matching” to align the two 2D polygons of bounded roof areas created in sub-steps (i) and (iii). Ex. 1003

at 45 (Section 3.4). This step is necessary because the extraction of polygons—which involves the strategy of, for each vertex (point) in the left polygon, computing the corresponding homologous point in the right polygon by intersection of the epipolar line and the right polygon—can fail because it is “performed automatically” without user input. *Id.* This can occur due to various issues, including “when the number of points in both polygons is not equal, when there is an occlusion in one of the images and the polygons do not represent homologous areas, when there are a number of intersections per point, when a polygon line is parallel to the epipolar line, etc.” *Id.* Thus, the left and right polygons must be first matched or aligned.

37. To accomplish this, an iterative method for maximal matching between the two 2D polygons is used and based on an optimization model called “adjustment by conditions” (Cooper, 1987), namely, the epipolar linear and planar geometry conditions. Ex. 1003 at 45. The optimized solution minimizes the difference between the interior and exterior polygon areas of the two aligned polygons. *Id.* The left polygon “slides” in the direction of the right polygon until the condition is satisfied. *Id.* Perfect registration of these 2D polygons is crucial for the next step of 3D polygon extraction. Otherwise, it leads to spatial error of

the 3D roof model. During this sub-step, points of the left and right polygon are not changed.

38. The last sub-step of the loop for each “seed point,” sub step (v), involves creating an individual spatial polygon for the area corresponding to that “seed point.” Ex. 1003 at 46 (Section 3.5). In the previous step, it was discussed that a matching process was necessary because of various potential issues, such as the polygons created in the left and right images having a mismatched number of points. With the left and right polygons having been aligned in the previous step, an “adjacency matrix” is generated that matches the two closest points. *Id.* Unmatched points at the end of this process are deleted, which results in a final bounded polygon. For example, Figure 1 depicts a left polygon with 10 points and a right polygon with 6 points, whereas the final polygon has only 5 points. *Id.* Notably, the user provides no indication of the location of any points, nor does the user provide any indication of the number of points. Instead, the determination is automatic and not based on any user input. From here, a 3D spatial polygon can be extracted using homologous points and epipolar geometry. *Id.* at 45, 46. Once a spatial polygon is extracted in Avrahami, it is not modified. The sub-title of Section 3.5 of Avrahami is “Reconstruction of the 3D spatial contour” and corresponds to the box of Figure 2 labelled “Reconstructing the 3D roof plane.”

Id. at 46. However, “reconstruction” in this context refers not to modifying anything pre-existing, but rather re-creating a real-life roof plane in virtual reality. This can be seen from uses of the term within Avrahami itself and the titles of other articles listed in the reference section. *Id.* at 44 (“Due to the complexity of automatic reconstruction of 3D reality from aerial images (occlusions, image quality, etc.), each method attempts in its own way to minimize the dependency on radiometric parameters of the image.”), 48 (three separate articles with titles mentioning building reconstruction).

39. As discussed above, the sub-steps (i) to (v) of step 2 of the algorithm are repeated for each “seed point” indicated by the user. These steps are fully automatic and require no input by the user. At the completion of step 2, no three-dimensional model of the roof exists, but instead a collection of individual spatial polygons.

40. The third and final step of the Avrahami process involves extracting the three-dimensional roof of the subject building. Ex. 1003 at 46 (Section 4). As preparation for this step, the algorithm requires that each polygon includes only one seed point. *Id.* If there are two or more seed points for a single polygon, then these points must be merged and consequently the areas which are represented by the points are also merged. *Id.* These preparations are performed fully

automatically and I see absolutely no indication or necessity for user-input. For example, it would be relatively straight forward for a computer to detect that a 3D spatial polygon is composed of multiple planar surfaces.

41. Once these prefatory tasks are completed, the topology between the roof planes is built up according to adjacency relationships between shared lines composing the 3D planar polygons. *Id.* Finally, spatial intersection of adjacent planes is performed. *Id.* Here, polygon misalignment errors would lead to intersection gaps or extraneous triangles.

42. Thus, the semi-automatic algorithm of Avrahami discussed above, starts with user input at only one time for “seed points” on a single image, and then automatically constructs a single 3D polygonal roof model. However, the algorithm may have spatial accuracy issues, including by possibly missing or extraneous triangles.

43. Avrahami presents a comparison of the accuracy of the results of the proposed algorithm compared to the same roofs “measured manually by an operator in the ERDAS IMAGINE 8.6® software.” Ex. 1003 at 47. As shown Table 1 of Avrahami and as discussed in the reference, the proposed algorithm required less work on the part of the operator, with the tradeoff of achieving less accurate results compared to the manual method. *Id.* at 47, 48.

Table 1. Horizontal and vertical measurement accuracy in both test areas (m).

Accuracy (m)		Test area 1		Test area 2	
		H	V	H	V
1	Manual	0.08	0.13	0.05	0.09
2	Compared	0.17	0.39	0.11	0.22
3	Semi-automatic	0.16	0.37	0.10	0.20

Id. 47.

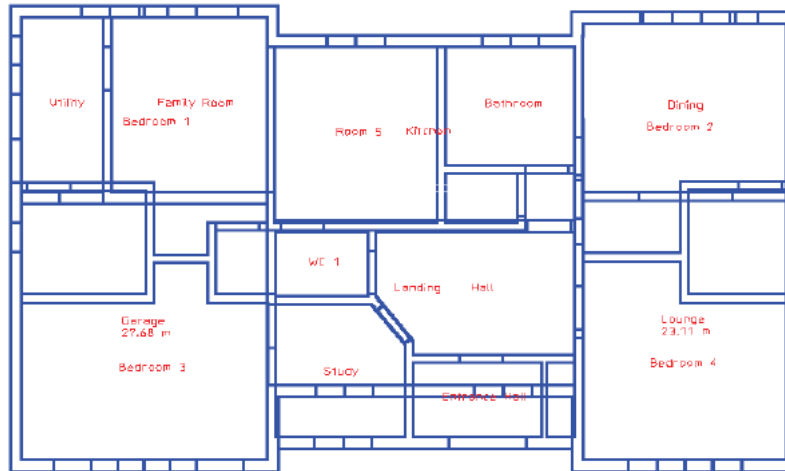
2. AppliCad

44. The AppliCad reference appears to be a product bulletin for CAD (computer aided design) based roofing software that allows a user to draw a 3D roof, from which the software calculates the amount of material needed to cover that roof. Ex. 1004 at 1, 2. The target audience of AppliCad appears to be “roofing professional[s]” or end-users of the software.

45. AppliCad does not disclose creating a model of a roof from a pair of aerial images. In order to draw up a roof, AppliCad requires the user to provide certain numeric information about the desired roof. For example, it states that “[p]roviding you enter the dimensions for the perimeter of the roof accurately, and given the correct angle or slope, then the roof generated on the screen should resemble the roof in question.” Ex. 1004 at 3 (Section “2. Drawing up the Roof”).

46. As one method of starting the process, AppliCad discloses the importation of two-dimensional roof outlines or floor plans. Ex. 1004 at 4 (Section

“3. Importing Roof of Building outlines from another CAD system”). AppliCad discloses that a 2D CAD drawing can be imported “to get the roof outline in” and shows such an example:



47. After a 2D CAD drawing is imported, the user is required to manually enter certain roof information. Ex. 1004 at 4 (“By using the command *Digitise Outline* we can then move the cursor to the extremities of the wall outline, by ‘snapping’ to those points, **and after entering the pitch or slope of the roof and the eave offset from the wall**, the roof is generated automatically, resulting in an accurate and fast method of working out the areas and lengths.”) (emphasis added).

48. Two other methods are available to start the process. Users can also import 2D roof or building outlines from a scanned 2D image or bitmap. Ex. 1004 at 6 (“We recognize that you may not have the luxury of obtaining the CAD file for the drawing in question, but you may be able to scan the roof plan, using a

flatbed scanner.”). In this situation, the user is required to enter “the true measurement from one reference line” in order to proceed. *Id.* As an alternative to scanning an image, users can also “enter the direction and dimension of each wall to produce the wall outline.” The CAD based software will then proceed to generate a hipped roof model. *Id.* at 7.

49. AppliCad discloses that the user may manually model other roof features, such as multi-hip roofs or first story roofs. Ex. 1004 at 10 (“6. Drawing up Multi-Hip Roofs”), 11 (“7. Drawing up first storey Roofs”), 13 (“8. Modifying the Roof”), 14 (“9. Changing the Pitch of any roof planes.”), 15-16. However, because AppliCad does not rely on the use of aerial images, these modelling tasks are not performed with reference to a 3D wire frame model, projected and overlaid on two aerial images, for 3D model accuracy.

50. Once a model is generated, the AppliCad software will assist in proving costing information, such as the numbers and sizes of flashings and other materials needed for the roof, accounting for issues such as wastage. *E.g.* Ex. 1004 at 25, 28.

51. AppliCad discloses that the user may then print customizable templates that show information generated for the roofing quote, such as a tax invoice, a roofing pay summary, a quotation cutting list, and quotation details. Ex.

1004 at 39–40. The precise contents of these templates is not entirely disclosed by the user guide and the user guide instructs that “[i]f you wish to receive more information on these outputs, please do not hesitate to contact our office.” *Id.* at 39.

3. Abhyanker

52. Abhyanker is titled “Marker Placement in a Mapping Environment” and is directed to solving the problem of the accuracy of marker placement in mapping software. Ex. 1006 at Abstract. It includes generating placement of a marker in a mapping environment based on address data and updating the location of that marker based on user input. *Id.*

53. Abhyanker does not claim to have invented providing a mapping data server for aerial images organized and search accessible by geo-location or location address. Instead its innovation is to correct the inaccuracy of marker placement on maps served up by one of existing Microsoft Virtual Earth, Google Earth, Yahoo Maps, etc. *Id.* ¶¶ 4, 5. The patent requires digital location referenced data from some mapping data servers and uses a block region based gridding and interpolation algorithm on that digital map for first assigning a marker to a physical location identified through the address data. *Id.* ¶ 46. It then allows users to relocate the marker in the mapping environment to better the physical location

identified through a view of the location served up by the mapping data server, namely, one of Microsoft Virtual Earth, Google Earth, Yahoo Maps, etc. *Id.* ¶¶ 48–55.

B. Ground 1: The Combination of Avrahami and AppliCad Does Not Render Claims 1, 11, and 14 Obvious

54. It is my opinion that the combination of Avrahami and AppliCad does not render claims 1, 11, and 14 of the '770 patent obvious.

1. *Neither Avrahami Nor AppliCad Discloses “displaying . . . a graphical user interface . . . and also at least one first visual marker that is moveable by a user” and “moving the first visual marker with respect to the first aerial image of the roof structure to a first location in response to input from the user;” (claim 1)*

55. I understand that Petitioner relies solely on Avrahami to satisfy this limitation, which involves “displaying . . . at least one first visual marker that is moveable by a user” and “moving the first visual marker with respect to the first aerial image of the roof structure to a first location in response to input from the user.”

56. Avrahami fails to teach or disclose this limitation because the selection of an initial “seed point” relied on by Petitioner does not teach or suggest a “visual marker that is movable” as required by claim 1. Avrahami’s “point[ing] to and identif[y]ing seed points” (see Paper 7 (Petition) at 14 (citing Ex. 1003 at

43)) does not constitute movement of a first visual marker. The claims require a first visual marker to be present and then subsequently moved. Pointing to and clicking on a location to identify a seed point cannot be “moving the first visual marker” because prior to the user’s click, the seed point does not exist, and therefore there is nothing to move. *Id.* at 43. Further, in Avrahami, once the user selects the “seed point,” there is absolutely no indication that it can be moved to another location or that the algorithm can detect that user’s selection has changed. Avrahami describes the algorithm as being fully automatic after the placement of the “seed point.” *Id.* at 43. Furthermore, as discussed above, I see no indication that any of the steps after the “seed point” placement require user intervention. Indeed, a later manual intervention is contrary to Avrahami’s requirement that all later steps of the algorithm be “fully automatic.” Not giving users the ability to input corrections or otherwise affect what is generated is contrary to the purpose of the ’770 patent, which provides the benefit of adjustments made in one image being propagated and verified in the other. *E.g.* Ex. 1001 at 14:57–61 (“In this manner, the operator can switch between various images of the building roof 407, making refinements to the 3D model by adjusting the wire frame in whichever image is more convenient and/or provides a more suitable perspective/view of the model.”

2. *Neither Avrahami Nor AppliCad Discloses “displaying a location of a second visual marker on the roof structure of the building in the second aerial image of the roof structure based on an indication received from the stored data in the memory of the first location on the displayed first aerial image to which the user had moved the first visual marker” (claim 1)*

57. I understand that Petitioner relies solely on Avrahami to satisfy this limitation, which requires “displaying a location of a second visual marker on the roof structure of the building in the second aerial image of the roof structure based on an indication received from the stored data in the memory of the first location on the displayed first aerial image to which the user had moved the first visual marker.”

58. Avrahami fails to disclose or suggest this limitation because it does not teach that the second aerial image should be displayed at all during the algorithm’s process. Avrahami includes illustrative Figures 1, 3, and 5 that show side-by-side images of a roof, but those are included in the paper to illustrate the internal operation of the Avrahami algorithm graphically. Ex. 1003 at 46–48. The presence of these figures does not teach or disclose that the images in the figures should be displayed during performance of the algorithm. Though Petitioner relies on language from Avrahami stating that two images are required to perform the algorithm (Paper 7 (Petition) at 15-16), Avrahami does not state anywhere that that the second aerial image is actually displayed. This is because, as discussed above,

Avrahami only takes user input at a single time, when the user provides initial “seed points” for the left image to start the proposed algorithm. Ex. 1003 at 44, 46. There is no need in Avrahami to display both images, as there is no opportunity for user interaction with the modeling process after the placement of the initial “seed point” and generation of the model.

59. Furthermore, because Avrahami only accepts user input once and has no mechanism by which the user can change or modify that initial user input, Avrahami also has no mechanism to update a second image in response to where the user had moved a marker in the first image. Thus, I do not believe that a person of ordinary skill in the art would have arrived at this limitation based on the asserted combination.

3. *Neither Avrahami Nor AppliCad Discloses “generating and outputting a roof estimate report using a report generation engine, wherein the roof estimate report includes one or more top plan views of a model of the roof annotated with numerical values for corresponding slope, area, or lengths of the edges of at least some of the plurality of planar roof sections of the model of the roof” (claim 1)*

60. I understand that Petitioner relies on both Avrahami and AppliCad to satisfy this limitation, which involves generating and outputting a roof estimate report that includes certain items. In my opinion, a person of ordinary skill in the art would not combine the Avrahami and AppliCad references in a way that results

in the claimed invention because systems described by the two references are not interoperable and because they are directed to disparate purposes. Avrahami discloses an algorithm for extracting roof plane polygons from a pair of aerial images of a roof of unknown measurements, whereas AppliCad discusses generating a roof model using CAD software starting with an existing floor plan and at least some known measurements.

61. First, I disagree with Mr. Schuch's contention that "the AppliCad system can also import a model generated in another computer program, in the form of a roof or wall outline in three dimensions." Ex. 1008 ¶ 58 (emphasis added); *see also* ¶ 43. As discussed above, AppliCad does not disclose the ability to import a three-dimensional model of a roof, as indicated by the necessity to input at least some roof measurements, such as roof pitch and possibly the length of one wall. Ex. 1004 at 4–7. That AppliCad also discusses importing a .dxf file (*Id.* at 4) is of no consequence, because such a file can contain two-dimensional roof or building CAD drawing information or two-dimensional scanned information only. Alternative methods of importing information described by AppliCad confirm that only two-dimensional models can be imported. For example, roof or building outlines may be scanned from an image or bitmap file. *Id.* at 5 ("4. Importing Roof of Building outlines from a scanned image or

bitmap”). As was the case with the imported .dxf files above, the user is required to “digitize around the outline,” but additionally must enter “the true measurement from one reference line” before a three-dimensional model can be generated. Ex. 1004 at 6. The “Track-Outline” command similarly requires the user to “enter[] the pitch (or slope), the eave offset and the eave height” (*id.* at 7–8) before the user can “view the roof in 3 dimensions” (*id.* at 9). As such, a person of ordinary skill would not understand that AppliCad is interoperable with Avrahami, and so, a person of ordinary skill in the art would not be motivated to combine them.

62. Second, a person of ordinary skill would not be motivated to combine the alleged report generation functionality of AppliCad relied upon by Petitioner with the model generation capabilities of Avrahami because the two references are directed to disparate purposes. AppliCad discloses generating a report—which includes estimates on pricing and materials needed for a roof—after the user has provided known measurements such as a 2D outline and a roof pitch. Ex. 1004 at 4. On the other hand, Avrahami is directed to creating a model of a roof with no inputted measurements at all, based solely on aerial images of the roof. Ex. 1003 at Abstract. However, because Avrahami provides no ability to modify the three-dimensional model, much less a way to review the model for accuracy as it is being generated; a person of ordinary skill in the art would not think to generate a

roof report from its output. Indeed, in Avrahami, the only disclosure of verifying its accuracy was by post comparison using results from another computer program. *Id.* at 47–48. Further, while creating a roof report in AppliCad after the user has designed a roof for a specific floor plan may be logical, doing so after creating a model from a pair of aerial images as in Avrahami is not obvious because the results may not be accurate. Accordingly, a person of ordinary skill in the art would not think to generate a roof report using the algorithm of Avrahami. Third, nevertheless, AppliCad does not disclose the claimed requirements of a roof report. The only report shown in AppliCad does not show a top-plan view of the roof that is annotated with the required values. Ex. 1004 at 40.

63. Fourth, though Petitioner cites Figure 1 of Avrahami as showing a top-down plan view of a roof (Paper 7 at 18), nothing in Avrahami shows a report annotated with roof measurement information. In fact, because Avrahami only extracts models in a “local coordinate system,” Ex. 1003 at 46, there are no roof measurements that can be annotated on any of the images.

64. Fifth, the ’770 patent’s roof report and its contents are intertwined with, and directly improve the functionality of, the underlying method of roof estimation. The usefulness of the roof report is improved by a three-dimensional modeling method that provides accurate results. The claimed values in the roof

report—which are generated from the three-dimensional model—allow for accurate estimation of the roof repair.

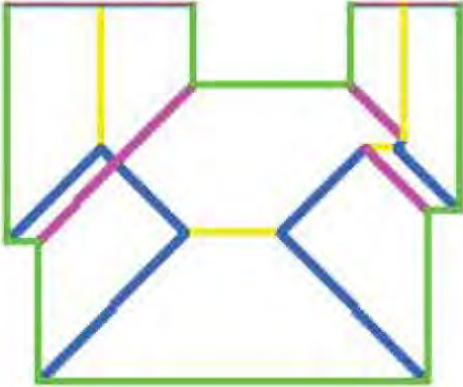
4. *Neither Avrahami Nor AppliCad Discloses “performing, by the roof estimation system, roof pitch determination of the roof structure based on the at least one location over the roof structure in the displayed aerial imagery to which the user moved the least one first visual marker” (claim 11) and “determining, by the roof estimation system, roof measurement information of one or more roof sections of the roof structure based on the at least one location over the roof structure in the displayed aerial imagery to which the user moved the least one first visual marker” (claim 14)*

65. Claim 11 includes the requirements of 1, plus the additional requirements of determining roof pitch based at least on the one location over the roof structure to which the user moved the visual marker. Similarly, claim 14 includes the requirements of claim 14, plus the additional requirements of determining roof measurement information based at least on the one location over the roof structure to which the user moved the visual marker.

66. Avrahami fails to teach or suggest these limitations. Petitioner relies on the seed points of Avrahami as the “first visual marker,” but the pointing to and identifying of seed points in Avrahami does not constitute movement of the first visual marker. Thus, Avrahami fails because there is no “location over the roof structure in the displayed aerial imagery to which the user moved the least one first visual marker” on which to base any measurement. Further, Avrahami is focused

entirely on 3D model generation from aerial images, and has nothing to do with “roof pitch determination” or “determining . . . roof measurement information of one or more roof sections.” In fact, Avrahami does not once refer to roof “pitch” or “slope.”

67. AppliCad does not supply any of the elements missing from Avrahami. AppliCad does not disclose a “first visual marker” and therefore AppliCad cannot disclose a “location over the roof structure in the displayed aerial imagery to which the user moved the least one first visual marker.” Petitioner’s reliance on the appearance of “Roof Pitch 20.0” in the figure from AppliCad reproduced below, is misplaced:

Applicad Roofing 123 Church St Hawthorn 03 9810 3100 03 9810 3200 Home 2 ACN: Home 1		Date: November 2002 Job No:										
Customer: Phone: Mobile: Fax:	Address:	Site address: Builder name: Phone:										
		<table> <tr> <td>Roof Pitch</td> <td>20.0</td> </tr> <tr> <td>Height</td> <td>5.500</td> </tr> <tr> <td>Rafter CTS</td> <td>600</td> </tr> <tr> <td>Eaves</td> <td>0</td> </tr> <tr> <td>Gable Finish</td> <td></td> </tr> </table> For the supply and installation of Roof KS 1000 LP-Steel, Galvanized - Paint Ridge BHP Ridge capping, Mountain Blue Fascia Metal fascia, Torres Blue Gutter O Gee Gutter, Ebony Valley Not Included Barge Barge Rashing, Off white Batten Not Included Insulation Not Included Downpipes Not Included Curved Roof Not Included	Roof Pitch	20.0	Height	5.500	Rafter CTS	600	Eaves	0	Gable Finish	
Roof Pitch	20.0											
Height	5.500											
Rafter CTS	600											
Eaves	0											
Gable Finish												

Ex. 1004 at 40. In this figure, there are multiple roof panels and only one reference to pitch, such that the listed pitch does not correspond to “one location over the roof structure” as required. AppliCad also lacks any disclosure that this value is “based on the at least one location . . . to which the user moved the least one first visual marker.” Instead, in AppliCad, pitch is not determined based on aerial images at all. Rather, a user enters the values for roof pitch or slope manually. Ex. 1004 at 3 (“Providing you enter the dimensions for the perimeter of the roof accurately, and give the correct angle or slope, then the roof generated on the

screen should resemble the roof in question.”), 4 (“after entering the pitch or slope of the roof and the eave offset from the wall, the roof is generated automatically . . .”). This does not meet the claimed limitation.

68. Thus, I do not believe that a person of ordinary skill in the art would have arrived at the inventions claimed in claims 11 and 14 based on the asserted combination of Avrahami and AppliCad.

C. Ground 3: The Combination of Avrahami, AppliCad, and Abhyanker Do Not Render Claims 10 and 19 Obvious

69. For the reasons set forth below, it is my opinion that the combination of Avrahami, AppliCad, and Abhyanker does not render claims 10 and 19 of the '770 patent obvious.

1. A Person of Ordinary Skill in the Art Would Not Combine The Asserted Art

70. As a preliminary matter, I do not believe a person of ordinary skill would combine these references in a way that results in the claimed invention. I have already stated above the reasons why a person of ordinary skill would not combine Avrahami and AppliCad above.

71. Furthermore, a person of ordinary skill would also not combine Avrahami and Abhyanker to achieve the claimed functionality. As described above, Abhyanker is not a reference that deals with the field of aerial estimation

from a pair of images, but is instead directed to solving the problem of accurate placement of markers in mapping software. Furthermore, Avrahami does not aim to provide an aerial estimation program for end-users, but rather is simply testing algorithm and examining its accuracy. Avrahami does not suggest that obtaining suitable images for a particular building is a problem that exists or that should be solved. Therefore, I do not see an obvious synergy between the two references and do not believe someone would combine these two references to achieve the claimed inventions without utilizing hindsight.

72. Furthermore, another concern and reason not to combine Avrahami with Abhyanker would be the lack of an organized aerial image data server solution disclosed by Abhyanker. The '770 patent requires two aerial images for the same location that show distinct views of the building. Thus, an aerial image data server that serves up such a pair of images is essential to the '770 patent process. However, Abhyanker does not suggest that such a pair of images of a single building should or could be retrieved. Therefore a person of ordinary skill would not be motivated to combine Abhyanker in conjunction with Avrahami.

2. *The Combination Does Not Render Obvious The Elements of Claim 1 From Which Claim 10 Depends*

73. I understand that Petitioner does not rely on Abhyanker for any elements of claim 1. For the reasons stated above, the asserted combination does

render obvious claim 1. Because claim 10 depends on claim 1, the asserted combination also does not render obvious claim 10 for the same reasons as stated above.

3. *The Combination Does Not Render Claim 19 Obvious*

74. The asserted combination does not render claim 19 obvious for the same reasons as described above with respect to claim 1, which shares similar limitations as claim 19.

75. In particular, the asserted combination does not teach, suggest, or disclose the limitation of “*receive an indication of a selection . . . as a result of detection of movement of at least one first visual marker in a graphical user interface.*” As described above with respect to claim 1, because Avrahami does not disclose a marker that is moveable, similarly, Avrahami does not teach or suggest that the movement of a marker should be detected.

76. As described above with respect to claim 1, the asserted combination also does not teach, suggest, or disclose the limitation of “*display the location of a second visual marker corresponding to the first visual marker on the roof structure of the building in the second aerial image of the roof structure based on the indication received of the location on the displayed first aerial image to which the user had moved the first visual marker.*”

77. As described above with respect to claim 1, the asserted combination also does not teach, suggest, or disclose the limitation of “*generate and output a roof estimate report using a report generation engine, wherein the roof estimate report includes one or more top plan views of a model of the roof annotated with numerical values for corresponding slope, area, or lengths of the edges of at least some of the plurality of planar roof sections of the model of the roof.*”

VIII. SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS

78. I have been asked to opine regarding issues relating to secondary considerations of non-obviousness to support my opinion that claims 1, 10, 11, 14, and 19 of the '770 are patentable. I note that Mr. Schuch did not present any opinions regarding secondary considerations.

79. As discussed above, the art asserted by Petitioner teaches away from the claimed invention and, in particular, the teaching of the '770 patent to allow movement of an aerial marker and to project that movement on multiple aerial images, so that the user can verify the accuracy of the 3D model being generated.

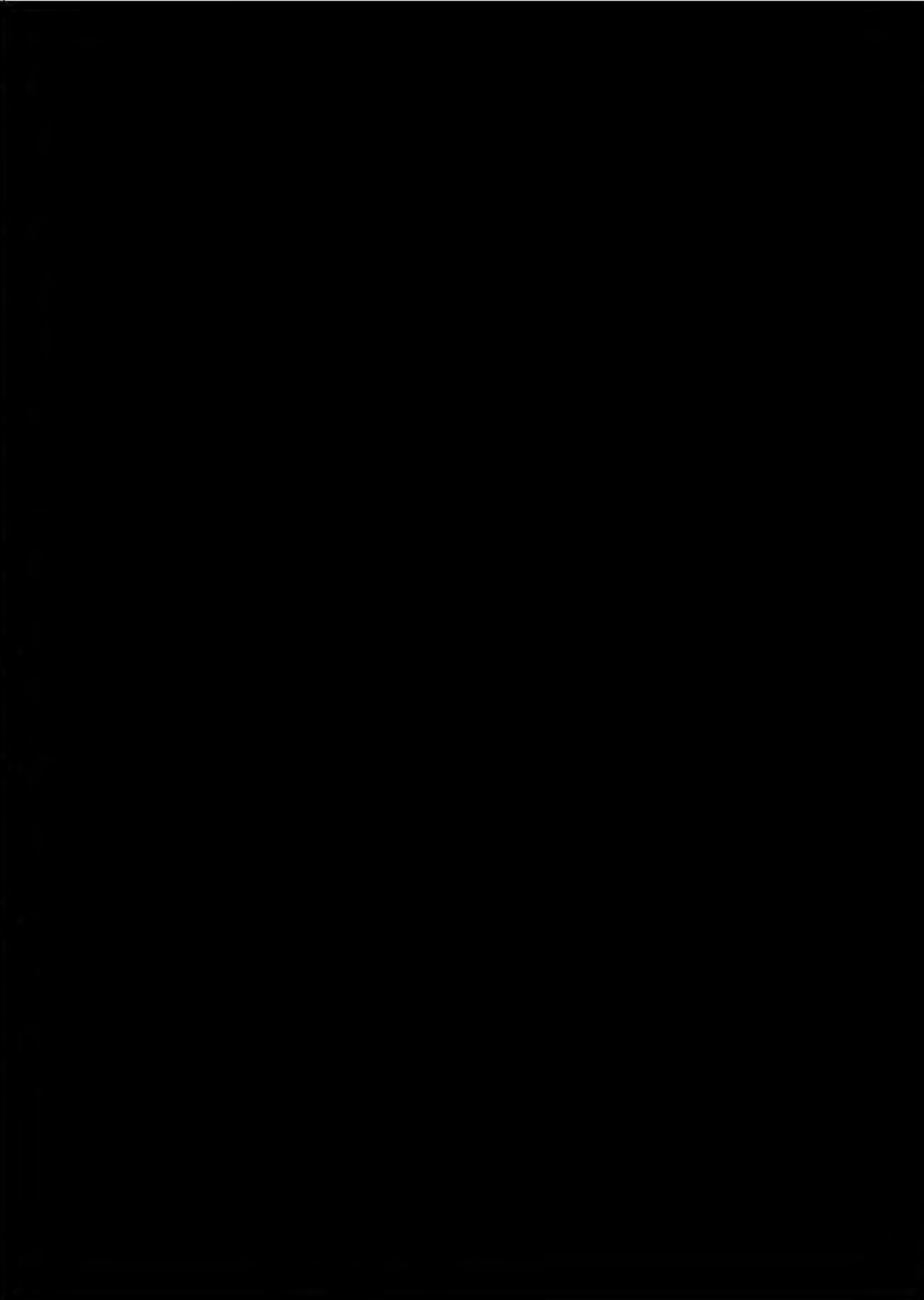
80. It is my opinion that Patent Owner's Twister and Render House software products embody at least claims 1, 10, 11, 14, and 19 of the '770 Patent. I include below a chart I prepared showing in detail how both the Twister and Render House products embody each and every limitation of these claims of the

'770 Patent. As part of my analysis I have discussed these products with engineers at Patent Owner who use the Twister and Render House products on a regular basis. During those discussions I personally directed Patent Owner's engineers to operate the Twister and Render House software to confirm my understanding of the products' operation. Based on my analysis of the Twister and Render House products, I have determined that each embodies the claims of the '770 Patent. My understanding of the features of the Twister and Render House products are further confirmed based on my review of user manuals for these two products. In my opinion the Twister and Render House software products generate accurate three-dimensional roof models and embody each limitation of claims 1, 10, 11, 14, and 19 of the '770 Patent.

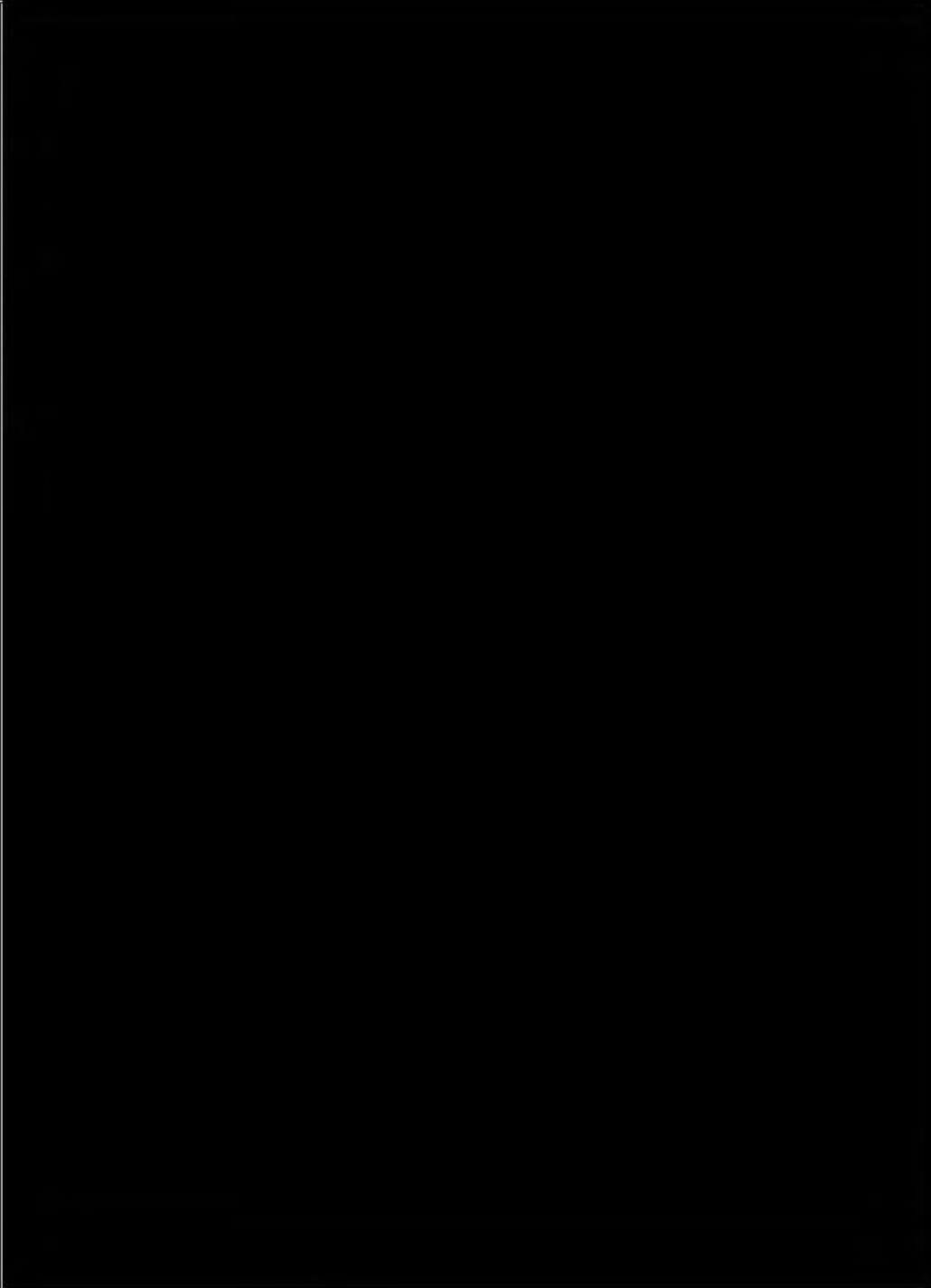
Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products</u>¹
Claim 1 [1.a]: A computer- implemented process in a roof estimation	

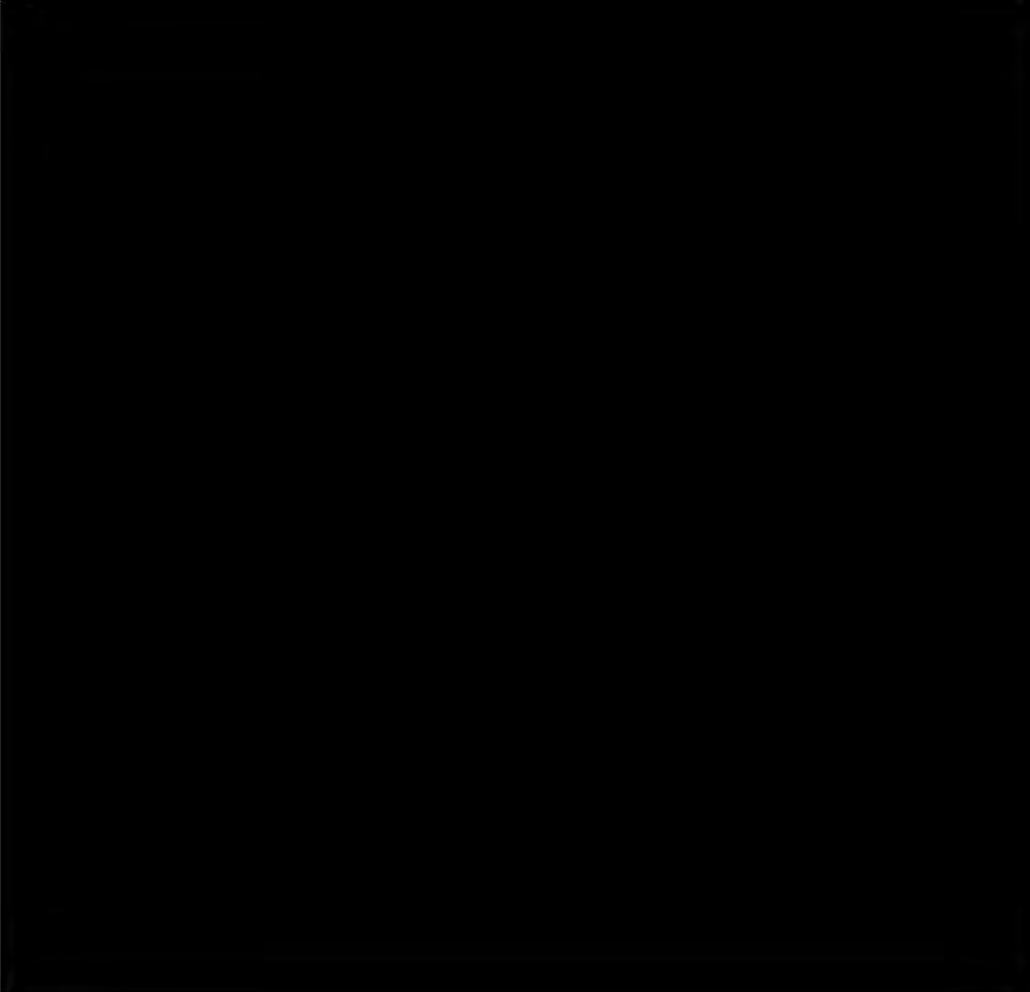
¹ Unless otherwise indicated, all screenshots in this claim chart were taken from version 2818.0 of Twister, and the version of Render House accessed therewith.

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
system comprising:	

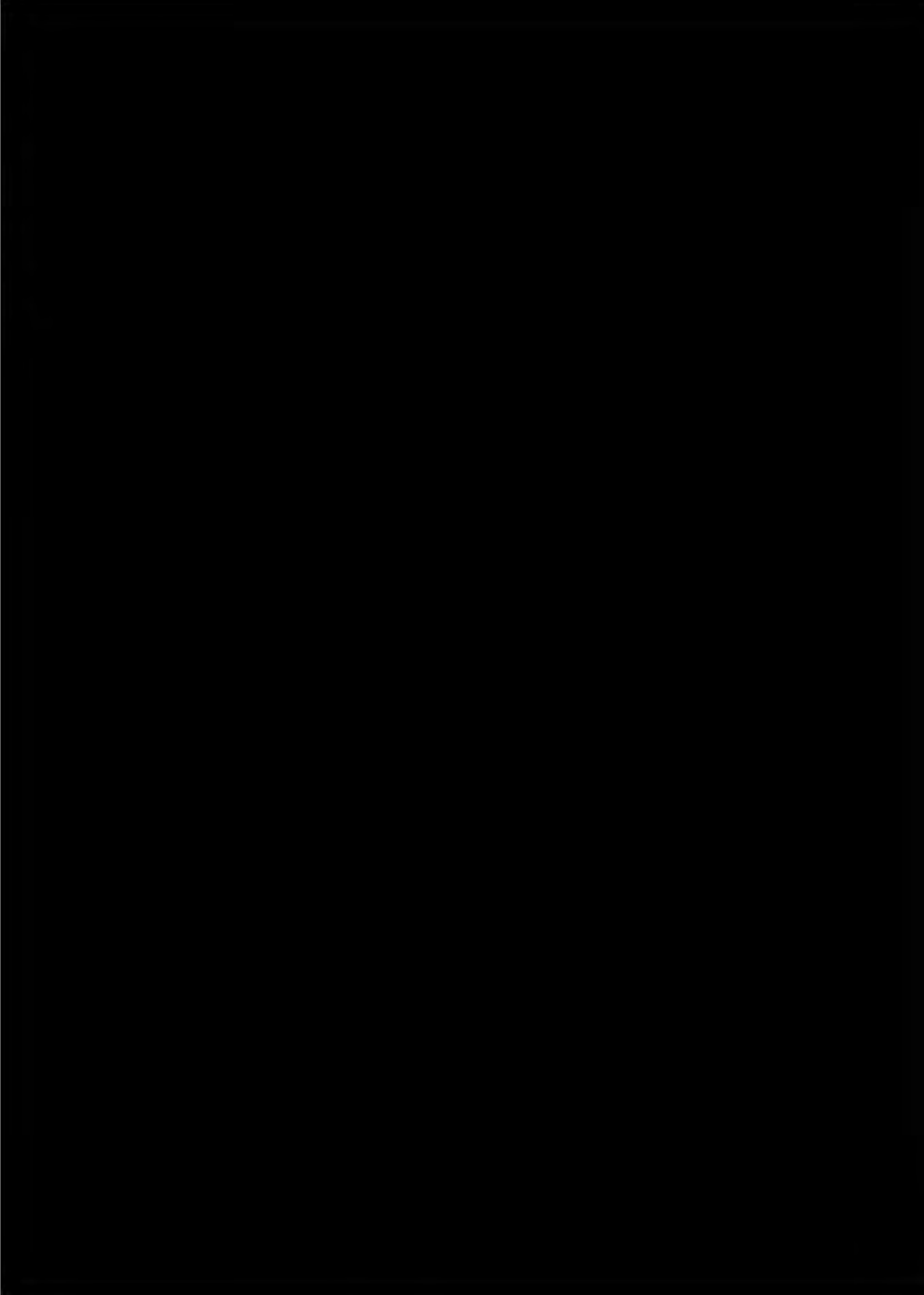
Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[1.b] displaying, by the roof estimation system, a graphical user interface including a first aerial image of a roof structure of a building and also at least one first visual marker that is moveable by a user in a same display window as the first aerial image while said first aerial image is displayed within the graphical user interface;	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[1.c] moving the first visual marker with respect to the first aerial image of the roof structure to a first location in response to input from the user;	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
	

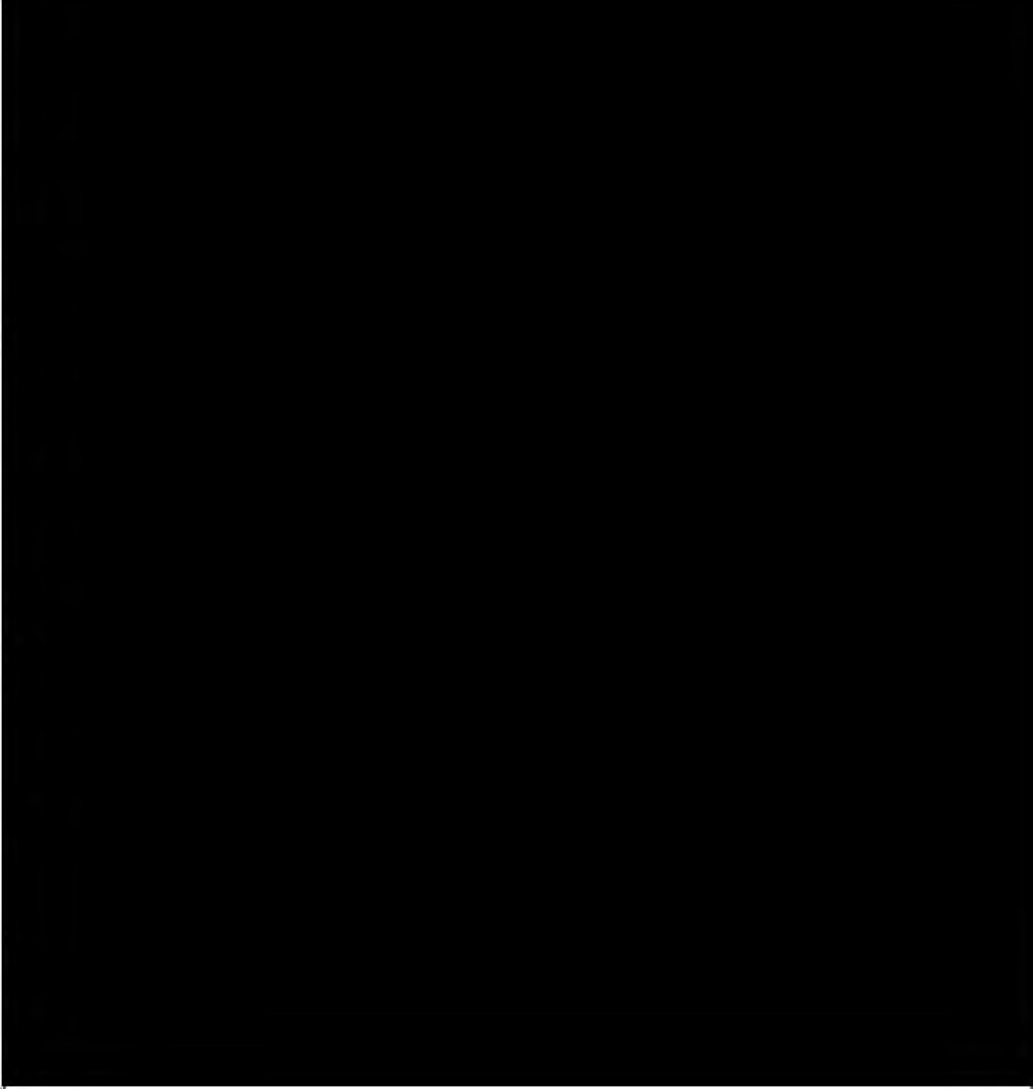
Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

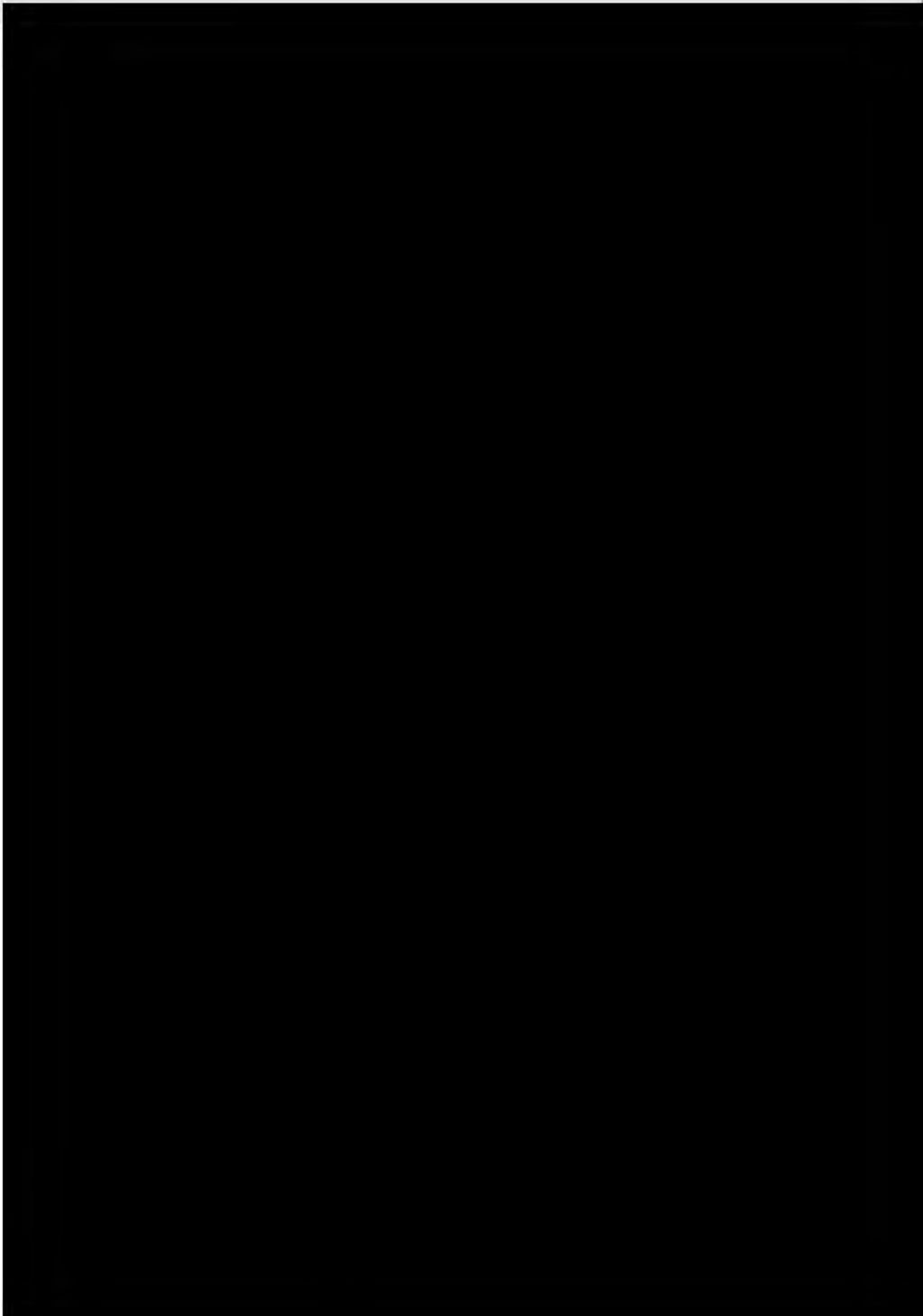
Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[1.d] storing data in a memory of the computer of the first location to which the first visual marker was moved;	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[1.e] displaying a second aerial image of the roof structure of the building, the second aerial image providing a different view of the roof than the first aerial image; and	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

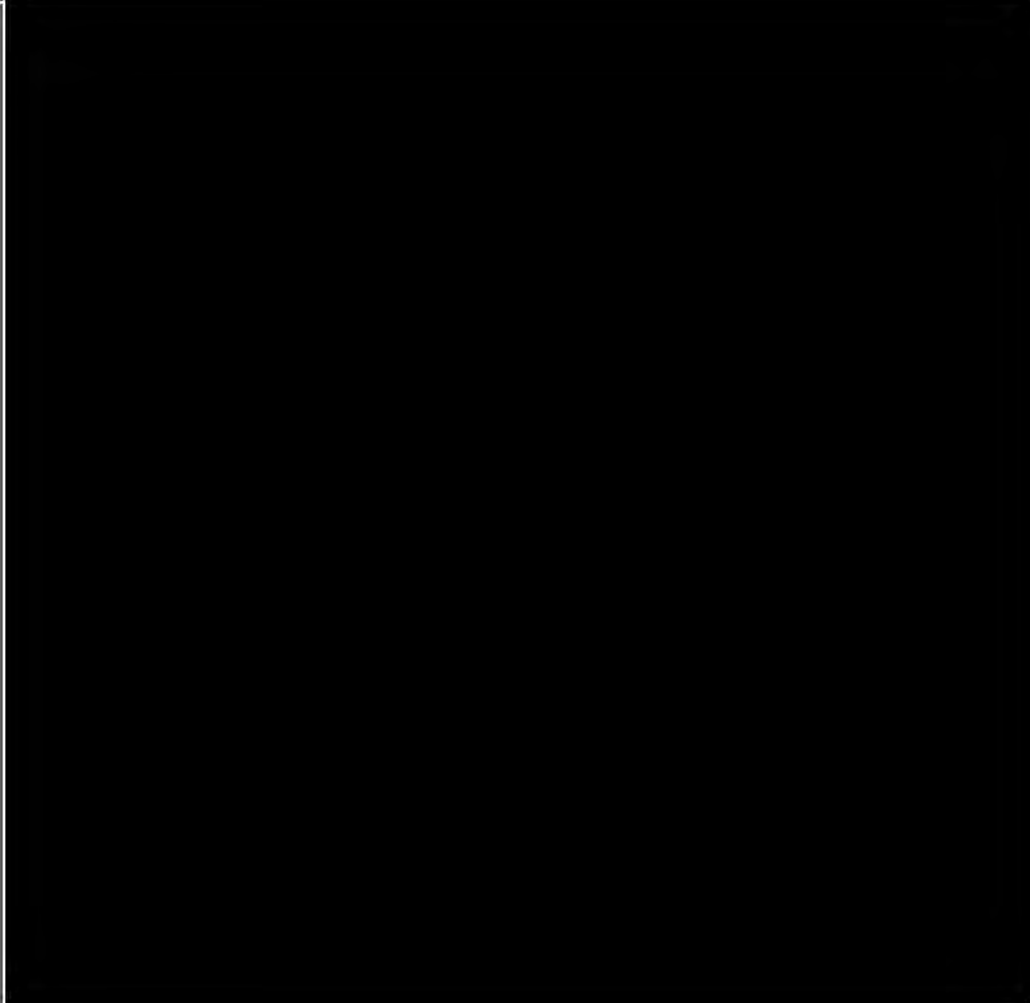
Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[1.f] displaying a location of a second visual marker on the roof structure of the building in the second aerial image of the roof structure based on an indication received from the stored data in the memory of the first location on the displayed first aerial image to which the user had moved the first visual marker; and	

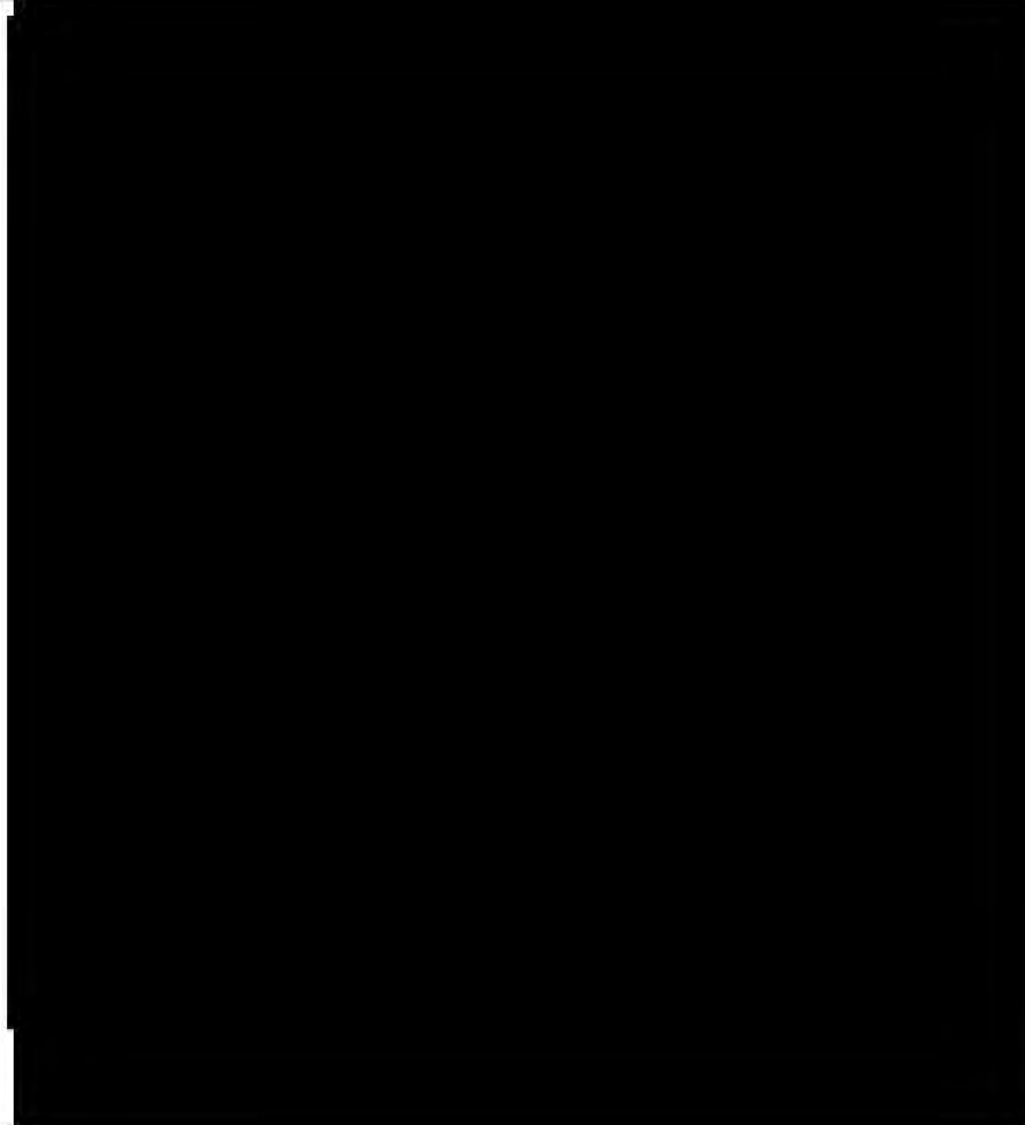
Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[1.g] generating and outputting a roof estimate report using a report generation engine, wherein the roof estimate report includes one or more top plan views of a model of the roof annotated with numerical values for corresponding slope, area, or lengths of the edges of at least some of the plurality of planar roof sections of the model of the roof.	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
Claim 10 [10.a]: The process of claim 1 further comprising: enabling, by the roof estimation system, a user to input location data corresponding to a location of a building; and	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[10.b] in response to the input, providing, by the roof estimation system, access to aerial imagery of a roof structure of the building corresponding to the location data, wherein	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
the location data is one or more of:	
[10.c] a street address, global positioning coordinates and a lot number of the building.	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
Claim 11: The process of claim 1 further comprising: performing, by the roof estimation system, roof pitch determination of the roof structure based on the at least one location over the roof structure in the displayed aerial imagery to which the user moved the least one first visual marker.	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
Claim 14: The process of claim 1 further comprising:	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
determining, by the roof estimation system, roof measurement information of one or more roof sections of the roof structure based on the at least one location over the roof structure in the displayed aerial imagery to which the user moved the least one first visual marker.	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
Claim 19 [19.a]: A non-transitory computer readable medium having computer executable instructions thereon that, when executed, cause at least	

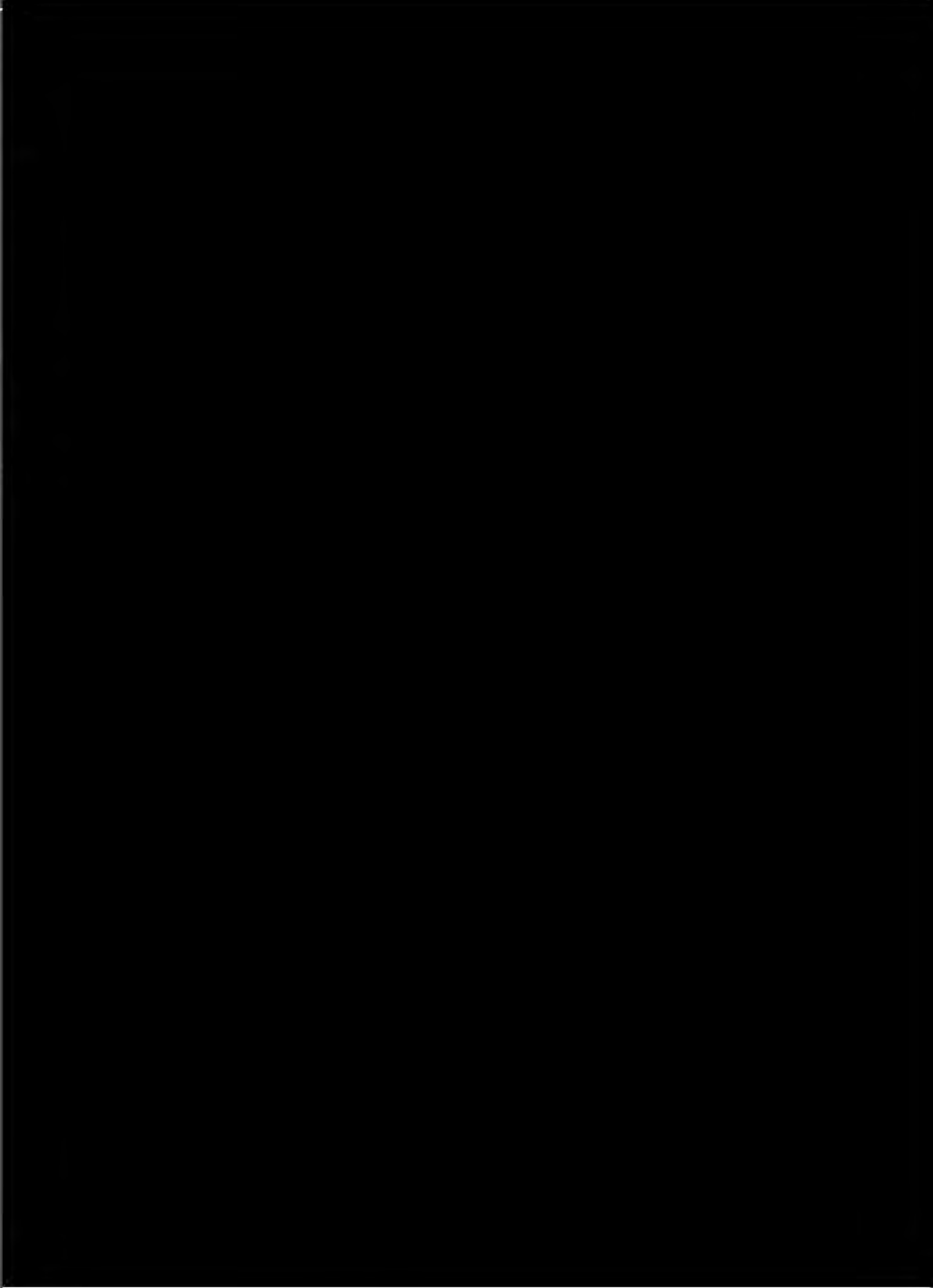
Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
one processor to:	
[19.b] enable a user to input location data corresponding to a location of a building;	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[19.c] in response to input of the location data, provide access to aerial imagery of a roof structure of the building, the aerial imagery including a first aerial image of the roof structure and a second	

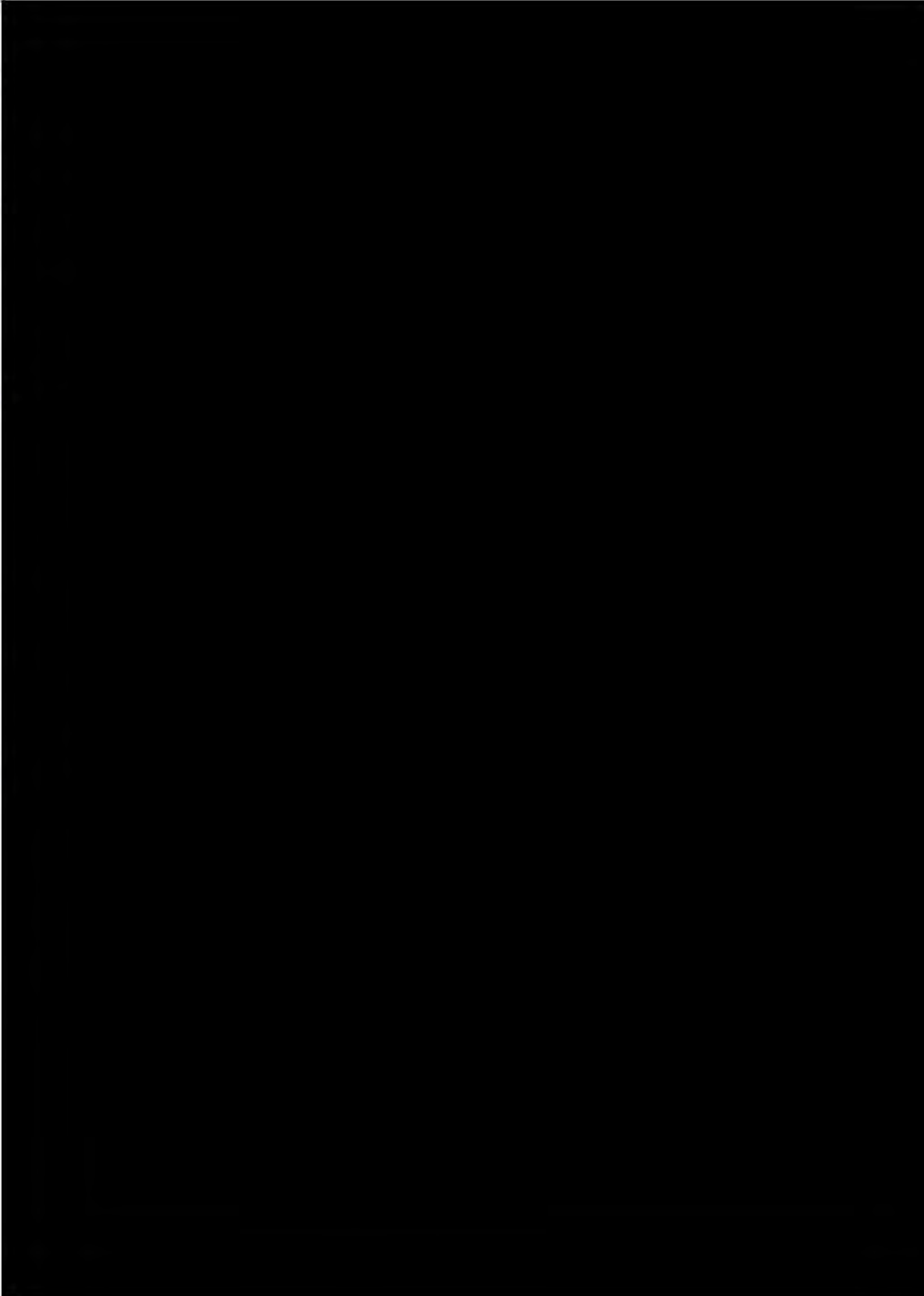
Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
aerial image of the roof structure that provides a different view than the first aerial image, corresponding to the location data;	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[19.d] receive an indication of a selection of at least one location on the roof structure indicated as a result of detection of movement of at least one first visual marker in a graphical user interface to the location on the roof structure in the first aerial image while the first aerial image is displayed within the graphical user interface;	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

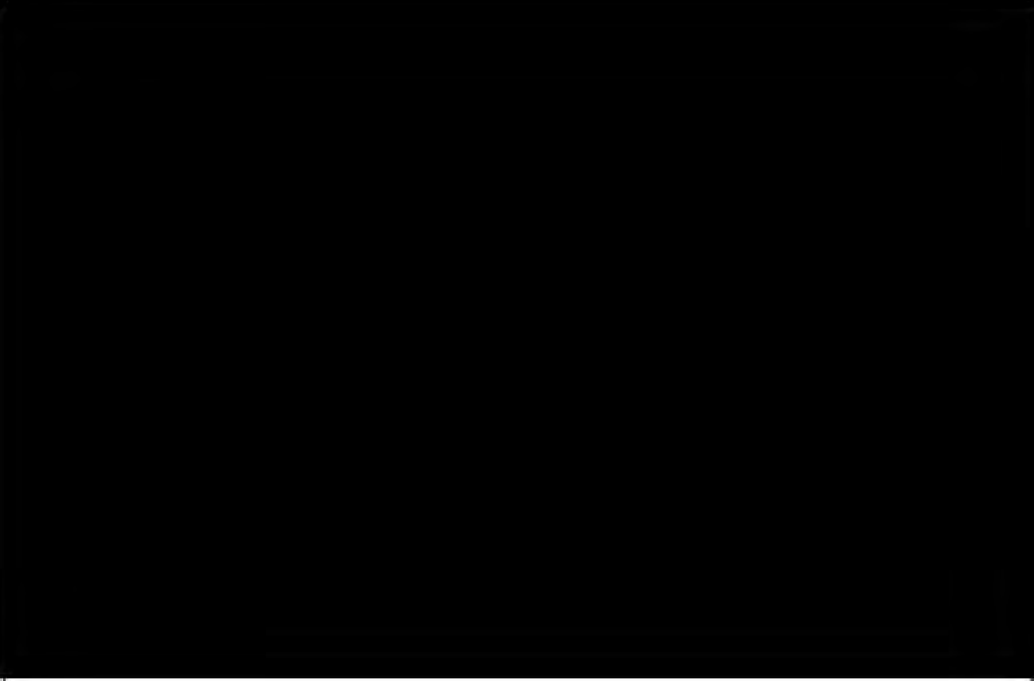
Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[19.e] use the indication of the selection of at the least one location on the roof structure to identify a location of the roof structure of the building in the first aerial image; and	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[19.f] display the location of a second visual marker corresponding to the first visual marker on the roof structure of the building in the second aerial image of the roof structure based on the indication received of the location on the displayed first aerial image to which the user had moved the first visual marker; and	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
[19.g] generate and output a roof estimate report using a report generation engine, wherein the roof estimate report includes one or more top plan views of a model of the roof annotated with numerical values for corresponding slope, area, or lengths of the edges of at least some of the plurality of planar roof sections of the model of the roof.	

Claim Terms in U.S. Patent 8,818,770	<u>Patent Owner's Twister and Render House Products¹</u>
	

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IX. UNDERSTANDING OF PATENT LAW

81. I have been advised by counsel of the following legal standards, which I have applied to my analysis.

82. I understand that prior art to the '770 Patent includes patents and printed publications in the relevant art that predate the priority date of the inventions recited in the '770 patent. I understand that the the earliest claimed priority date for the '770 Patent is Provisional Application No. 61/197,904, filed on Oct. 31, 2008.

83. I understand that a claim is invalid if it is anticipated or obvious. Anticipation of a claim requires that every element of a claim be disclosed expressly or inherently in a single prior art reference, arranged in the prior art reference as arranged in the claim.

84. I further understand that the disclosure in an asserted anticipating reference must provide an enabling disclosure of the desired subject matter; mere naming or description of the subject matter is insufficient if it cannot be produced without undue experimentation. I also understand that a disclosure is enabling if one of ordinary skill in the art could have combined the publication's description of the invention with his (or her) own knowledge to make the claimed invention.

85. Obviousness of a claim requires that the claim be obvious from the perspective of a person having ordinary skill in the relevant art at the time the alleged invention was made. I understand that a claim may be obvious from a combination of two or more prior art references.

86. For my obviousness analysis, I have been instructed to consider the following: (a) the scope and content of the prior art; (b) the differences between the prior art and the subject matter of the claimed invention; (c) the level of ordinary skill in the art at the time of the claimed invention; (d) the real-world factors constituting objective indicia of non-obviousness such as long-felt need, failure of others to solve the problems addressed by each invention, initial skepticism, unexpected results, recognition in the industry, copying, and commercial success.

87. I have been informed that when determining invalidity for obviousness by combining prior art references, it is relevant whether a POSITA

would have been motivated, taught, or suggested to combine the relevant teachings of the prior art and form the claimed invention. I have been informed that a POSITA is presumed to have had knowledge of analogous prior art in the field of invention. I have been informed that the motivation, teaching, or suggestion to combine prior art may come from the prior art itself, the knowledge of a POSITA, or from the nature of the problem to be solved. I also understand that it is not permissible to use hindsight in assessing whether the invention is invalid for obviousness. I understand that one should not look at the invention knowing what persons of ordinary skill in the art know today. Rather, you must place yourself in the shoes of a POSITA in the field of the technology of the patent at the time of the filing of the patent application.

88. I further understand that in an *inter partes* review a petitioner carries the burden of proof of showing unpatentability by a preponderance of the evidence.

I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct, and 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 understand that willful false statements and the like are punishable by fine or imprisonment or both. *See* 18 U.S.C. § 1001.

Dated: November 14, 2016



Dr. Chandrajit L. Bajaj