IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF DELAWARE

HONEYWELL INTERNATIONAL, INC., et al.,	:	
Plaintiffs,	:	
v.	:	C. A. No. 02-359-MPT
UNIVERSAL AVIONICS SYSTEMS CORP., et al.,	:	
Defendants.	:	

MEMORANDUM

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Dated: October 28, 2003

Wilmington, Delaware

Thynge, U.S. Magistrate Judge

I. Introduction

This is a patent infringement case involving technology in the aviation industry. Plaintiffs, Honeywell International Inc. and Honeywell Intellectual Properties Inc. ("Honeywell"),[1] filed suit alleging infringement[2] of five patents (U.S. Patent Nos. 5,839,080 ("the '080 patent"), 6,219,592 ("the '592 patent"), 6,122,570 ("the '570 patent"), 6,138,060 ("the '060 patent"), and 6,092,009 ("the '009 patent")) against defendants, Universal Avionics Systems Corp. ("Universal")[3] and Sandel Avionics ("Sandel").[4]

On July 30, 2003, Sandel moved for summary judgment on non-infringement. D.I. 161. On August 28, 2003, Universal moved for partial summary judgment of non-infringement. D.I. 173. This is the court's opinion on the motions.[5]

II. Background[6]

Each of the five patents in this case concerns terrain warning systems which warn pilots when the danger of having a "controlled flight into terrain" ("CFIT") accident increases. The patents-in-suit can be divided into two main categories: "look ahead patents" ('080, '570 and '592) and the "display patents" ('060 and '009). The primary

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[1]Honeywell International Inc. is a Delaware corporation with its principal place of business in New Jersey and Honeywell Intellectual Properties Inc. is an Arizona corporation with its principal place of business in Arizona.

[2]An order entered January 31, 2003, dismissed two defendants, Goodrich Corporation and Goodrich Avionics Systems, Inc.

[3]Universal is a Delaware corporation.

[4]Sandel is a Delaware corporation.

[5]Defendants have also filed summary judgment motions asserting that the patents-in-suit are invalid as anticipated and obvious based on the prior art, as well as, invalid as a result of the public use and on-sale bars. These motions are addressed in separate opinions.

[6]All facts are taken from the patents, their prosecution histories, and relevant deposition testimony, declarations and other exhibits submitted with the parties' briefing.

patent in this litigation is the '080 patent, which claims "the core forward-looking terrain alerting system." All of the patents-in-suit contain the same specification related to this system. The '570 patent, a continuation-in-part of the '080 patent, claims the ability to visually display the alert to the pilot, in addition to the core system. The '592 patent, also a continuation-in-part of the '080 patent, claims algorithms, which allow the system to detect horizontal, as well as, vertical terrain threats, in addition to the core system.

The display patents teach two methods for displaying the alert information on a visual screen in the cockpit. The '060 patent claims a system which causes certain information, including the severity of an alert, to "pop-up" on the pilot's screen. Similarly, the '009 patent claims a system which displays terrain information, as well as, compares the terrain and aircraft altitude and colors certain parts of the display based on this comparison.

Honeywell, the assignee of these patents, uses the technology of the patents in its Enhanced Ground Proximity Warning System ("EGPWS"). Honeywell asserts that each defendants' Terrain Awareness and Warning System ("TAWS") infringes.

III. Standard of Review

A grant of summary judgment pursuant to Fed. R. Civ. P. 56(c) is appropriate "if the pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if any, show that there is no genuine issue as to any material fact and that the moving party is entitled to a judgment as a matter of law."[7] This standard is applicable to all types of cases, including patent cases.[8] A Rule 56(c) movant bears the

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[7] FED. R. CIV. PRO. 56(c).
[8] *Johnston v. IVAC Corp.*, 885 F.2d 1574, 1576-77 (Fed. Cir. 1989).

burden of establishing the lack of a genuinely disputed material fact by demonstrating "that there is an absence of evidence to support the nonmoving party's case."[9] Therefore, summary judgment is appropriate when there is no genuine issue of material fact or, when drawing all factual inferences in favor of the nonmoving party, no "reasonable jury could return a verdict for the nonmoving party."[10]

The non-movant must be given the benefit of all justifiable inferences and the court must resolve any disputed issue of fact in favor of the non-movant.[11] In cases when the nonmoving party will bear the burden of proof on a dispositive issue, the non-movant must designate "specific facts showing that there is a genuine issue for trial."[12] Material facts are those which "might affect the outcome of the suit under the governing law."[13] Any doubt as to the existence of any issue of material fact requires a denial of the motion.[14]

IV. Positions of the Parties

The parties had the benefit of the court's claim construction opinion when briefing these motions for summary judgment.[15] Despite this benefit, the parties reach a contradictory conclusion whether the asserted claims of the patents read on the accused products.

Defendants assert that their devices cannot infringe, because their TAWS

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[9] *Celotex Corp. v. Catrett*, 477 U.S. 317, 325, 106 S.Ct. 2548, 91 L.Ed.2d 265 (1986).

[10] *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 248, 106 S.Ct. 2505, 2510, 91 L.Ed.2d 202 (1986).

[11] *Eastman Kodak Co. v. Image Technical Servs., Inc.*, 504 U.S. 451, 456, 112 S.Ct. 2072, 119 L.Ed.2d 265 (1992).

[12] *Celotex* Corp., 477 U.S. at 324, 106 S.Ct. at 2553.

[13] *Anderson*, 477 U.S. at 248, 106 S.Ct. at 2505.

[14] *Id.*

[15] The court constructed the disputed claims of the patents-in-suit in its opinion dated May 30, 2003.

systems do not contain one or more of the claim limitations as construed by the court. Sandel argues that its TAWS is missing one or more limitation of each of the claims at issue of the '080, '570 and '592 patents, as its system does not receive a signal representative of[16] flight path angle,[17] and does not define or use look ahead distance[18] as claimed. Sandel also argues its alerting methodology does not contain alert envelopes[19] as construed. Sandel asserts that its terrain alerts are not determined based on first and second functions of[20] look ahead distance,[21] flight path angle and terrain floor boundary[22] as construed.

Sandel argues that its TAWS does not infringe asserted claim 4 of '060 patent or that asserted claims 1-3, 8, 9, 13, 24, 27-36 and 41 of the '009 patent are infringed because the system does not show a numerical display of terrain elevations.[23] Therefore, according to Sandel, its TAWS does not include the 'h_{max}' requirement, or its

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[16]The construction of "signals representative of" is "the signals received by the apparatus are instantaneous values of the recited variables, i.e., they indicate the numerical value of the variable at a given sampling time." This construction applies to the '080, '592, '570 and '009 patents.

[17]The term "flight path angle" is construed to mean "the angle of climb or descent relative to level flight. This construction applies to the asserted claims in the '080, '592 and '570 patents.

[18]The court construed "look ahead distance" to mean "a distance along the ground track of the aircraft that makes the outer limit of each alert envelope and that is a function of aircraft speed and time to complete an evasive maneuver." This construction applies to the '080, '592 and '570 patents.

[19]The term "alert envelope" is construed as a "term of art in avionics and means an at least 2-dimensional region in the vertical plane surrounded by a continuous boundary." This construction applies to the '080, '592 and '570 patents.

[20]The construction of "function of" is "a mathematical or logical relationship." This construction applies to the '080, '592 and '570 patents.

[21]The court construed the claim term "function of . . . said look ahead distance" as "a mathematical or logical relationship to the look ahead distance."

[22]"Terrain floor boundary" is construed to mean "a boundary that extends downwardly below the aircraft which is proportional to the distance to the closest runway." This construction applies to the '080, '592 and '570 patents.

[23]The court construed the term "wherein said contour display includes highest h_{max} and lowest h_{min} terrain levels of said portion of terrain" to mean "the apparatus shows the highest and lowest points of the terrain within the portion of the terrain data displayed. This limitation requires that the display show a numeric value for the highest and lowest points." This applies the '009 patent and is found in independent claims 1 and 34, and the related dependent claims.

structural equivalent, as recited in independent claims 1, 34, and 41 (and claims dependent thereof) of the '009 patent; its system does not include the "warning means" or its structural equivalent of claim 27 (and its dependents) of the '009 patent; and its TAWS does not have the claimed "means for determining a severity of a terrain threat" or its equivalents, as required by claim 4 of the '060 patent.[24]

Universal contends that its TAWS does not infringe the asserted claims of the '080, '009 and '592 patents. Since its system does not include the limitations: "look ahead distance," " terrain floor boundary," "highest h_{max} and lowest h_{min} terrain levels" expressed as numeric values, and/or "flight path angle" as constructed.

Honeywell asserts that the claim construction precludes a grant of summary judgment because the accused Sandel and Universal products literally and/or equivalently infringe the patents-in-suit. To the extent that defendants disagree, Honeywell contends that the non-infringement motions should be denied as genuine

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[24]Initially, the court provided a limited construction of the term "means for determining a severity of a terrain threat, wherein the terrain information on the visual display changes color based on said severity" as a means-plus-function element. No further construction was provided. In its October 16, 2003, memorandum opinion on invalidity, in light of the requirements of 35 U.S.C. § 112,¶ 6 (under means-plus-function, the claim is limited to the structure disclosed in the specification and its equivalents), the court found that the corresponding structure was required to include the look-ahead warning generator, as described in the specification at Column 9:49-59 (which "generates both a terrain advisory signal and a terrain warning signal based upon the position and trajectory of the aircraft related to stored terrain data"); the two aspects of the generated signals (look-ahead distance/direction and terrain threat boundaries) found at Column 9:52-53, and their calculations or algorithms described in Column 9, line 56 through Column 22, line 14; a terrain floor boundary, terrain advisor boundaries and terrain warning boundaries; the structures necessary to translate the determined "severity of terrain threat" into a visual display found at 23:4-42; 24:12-18; 30:1-32:50 and Figures 1(as described at Column 5:51-65) and 1B. Since the court found that the function is for determining the severity of terrain threat, the structure that performs this function must be specifically programmed to perform the disclosed algorithms and calculations. Therefore, the details of the algorithms or calculations contained in the specification are essential to the structure of this means and serve to limit the structure and its equivalents. Thus, the portions of the specification, as outlined herein, disclose the corresponding structure that determines the terrain threat and supplies the information to the display to enable it to make the required color changes to the terrain information. To be an equivalent, the structure then must implement the disclosed algorithms or calculations substantially the same as those disclosed in the specification.

issues of material fact exist.

V. Analysis

Patent infringement requires a two-step analysis. The first step is for the court to make the legal determination of how the claims at issue are to be construed.[25] The second step is a factual determination of comparing the properly construed claims to the accused product to determine whether the accused product contains all the limitations, either literally or by equivalents, in the claimed invention.[26] If the accused devices do not contain at least one limitation required by the asserted claims, the court must conclude that the devices do not infringe as a matter of law and grant defendants' summary judgment motions.[27]

Absent literal infringement upon the express terms of the claim, infringement may be found under the doctrine of equivalents. Essential to the inquiry under the doctrine of equivalents is whether the accused product or process is identical or equivalent to each claimed element of the patented invention.[28] Nevertheless, prosecution history estoppel provides a legal limitation on the application of the doctrine of equivalents by excluding from the range of equivalents subject matter surrendered during prosecution

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[25] *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1365 (Fed. Cir. 2002).

[26] *Id.*

[27] *See Telemac Cellular Corp. v. Topp Telecom, Inc.*, 247 F.3d 1316, 1323 (Fed. Cir. 2001)("[s]ummary judgment of noninfringement is appropriate where the patent owner's proof is deficient in meeting an essential part of the legal standard for infringement, such failure will render all other facts immaterial."); *Southwall Techs., Inc. v. Cardinal IG Co.*, 54 F.3d 1570, 1575 (Fed. Cir. 1995); *see also Warner-Jenkinson Co. Inc., v. Hilton Davis Chem. Co.*, 520 U.S. 17, 39 n.8, 117 S.Ct. 1040, 1053-1054, 137 L.Ed.2d 146 (1997)("[w]here the evidence is such that no reasonable jury could determine two elements to be equivalent, district courts are obliged to grant partial or complete summary judgment.")

[28] *Warner-Jenkinson Co. Inc.*, 520 U.S. at 40, 117 S.Ct. at 1054.

of the application for the patent.[29]

A. Doctrine of Equivalents

Before analyzing the parties' arguments regarding literal infringement, the court must address the dispute regarding whether the doctrine of equivalents is applicable to this case. Sandel and Universal argue that Honeywell should be precluded from relying on equivalents because its expert report, authored by Dr. Hansman, contains no mention of this doctrine. In addition, Sandel contends that Dr. Hansman's "belated doctrine of equivalents testimony" should be stricken since it resulted from improper coaching in violation of court rules.[30]

A review of the portions of Dr. Hansman's deposition provided by the parties clearly shows that prior to his deposition, he did not evaluate Sandel's or Universal's system under the analysis of the doctrine of equivalents. There was no discussion in his report as to whether or not any differences between the accused systems and the claims of the patents were insubstantial. He was neither requested, nor did he analyze whether the accused systems, in relation to the claims of the patents, perform a similar function in substantially the same way to achieve substantially the same result. He

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[29]Prosecution history estoppel ensures that a doctrine of equivalents argument remains linked to its underlying purpose. It arises when an amendment is made to a patent during its prosecution and as a result, the scope of the patent is narrowed. To determine the extent of the claim, prosecution history estoppel requires an examination of the subject matter surrendered. While the patent cannot extend as far as the original claim, the narrowing amendment does not relinquish unforeseen equivalents or those equivalents that do not vary far beyond a fair interpretation of the surrendered material. *See Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.,* 535 U.S. 722, 737-738, 122 S.Ct. 1831, 1840-1841, 152 L.Ed.2d 944 (2002).

[30]Under *Tuerkes-Beckers, Inc. v. New Castle Associates*, 158 F.R.D. 573, 575 (D.Del. 1993), counsel for a witness may not consult with the witness regarding the subject matter of his testimony while the witness remains under examination by an opposing party. Further, in *Deutschman v. Beneficial Corp.,* C.A. No. 860595 at 3, MMS (D.Del. Feb. 20, 1990), Judge Schwartz held that "[i]t is improper for counsel during a recess to 'coach' a deponent off the record regarding deposition testimony already given or anticipated."

agreed that such an analysis could have been done by him prior to the serving of his opening report, and before the rebuttal report of Sandel's expert, Mr. Gibson, "if [he] had been requested to."[31]

According to the scheduling order entered in this matter, the exchange of initial expert reports operated on who had the burden of proof. Therefore, when the initial exchange of those reports occurred, Honeywell had the obligation to provide a "complete statement of all opinions to be expressed" by the expert "and the bases and reasons therefor," as well as, the data or other information considered by the expert in forming his opinions.[32] Since Honeywell's position on the doctrine of equivalents is only supported by Dr. Hansman's deposition testimony on direct examination and is not contained in his expert report, Honeywell is precluded from relying on his deposition testimony to argue infringement by equivalents.

As noted in the case law of this jurisdiction, the testimony of expert witnesses is limited to the information contained in their expert reports.[33] Therefore, since Hansman's testimony on the doctrine of equivalents would not be allowed at trial, it will not be relied upon by the court in deciding defendants' motions for summary judgment on non-infringement. The court's analysis on these motions shall be limited to an

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[31]During his deposition, after being initially questioned by defense counsel on his comparison of the claims of the patents to defendants' products as based solely on direct infringement, he was requested to evaluate the alleged infringing products under the doctrine of equivalents during direct examination by Honeywell's counsel.

[32] FED. R. CIV. P. 26(A)(2)(B).

[33]See *Moore No. Amer., Inc. v. Poser Business Forms, Inc.,* 2001 WL 253117 at *7 (D.Del. Mar. 8, 2001) (where the court eliminated the defense of enablement and granted plaintiff's motion for summary judgment because defendant's expert reports/statements contained nothing on that issue); *Arthrocare Corp.v. Smith & Nephew, Inc.*, 2003 WL 1905636, at *1 (D. Del. April 4, 2003) (where the court excluded certain expert *testimony* of plaintiff because "experts are limited by their reports").

evaluation of literal infringement by the accused systems.[34]

B. The Accused Devices

Sandel asserts that at least five different limitations common to all the asserted claims are missing from its accused device, the ST3400 TAWS, as construed by the court. Universal asserts that its TAWS system does not include "flight path angle," "look ahead distance," "terrain floor boundary" and "highest h_{max} and lowest h_{min} terrain levels" expressed as numeric values as construed by the court. Defendants contend that Honeywell has failed meet its burden to provide evidence sufficient to raise a genuine issue of material fact with regard to each and every one of the claim limitations, and therefore, there can be no infringement.

1. The Look Ahead Patents

The independent claims of the three look ahead patents all share the same claim limitations. Sandel and Universal assert that their respective TAWS does not include one or more of these common limitations.

a. Signals representative of . . . a flight path angle

The claim limitation flight path angle was construed as the "angle of climb or descent relative to level flight." The parties did not dispute the construction of this limitation. Both Sandel and Universal assert that their TAWS does not include this limitation as their system does not receive "signals representative of . . . a flight path angle" of the aircraft.

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[34]In light of this holding, the court need not address Sandel's arguments regarding alleged improper coaching of Dr. Hansman. Moreover, the court need not resolve whether Honeywell should be estopped as a matter of law, from raising the doctrine of equivalents based on the prosecution history of the patents-in-suit.

Sandel contends that its TAWS does not include an input for receiving a signal representative of flight path angle. When construing the claim term "signals representative of," the court reasoned that in order for the warning system to provide an alert to the potential of flying too close to dangerous terrain, an alert system must have stored information about the terrain in the vicinity of the aircraft and be able to access the speed, the angle of the flight path and the position of the plane. Because a pilot cannot read a signal, the signals are transformed into numbers. Sandel asserts that the court construed the limitation, whereby an input is required to *receive a* signal representative of flight path angle.

In his opening expert report, Hansman opines that the "Functional External Interface Diagram" of the Sandel TAWS indicates the existence of an input for receiving signals representative of the position and speed of the aircraft and flight path angle. Hansman opines that "flight path angle is indicated by the variable 'k_range' . . . and 'proj_alt' . . . as the vertical speed divided by the ground speed." Hansman states that this interface diagram contains vertical speed and ground speed inputs, which may be used in combination to calculate flight path angle. The Function External Interface Diagram denotes the receipt of vertical speed and ground speed from the GPS/FMS receiver to the TAWS.

Sandel's software code calculates flight path angle by dividing vertical speed and ground speed. The software uses the k_range variable to represent this calculation. Sandel asserts that the calculation is made internally within the system and is not received through an input and thus does not meet the claim limitation. Sandel, therefore, argues that the variable is immaterial to the issue of whether the TAWS

includes an input for receiving signal representative of flight path angle of the aircraft because the claim requires a recited value be received through an input.

While the k_range variable may be calculated internally, the system receives the values used to calculate vertical speed and/or ground speed from an outside source, namely the GPS/FMS receiver. Whether the TAWS receipt of these values, which are indicia of vertical speed and ground speed, from the GPS/FMS receiver constitutes the receipt of signals representative of flight path angle through an input is an issue beyond the scope of the construed claim limitations. Simply stated, genuine issues of material fact exist as to whether the Sandel system receives these values through an input.

Additionally, Universal argues that its TAWS never calculates or uses flight path angle to determine the boundaries of its alert envelope. Universal concedes that its TAWS does receive signals for vertical speed and ground speed from which flight path angle could be calculated, but contends that its TAWS uses only constant preset values, which do not modulate with the condition of the aircraft and therefore, does not meet this claim. Universal also claims that its TAWS does not receive signals representative of a flight path angle to construct alert envelopes because the forward extent of its envelopes are determined using a fixed time to impact, which is not affected by type of aircraft, ability to bank or bank angle.

Honeywell asserts that Universal's system uses a flight path angle that varies depending on whether the aircraft is in level flight, climbing or descending. Honeywell points to Universal's Software Requirements specification, which illustrate the envelopes for climb, level flight and descent as proof that the envelopes of Universal's TAWS vary as a function of the flight path angle. Honeywell notes that nothing in its

claims requires precluding the use of preset values.

While the Universal TAWS uses constant values for “near miss angle” and “look above angle” to calculate its alert envelope, this fact alone does not warrant a finding of non-infringement. The claim language clearly sets forth that there are two distinct alert zones, with boundaries that are formed as a first and second “function of flight path angle, look ahead distance, and terrain floor boundary.” (“Two distinct alert zones, the boundaries of which are independently determined by distinct first and second functions of the same variables; specifically, flight path angle, look ahead distance and terrain floor boundaries.”) The court did not construe how flight path angle is calculated for the purpose of meeting this limitation. As such, whether Universal’s calculation of flight path angle infringes is a question left to the fact finder and not appropriate for summary judgment.

b. Alert Envelopes

Sandel argues that its TAWS system does not contain alert envelopes, while Honeywell contends that Sandel’s “search volume” satisfies the construed definition of an alert envelope. An “alert envelope” is a “term of art in avionics and means an at least 2-dimensional region in the vertical plane surrounded by a continuous boundary.” In construing this limitation, the court relied on the claim language, which recognizes that an alert envelope is an area around the plane that is a danger zone.

Sandel contends that its system uses alerting criteria, which are applied on a cell-by-cell basis for the area in question, whereby the alerting algorithms comprise a straight-line analysis from the aircraft’s current position to the center of individual tagged terrain cells. In order words, Sandel argues that this analysis is “one-dimensional” and

not a volumetric or area-based analysis, and therefore, the output of the alert is not based on an envelope.

Sandel believes that the only two-dimensional region present in its alerting system is what is referred to as a “search volume.” However, Sandel argues that this search volume lies only in the horizontal plane. Sandel contends that this search volume is used only to identify a subset of the terrain “cells” in memory that are examined further in determining whether an alert condition exists. Once these cells have been “tagged,” Sandel notes that the search volume has no further role in determining the presence of an alert. In other words, Sandel contends that there may be terrain in a cell inside the search volume that is above the projected altitude, that is, a cell that intersects the projected altitude, yet an alert will not be generated. In further processing steps, its TAWS applies additional alerting criteria to the terrain data within the search volume to determine whether or not to generate an alert.

Nevertheless, Sandel’s search volume arguably may constitute an alert envelope because the system defines a vertical clearance below the flight path of the aircraft. Honeywell cites to diagrams set forth in Sandel’s Design Requirements which suggest that the Sandel TAWS may create a two-dimensional region in the vertical plane surrounded by a continuous boundary. The documents provide that Sandel’s Forward Looking Terrain Avoidance (“FLTA”) capability looks ahead along and ahead below the aircraft’s lateral and vertical flight path and provides an appropriate alert if a CFIT threat exists.

According to Sandel, the figure and text as set forth in the design requirements relied upon by Honeywell, are conceptual in nature and do not reflect the system’s

actual implementation. Sandel notes that Honeywell has failed to challenge its explanation of how the TAWS operates, despite reviewing the source codes, which show the accurate implementation of the system. However, the issues related to the figure and text set forth in the design requirement go to the weight of the evidence, as the parties dispute the proper operation of the Sandel system. As a result, disputed issues material to the function of Sandel's system in relation to this claim term (alert envelope) exist.

As disputed factual issues remain whether Sandel's system contains alert envelopes, Sandel's argument that its system does not meet the additional "outputting" limitation of claim 1[35] is similarly rejected. This limitation, "when a subset of the stored terrain information is located within the boundaries," was constructed based on the claim language. The limitation pertains to outputting an alert signal, and this depends upon the stored information within the boundaries of an alert envelope. Since disputed issues of material fact exist to whether Sandel's system contains alert envelopes, the information contained within said boundaries of the alert envelopes cannot be conclusively determined.

c. Look Ahead Distance (LAD)

Both Sandel and Universal assert that their respective systems calculate look ahead distance differently than set forth in the claim. "Look ahead distance" is construed as "a distance along the ground track of the aircraft that marks the outer limit

[35]The court construed the limitation "when a subset of the stored terrain information is located within boundaries" as an alert signal is outputted every time the terrain data intersects with one of the "alert envelopes." This construction applies to the '080, '592 and '570 patents.

of each alert envelope and that is a function of aircraft speed and time to complete an evasive maneuver." When construing the claim limitation, the court noted that Honeywell presented no evidence that showed a common understanding of "look ahead distance" at the time when the patent was filed in 1995. As such, the specification and prosecution history were used to understand the meaning of the term.

Sandel argues that the court's construction includes solely the embodiment as disclosed in the specification, which defines look ahead distance in terms of time to complete a specific, corrective maneuver. As a result, Sandel asserts that there is clearly no disclosure in the specification of a fixed time embodiment of look ahead distance. Honeywell argues that the court's construction did not limit the claim to specific evasive maneuvers or to the calculations in the specification.

Sandel's TAWS calculates the forward extent of its alerting volume based on fixed times, nominally 60 seconds, which is referred to as a "time to impact" scheme. Sandel's TAWS provides a "caution" alert at 60 seconds and a "warning" alert at 30 seconds, using the forward-looking extent of its alerting criteria. In certain conditions, such as when the aircraft nears the airport or is in a steep dive, the system can compress these times to eliminate some nuisance warnings. The system is predicated upon a certain predetermined amount of time before impact with the threatening terrain. According to Gibson, Sandel's expert, the Sandel system provides the pilot time to decide what is the best course of action under the unique circumstances presented. Honeywell contends that this comment by Gibson shows that Sandel's system calculates the look ahead distance consistent with the court's construction because the time provided would allow the pilot to avoid terrain.

However, Dr. Hansman testified that a fixed or predetermined look ahead time may not provide the minimum amount of time necessary to complete an evasive maneuver in certain situations. Further, he also concluded that the specification of the '080 patent calculates look ahead distance as the time to complete two 180 degree turns plus a pilot's reaction time.

Universal asserts that its TAWS does not use look ahead distance as required by the patent claims. Like Sandel's system, rather than calculate look ahead distance based on time to complete an evasive maneuver, Universal's TAWS also uses a fixed "time to impact" which is a function of flight phase. Universal asserts that its TAWS look ahead distance does not depend on an aircraft's ability to bank or its bank angle. Honeywell argues that Universal's System Requirements for the TAWS describes Universal's envelopes as a function of look ahead distance, which is calculated as a function of ground speed and look ahead time. Honeywell asserts that the look ahead times are set to a default of 30 and 60 seconds so that the boundaries of the envelope will give the pilot time to avoid the terrain.

At the time of the claim construction briefing and oral argument, Honeywell relied solely on the proposition that look ahead distance has a plain and ordinary meaning to one skilled in the art and required no construction. The court disagreed, finding that Honeywell presented no evidence showing a common understanding of the term at the time of the filing of the '080 patent application. As a result, there was no common usage in the art for the term in 1995. In such a circumstance, the patentee's definition, as seen through the specification, controls the interpretation of the claim language.

When only one embodiment is provided, and the patentee fails to support a

broad meaning of the disputed language, as in this case, the court may limit the patentee to that embodiment. In construing look ahead distance, the court turned to the specification and the prosecution history, and found that Sandel's construction was consistent with the purpose of the invention. The single embodiment in the specification provides that the look ahead distance for a terrain advisory condition is considered first in determining the look ahead distance, on the assumption that the pilot could make a 30° bank turn at any time at a turning radius R. As a result, the look ahead distance is equal to the product of the speed of the aircraft and the *total* look ahead time. The calculation for the total look ahead time, as well as, equations for the elements within the calculation are described in detail in the specification, along with the calculation for the look ahead distance for the terrain warning. Clearly, the specification references certain equations (including calculations for R, T_1, T_2 and TG or roll) that are used to compute the time to complete an evasive maneuver. See also, Figure 5 and Table 1. In determining the time to complete an evasive maneuver, the invention provides and relies upon *how* to calculate the time to complete an evasive maneuver.[36]

Although Honeywell is not the moving party, it does have the burden of proving infringement. Therefore, it is obligated to produce facts which show that there is a genuine issue for trial.

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[36]Although not part of the exhibits to this motion, in defendants' motion for invalidity based on the public use and on-sale bars, documents, in particular, notes maintained by the inventors (referred to as Muller-Grams) prior to the filing date show that time to impact was initially considered before developing the detailed equations for the time to complete an evasive maneuver. After those computations were developed, they were used rather than time to impact. Any subsequent modifications to or evaluation and testing of the system throughout its development did not rely upon time to impact. In fact, these notes reference the difference between the initial approach and what was eventually used in the Honeywell system and incorporated in the specification. Figure 5 of the patent is basically the same as drawing WX 11D captioned "turn distance calculation" contained in the Muller-Grams.

In calculating look ahead distance, as noted by the specification and testified to by Hansman, Honeywell includes pilot reaction time as a component. Further, the specification does not describe a time to impact application or fixed times in its alerting criteria to calculate look ahead distance as Sandel's and Universal's systems do. Moreover, there is no evidence that either Sandel's or Universal's system uses pilot reaction time or an assumed or specific pilot reaction time in their determination of look ahead distance.[37] Although Sandel uses the term "look ahead distance" in its Design Requirements, that fact, in and of itself, does not rise to a genuine issue of material fact.[38] Similarly, Universal's use of "look-ahead" terminology does not rise to a genuine issue of material fact. Therefore, the court finds that the "look ahead distance" of the accused devices do not infringe claims 1 and 9 (the independent claims) of the '080 patent. As a result, Sandel's and Universal's look ahead distance does not infringe the remaining asserted claims, since they are dependent of claims 1 and 9 and contain the same claim limitation.[39]

d. Terrain Floor Boundary

Both Sandel and Universal assert that their respective TAWS do not calculate a clearance below the aircraft in accordance with the construction of the claim

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[37]Honeywell emphasizes Sandel's Design Requirements as evidence that the TAWS computes look ahead distance consistent with the court's construction. While the parties dispute whether these documents are an accurate representation of Sandel's TAWS as implemented, the Design Requirements describe the search volume as consisting of a computed look ahead distance, which is "a lateral distance on both sides of the aircraft's flight path," and calculated as a function of aircraft speed, with warning and caution times of 30 and 60 seconds, respectively.

[38]As discussed in the claim construction opinion, following the implementation of the Federal Aviation Association's ("FAA") Technical Standard Order ("TSO"), the phrase "look ahead distance" became more commonly used in the industry. This did not occur until after the filing of the application for the '080 patent.

[39]The court acknowledges that its finding regarding look ahead distance may affect the non-infringement analysis of other terms to the extent that they rely upon look ahead distance.

limitation “terrain floor boundary.” Terrain floor boundary was construed as “a boundary that extends downwardly below the aircraft which is proportional to the distance to the closest runway.” When constructing this limitation, the court noted that Honeywell was estopped from asserting its patent against technology which uses some other variable to form the lower boundary of the alert zone.

In responding to Sandel’s motion, Honeywell refers to Sandel’s Design Requirements. Honeywell argues that “Figure 3-4 : Search Volume” set forth in the design requirements show that Sandel’s system calculates a clearance below the aircraft. Honeywell asserts that Sandel’s Design Requirements also confirm that its TAWS includes a distance that is proportional to the distance to the closest runway. This argument is reflected in greater detail in Sandel’s “Equation 2: RRTC Level Flight Terrain/Obstacle Clearances,” where the Terrain/Obstacle Clearance varies in proportion to the R_{eff} (the Effective Range from the airport/runway threshold and the aircraft). Honeywell cites numerous equations showing that the calculation of the effective range as distance to the runway changes. Honeywell argues that the R_{eff} variable varies in proportion to the distance to the runway, and its patent does not exclude this variation in steps. Rather, according to Honeywell, the stepped variation is exactly what is shown in the example of the Honeywell patent, specifically Figure 6.

Sandel does not argue that its system makes this stepped variation calculation. However, Sandel again notes that Honeywell is trying to create an issue of fact by asserting that the Design Requirements somehow discredit the declaration of Leslie Corn (a software engineer and consultant to Sandel) that the clearance buffer is applied to specific terrain cells rather than as a “boundary . . . below the aircraft.” According to

Sandel, this reliance on a conceptual drawing of its TAWS system is improper. Sandel argues that its system stores a “clearance buffer” in each terrain cell. The buffer is subtracted from the projected altitude for each cell and not used to generate a lower boundary for any part of an “envelope.” As previously stated herein, disputed factual issues pertaining to the accuracy of the Sandel’s Design Requirement documents as representative of Sandel’s TAWS, that is, whether the TAWS calculates a clearance below the aircraft, is a question regarding the weight of the evidence that should be left to the finder of fact.

However, the Sandel TAWS does not meet the second part of the limitation which requires that terrain floor boundary be proportional to the distance to the closest runway. Although Honeywell correctly argues that Sandel’s clearance buffer varies as a function of “Effective Range,” it has not shown that the calculation of the clearance buffer is proportionate to the distance to the nearest runway.

Sandel’s buffer is based on Effective Range and not distance to the closest runway. “Equation 1: RRTC Level Flight Look Ahead Ranges” establishes that the effective range calculation factors in both distance (from either a runway or an airport reference point) *and* the altitude of the aircraft above a blended runway elevation. Clearance buffer is a height, which is calculated, in part based on the “Effective Range.” This effective range is based on both the distance of the aircraft from and the altitude of the aircraft above the weighted average distance of the nearest *runways* or airport reference points. As stated by Corn, this is not a simple distance calculation. Moreover, the value of the buffer is not directly proportional to this effective range as the buffer also varies with the vertical speed of the aircraft.

Additionally, since the Universal TAWS does not change the vertical boundary of its predictive envelope based on distance to the closest runway, it does not infringe the terrain floor boundary limitation. Instead of using the technology set forth in the patented invention to calculate the terrain floor boundary, the Universal system uses flight phase to select the appropriate ROC ("Required Obstacle Clearance"), in addition to an alert mode. Universal explains that flight phase is determined as a function of position relative to the destination or departure airport. As shown by its TAWS software logic, once distance from the destination and ground speed is known, the TAWS establishes the vertical boundary of its alert envelope. The changes in ROC in enroute and terminal phases occur independent of distance to the closest runway, but are, instead, dependent on phase of flight and aircraft positional data.

Unlike the patented system, the focal point of the Universal TAWS is the destination runway. The system determines the phase of flight and ROC based on TERPS recommendations. Thus, a greater protection occurs when an aircraft is in the vicinity of a "closest runway," but not landing at that runway. As a result of its TAWS focal point, the Universal system, when an aircraft is in the vicinity of an airport, would disregard the closest runway and change the ROC only when its destination is reached. In explaining the operation of its system, Universal relies on the deposition of Patrick Krohn, its former Director of Advanced Displays, who testified that the TAWS determines flight phase and distance from the destination airport. Universal's system does not just default to the closest runway, when the destination is not determined by FMS. As previously stated, the court's construction defines the boundary as proportional to the distance to the closest runway.

Since the calculation of the clearance buffer uses some other variable to form the lower boundary of the alert zone, the Sandel TAWS does not infringe claims 1 and 9 (the independent claims) of the '080 patent. As a result, Sandel's clearance buffer does not infringe the remaining asserted claims, since they are dependent of claims 1 and 9 and contain the same claim limitation. Additionally, Universal's TAWS does not literally infringe claims 1 and 9 (the independent claims) of the '080 patent as the calculation of its "terrain floor boundary" is not proportional to the distance to the closest runway, but the departure or destination runway. As a result, the Universal TAWS does not infringe the remaining asserted claims as they are dependent on claims 1 and 9 and contain the same claim limitation.[40]

2. Display Patents

Honeywell continues to assert infringement of claim 4 of the '060 patent and claims 27-33 of the '009 patent. The parties agree that these claims include the alerting logic set forth in the specification of the '080 patent. Honeywell and Sandel acknowledge that, pursuant 35 U.S.C. § 112 ¶ 6, claim 4 of the '060 patent includes the structural equivalents to the alerting logic.

a. '060 Patent : Claim 4

Literal infringement of a claim pursuant to a 35 U.S.C. § 112 ¶ 6 limitation requires that the relevant structure in the accused device perform the identical function recited in the claim and be identical or equivalent to the corresponding structure in the

[40]The court acknowledges that its finding regarding terrain floor boundary may affect the non-infringement analysis of other terms to the extent that they rely upon terrain floor boundary.

specification.[41] The parties agree that the "Look-ahead Warning Generator" comprises hardware and software to implement the specific alerting algorithms disclosed in the specification, that is, the look ahead logic of the '080 patent. As noted in the court's recent opinion regarding invalidity of certain asserted claims of the display patents, a complete construction of this claim was not provided prior to briefing on case dispositive motions. The analysis and construction of this means-plus-function claim as set forth in the memorandum opinion of invalidity based on anticipation is incorporated herein, and is described in footnote 24 in this opinion.

The calculation of look-ahead distance/direction described in Column 9, line 56 through Column 11, line 42, while the algorithms of the terrain threat boundaries are described in Column 11, line 42 through Column 22, line 14, and include a terrain floor boundary, terrain advisory boundaries and terrain warning boundaries. It has been previously found that Sandel's device does not infringe the '080 patent, specifically because the established claim limitations for "look ahead distance" and "terrain floor boundary" are not satisfied. Similarly, as claim 4 of the '060 patent incorporates the look ahead distance and terrain floor boundary claim limitations set forth in the '080 patent, there is also no infringement of this claim.

b. '009 Patent

Defendants separate the asserted claims of the '009 patent into three categories: "'h_{max}' claims," "warning display claims" and "relative altitude claims." Claims

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[41] *Odetics, Inc. v. Storage Tech. Corp.*, 185 F.3d 1259, 1268-69 (Fed. Cir. 1999). When construing claim 4 of the '060 patent, the court concluded that the limitation is written in a means-plus-function format, that is the claim recites a function to be performed rather than a definite structure. See also, footnote 24.

1-3, 8-9, 13, 23, 24, 34-36, 39 and 41 are referred to as the "'h_{max}' claims" because the claims require a map display with a plurality of terrain contours "including the highest h_{max} and lowest h_{min} terrain levels of said proportion of the terrain." Claims 27-33 are the "warning display claims" since they teach a visual display in combination with the "warning display" of the type disclosed in the look ahead patents. The "relative altitude claims," claims 43-45, recite the additional limitation of color-coded contours based on elevation of the terrain relative to the proximity of the aircraft.[42]

i. The 'h_{max}' max claims

Defendants asserts that their systems do not display numerical values and in fact, do not store values analogous to h_{max} and h_{min}. These claims, that is, 1-3, 8-9, 13, 23, 24, 34-36, 39 and 41, were found to be invalid as anticipated.

Nevertheless, the accused TAWS products do not infringe these claims. Dr. Hansman opines that contour means of claim 1 of the '009 patent includes the look ahead warning logic. The court has previously concluded that the accused TAWS systems do not meet the look ahead and terrain floor boundary limitations as construed. Since the look ahead warning logic is a limitation of the 'h_{max}' claims, there can be no infringement of these claims.

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[42]The October 16, 2003, memorandum opinion invalidated the the 'h_{max}' claims and relative altitude claims as anticipated by the prior art in the field. However, these claims will also be evaluated regarding non-infringement to complete the analysis. Although Honeywell argued in the invalidity motion, which is repeated in its defense of this motion, that there was no case or controversy and therefore, the court lacks jurisdiction to consider these claims, this argument was rejected by the court in its invalidity opinion. Although case law provides that an infringement analysis is not required since there can be no infringement of an invalid claim, case law also suggests such an instruction is nonsense. *See generally*, *Dow Chemical Co. v. Halliburton Oil Well Cementing Co.*, 324 U.S. 320 (1945); *Smith v. United States*, 145 F. Supp. 396 (Ct.Cl. 1956); *Spectra-Physics, Inc. v. Coherent, Inc.,* 827 F.2d 1524, 1535 (Fed. Cir. 1987).

Moreover, the construed limitation, "wherein said contour display includes highest h_{max} and lowest h_{min} terrain levels of said portion of terrain," requires that the display show a numeric value for the highest and lowest points. Based on this construction, Dr. Hansman agreed that the Sandel system does not infringe this claim because the accused system does not have numeric values of terrain levels.[43]

Similarly, Dr. Hansman did not initially limit his conclusions regarding the Universal TAWS to the construction by the court, but admits that this system does not display a numerical value for the highest and lowest points of terrain, and instead employs a color-coding to display terrain levels. Color-coding is insufficient to literally infringe the claim. As a result, Universal's system does not infringe these claims of the '009 patent.

ii. The warning display claims

These claims incorporate the warning means of the look ahead logic, which includes the look ahead distance, flight path angle and terrain floor boundary limitations as set forth in the '080 patent.[44] Since the court has found that there is no infringement of the claim limitations of look ahead distance and terrain floor boundary, there can be no infringement of these claims.

iii. The relative altitude claims[45]

Both defendants assert non-infringement of these claims. The claims, that is, claims 43-45, were found to be invalid as anticipated. Dr. Hansman opines that the

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[43]Dr. Hansman admitted that his original conclusion that Sandel's system infringed this limitation of the '009 patent was not based on the court's claim construction and was not limited to numerical values.

[44]The parties agree that these claims include the alerting logic set forth in the '080 patent.

[45]Minimal argument by the parties were directed to these claims.

contour means of claims 43 and 44[46] of the '009 patent includes the look ahead warning logic set forth in the '080 patent. Assuming *arguendo* that this is accurate,[47] and since the court has concluded previously that the accused TAWS products do not meet the look ahead and terrain floor boundary limitations as construed, defendants' systems do not infringe these claims.

Regarding claim 45, none of the parties in their briefs directly address this claim in any detail. Universal incorrectly asserted that the h_{max} and h_{min} limitations are part of this claim. A cursory reading of this claim contains no mention of these limitations. The court has previously held that this claim is invalid and therefore, will not further address this claim.

VI. Conclusion

Based on the application of the court's construction of certain disputed claim terms to the accused devices, defendants' systems do not infringe the asserted claims of the '080, '570 and '592 patents and the '009 patents. Additionally, Sandel's system does not infringe claim 4 of the '060 patent. As discussed herein, the Sandel and Universal systems cannot infringe because they do not contain the "look ahead distance" and "terrain floor boundary" limitations identical to that disclosed and claimed in the '080 patent.

For the reasons contained herein, Sandel's motion for summary judgment is GRANTED. Universal's motion for partial summary judgment is GRANTED.

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[46]Dr. Hansman only expressed an opinion in his report regarding Universal's infringement of claim 44.

[47]Sandel disputes that the contour means limitation applies to claim 44 and relies primarily on the argument that this claim is invalid.