

|   |  |   |  |   |   |
|---|--|---|--|---|---|
| A |  | B |  | C | X |
|---|--|---|--|---|---|

File Number: T 1086/92 - 3.5.1

Application No.: 84 307 602.7

Publication No.: 0 145 249

Title of invention: Image distortion correction system for electro-optic sensors

Classification: G06F 15/68

**D E C I S I O N**

of 5 April 1993

Applicant: GEC-Ferranti Defence Systems Ltd.

Headword:

EPC Articles 56, 84

Keyword: "Inventive step (yes)"



Europäisches  
Patentamt

European  
Patent Office

Office européen  
des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Case Number : T 1086/92 - 3.5.1

**D E C I S I O N**  
**of the Technical Board of Appeal 3.5.1**  
**of 5 April 1993**

**Appellant :** GEC-Ferranti Defence Systems Ltd.  
The Grove  
Warren Lane  
Stanmore  
Middlesex HA7 4LY (GB)

**Representative :** Cockayne, Gillian  
The General Electric Company plc  
Patent Department  
GEC Marconi Research Centre  
West Hanningfield Road  
Great Baddow, Chelmsford  
Essex CM2 8HN (GB)

**Decision under appeal :** Decision of the Examining Division of the  
European Patent Office dated 1 July 1992 refusing  
European patent application No. 84 307 602.7  
pursuant to Article 97(1) EPC.

**Composition of the Board :**

**Chairman :** P.K.J. van den Berg  
**Members :** R. Randes  
G. Davies

### Summary of Facts and Submissions

I. Appellant's European patent application No. 84 307 602.7, filed on 2 November 1984, claiming priority from a previous application in the U.K. dated 4 November 1983, was refused by a decision of the Examining Division dated 1 July 1992.

II. The grounds for the decision were said to be:

"In the communication dated 09-04-91 the applicant was informed that the subject-matters of Claims Nos. 1-6, received on 16-01-91, are not patentable. He was also informed of the reasons. Without commenting thereon, the applicant, by letter received in due time on 27-02-92, merely stated that applicant denies examiner's allegations concerning a lack of inventive step in Claim 1. Applicant's statement is equivalent to a request for a decision according to the state of the files. The application must therefore be refused."

III. In the said communication, reference was made to

D1: IMAGE PROCESSING TECHNIQUES, AGARD LECTURE SERIES, No. 119, June 1982, Athens/Paris/The Hague,

D1(1): pages 4-1 to 4-25; T.R. Berry: "IMAGE GENERATION AND DISPLAY" and

D1(2): pages 6-1 to 6-12, Klaus A. Ulbricht:  
"DFLR's DIBIAS, DESIGN AND IMPLEMENTATION OF A  
DIGITAL INTERACTIVE IMAGE PROCESSING SYSTEM"

D2: AFIPS CONFERENCE PROCEEDINGS, 1979 NATIONAL COMPUTER CONFERENCE, New York, 4th-7th June 1979, vol. 48, pages 147-156, AFIPS Press, New Jersey, US; S.K. Chang et al.: "A generalized zooming technique for pictorial database systems"

In the said communication, dated 09-04-91, it was stated that neither the subject-matter of Claim 1 nor of the dependent Claims 2 to 5 involved an inventive step. Having regard to Claim 6, it was said that this claim did not meet the requirements of Article 84 EPC. Moreover, it was stated that, even if the functional terms of Claim 6 were to be clarified by means of technical features, as apparent from the description, they nevertheless would not add any inventive subject-matter to Claim 1.

- IV. A notice of appeal was filed against this decision on 24 August 1992 and the appeal fee was paid on the same date. A Statement of Grounds of Appeal was submitted on 9 November 1992.
  
- V. With the Statement of Grounds of Appeal the Appellant filed an additional independent Claim 7.
  
- VI. In the Statement of Grounds of Appeal the Appellant argued that D1 disclosed the conventional uses of line by line sensors and also the conventional use of framing sensors, however, nowhere was there an indication that a framing sensor could be used in the way proposed by the invention. He stated that linescanning systems had usually been used for large-area surveillance, but they had suffered from many inherent distortion problems and had not had an appropriate resolution for small targets.

He referred to Figure 8 of D1(1), which was said to show the principle of the known "bow-tie" effect at line by line scanning, in which, if lines were to be contiguous with one another in a region underneath the aircraft, they would tend to overlap due to broadening of the viewing window as it was moved to either side of the vertical condition. Because of this, objects further away from the aircraft tended to be heavily distorted or elongated in the along track direction. In D1(1) an expression had been derived

which could be used to correct approximately the size of a rather large object. Small objects were not discussed.

Appellant also referred to Figure 11 of D1, which disclosed as an alternative that it was possible to sample an IR video in angle intervals which related to increments in ground distance rather than increments of scale angle. By such selective sampling, however, data were in effect discarded.

When a frame sensor of TV type had been used in the past for large area surveillance, according to the Appellant it had been necessary to use a camera having a wide field of view. When at the same time a high resolution of small targets had been desirable, it had been necessary to use two cameras, i.e. an additional camera having a narrow field of view.

Appellant's invention was said to make it possible to store a maximum of information within a frame store, which information could be accessed and displayed either as a part of a large-area surveillance or it could be displayed to a larger scale to aid target verification.

According to the Appellant, also a combination of the teachings of the documents D1 and D2 would not lead the skilled man to the invention according to his application.

VII. The Appellant thus requested that the decision of the Examining Division be set aside and a patent granted on the basis of ~~Claims 1 to 6~~ filed on 10 January 1991 and Claim 7 filed with the grounds of appeal.

Claims 1 to 7 read as follows:

1. An image correction system for providing a view of a scene scanned by an electro-optic framing sensor, characterised by

- a) control means operable to cause the sensor to scan the scene in a number of separate frames each of which is viewed at a different viewing angle relative to a set of datum axes,
- b) pickoff means associated with the sensor to produce signals representing the viewing angle of each frame,
- c) storage means operable to store the image information derived from each of said frames,
- d) circuit means operable to transform the image information contained in each storage means so as to remove distortions caused by the different viewing angles,
- e) and a picture store operable to store the transformed image information from each frame of the scan such that the contents of the picture store represent a view of the scene from a predetermined viewing angle.

2. A system as claimed in Claim 1 characterised by sensor drive means operable to control the attitude of the sensor under the control of the control means.

3. A system as claimed in Claim 2 characterised in that the control means receives signals from a pickoff means and applies these to the circuit means.

4. A system as claimed in Claim 3 characterised in that the sensor is mounted in a platform movable relative to the viewed scene about a reference axis system of the platform, the control means also receiving signals indicative of the altitude and velocity of the platform relative to the scene being viewed and the signals from the pickoff means indicating the attitude of the sensor relative to the platform.

5. A system as claimed in and one of Claims 1 to 4 characterised in that the storage means includes a separate store for storing the image information for each of a predetermined number of frames.

6. A system as claimed in any one of the preceding claims characterised in that the circuit means is operable to select for each frame those scan lines containing image information required to be applied to the picture store and to select, for each such scan line, the image information to be applied to the picture store.

7. An image correction system for providing a view of a scene scanned by an electro-optic framing sensor, characterised by control means operable to cause the sensor to scan the scene in a number of separate frames each of which is viewed at a different viewing angle relative to a set of datum axes, each frame comprising lines and pixels, pickoff means associated with the sensor to produce signals representing the viewing angle of each frame, storage means operable to store the image information derived from each of said frames, circuit means operable to select lines and pixels from each frame storage means so as to remove distortions caused by the different viewing angles, and a picture store operable to store the transformed image information from each frame of the scan such that the contents of the picture store represent a plan view of the scene from the perspective view provided by the sensor.

The characterising features of Claim 1 have been identified by the Board by the letters a to e.

### Reasons for the Decision

1. The appeal is admissible.
  
2. In the examination proceedings, Claim 2 was corrected in that the expression "to control the altitude of the sensor and the control of the control means" in Claim 2 was changed into "to control the attitude of the sensor under the control of the control means" and Claim 4 was corrected in that the word "altitude" (penultimate line) was changed into "attitude". These amendments clearly meet the requirements of Rule 88 EPC (cf. page 3, lines 16 to 24, in the original description).

Independent Claim 7 relates to an alternative embodiment of the invention according to Claim 1. The subject-matter of this claim clearly meets the requirements of Article 123(2) EPC, as it in fact relates to the embodiment described in the description (from page 3, line 25 in the original description to page 6, line 24).

3. None of the prior art documents referred to in the proceedings discloses all the features of the independent claims. Novelty of the subject-matter can accordingly be acknowledged.
  
4. It remains to be considered whether Claims 1 and 7 satisfy the requirements of Article 56 EPC in respect of inventive step.

The Board ~~agrees with the characterization of D1(1) made by the Appellant~~ in that this document is concerned with a general survey of different image generation and display methods. In this survey, a clear distinction was made between the "line by line sensors" and the "framing sensors". The part of this article discussing framing sensors, of the type which internally scan a photosensitive image of the object scene, describes the different cameras



of TV type and does not mention how the sensors are actually operated during action. Moreover, a direct sensing frame sensor (forward looking infrared device - FLIR) is described. This type of sensor normally has a group of detectors so as to form a multi-element column array which scan a frame horizontally. However, it is said that because of the cost the vertical dimension of the frame can be broken down into some (4 to 10) stacked "swaths" which are scanned in turn. In this part of the article (2.2.1.2.), no explanation is given as to how this "scanning in turn" is performed, nor as to whether the method suffers from distortions, nor as to how such distortions - if they existed - could be removed.

D2 relates to a generalized zooming technique for pictorial database systems and discloses how image data stored in a database can be treated and manipulated in order to visualize different kinds of maps on a display screen. The Examining Division has pointed out in the said communication that D2 (page 156, first column) discloses the case of combining frame buffers to render a viewing window. This document, however, does not at all disclose how the data have been collected, selected and transferred into the frame buffers of the database.

In the examination proceedings, reference has also been made to the following citation taken from D1(2):

"For effective working, it is necessary to store images and intermediate images in the memory, so as to combine them if necessary, ~~e.g. different spectral regions of the same scene, neighbouring parts of LANDSAT scenes etc.~~"

According to the Examining Division, it was thus known from this document to combine neighbouring parts of satellite digital images and therefore obvious to combine a plurality of frames depicting regions to obtain coverage of a wide area.

5. In the light of this closest state of the art, the technical problem underlying the present patent application may be seen in creating a system which enables a framing sensor having a relatively narrow field of view to be employed also for large area surveillance. Thus, although an image of a large area is created, the sensor used has a high resolution and enables a large amount of detailed information to be gathered.
  
6. Having regard to the prior art documents cited in these proceedings, it appears to the Board that the first feature (a), in fact, reveals the principal idea of the present invention, i.e. to produce an image of a number of areas in succession with a framing sensor having a narrow field of view, whereby the viewing angles from the sensor to the different areas differ from each other. Such a sensor could be mounted e.g. in an aircraft and moved in a direction perpendicular to the direction of flight. This idea, although simple, has not been shown to have been known before the priority date of this application.

Also, the following features of Claim 1 are disclosed neither individually nor in combination by the cited documents. These features, however, together define a system that solves the technical problem referred to in paragraph 5, above.

Thus, feature (b) provides that the corresponding angle of each frame is registered, so that the circuit means (feature (d)) accordingly can remove distortions caused by the different viewing angles from the different storage means of each frame (feature (c)), when the said different frames are combined in the picture store (feature (e)) in order to represent a view of a scene from a predetermined viewing angle.

The Board thus notes that nowhere is there an indication that frames having different viewing angles could be

combined to produce an image that represents an overall image of the surveyed area seen from a predetermined viewing angle. As indicated above, documents D2 and D1(2) disclose that parts of an overall image can be stored in different frame stores. However, there is no indication anywhere that they originate from a frame sensor which has scanned the scene from different viewing angles. The reference to LANDSAT in D1(2) rather suggests that already the data collected during sensing correspond to a plan view, as the sensor apparently works at a great altitude.

Also nowhere is it indicated that such storage of data could be performed in two steps as proposed by the invention, i.e. the maximum information is stored within a frame store, whereafter this information is transformed into an information corresponding to the pre-determined angle and as such transferred to the picture store. The Appellant has pointed out that the fact that the maximum information is stored within a frame store, in addition to the advantages mentioned in the application, gives the possibility to access and display it on a larger scale to aid target verification. Thus the system can perform a dual role of general large area surveillance and high-resolution high-definition target recognition.

It is true that section 2.1 of D1(1), treating line by line sensors, discusses the problems caused by distortion and how they might be removed. However, as has been pointed out by the Appellant (cf. under VI above), there is no suggestion of the need to correct for perspective effects in the sense described in the invention. Neither is there a suggestion that the information gathered could be stored and treated in two steps as according to Claim 1.

The Board, therefore, comes to the conclusion that the subject-matter of Claim 1 cannot be derived in an obvious manner from the state of the art.

7. As indicated above, Claim 7 defines an alternative embodiment to the one defined in Claim 1 in that the information gathered and stored in the said storage means is transformed and transferred to the picture store in such a way that the contents of the picture store represent a plan view of the scene. This claim, moreover, is restricted in relation to Claim 1 in that it is stated therein that the frames from the framing sensor contain lines and pixels and that the circuit means is operable to select lines and pixels from the frame stores so as to correct for distortions.

Having regard to the fact that, in this case, the representation of a plan view of the scene can be considered as an independent alternative to the representation of the scene from a predetermined angle (as in Claim 1), and that Claim 7 with regard to its technical features is more restricted than Claim 1, it is apparent that also the subject-matter of Claim 7 cannot be obvious having regard to the prior art.

8. Dependent Claims 2 to 6 appended to Claim 1, which only relate to preferred embodiments claimed in Claim 1, are also acceptable.

With regard to the clarity of Claim 6, which was objected to by the Examining Division, the Board is of the opinion that Claim 6 as it stands is sufficiently clear. This claim is dependent on Claim 1, which claim the Board considers patentable. Therefore, it appears to the Board that the ~~additional features of Claim 6 in fact specify the system~~ as defined in Claim 1. It is true that these features can be seen as functional features, moreover the wording of the claim does not explain in detail how the corresponding functions can be carried out. However, they nevertheless specify how the removal of distortion (a matter only generally mentioned in Claim 1) can be performed and it appears that the skilled man would not have any difficulty

in realizing that performance having regard to the description of the application.

The Board is, like the Appellant, of the opinion that the primary function of a claim is to set out the scope of protection (Article 84 EPC, first sentence). However, it must be supported by the description, be formally clear and contain all essential features (Article 84 EPC, second sentence). The necessary restriction of a claim is always dependent on the closest prior art. When there are no references or only weak ones cited in a case, it is obvious that an independent claim, as in the present case, can be very generally formulated, i.e. the essential features can be of a general form. It is then up to the Applicant to add dependent claims to the independent claim and to decide on the extent to which he wants to claim protection for details disclosed in the description. Of course, also these dependent claims must meet the requirements of Article 84. However, as has been made clear in the first part of this paragraph, the Board considers that the present Claim 6 does meet these requirements.

9. The Board notes that the claims do not contain reference signs placed between parentheses relating to features indicated in the figures as is recommended by Rule 29(7) EPC. It appears that in this case the intelligibility of the claims clearly would be improved by such reference signs and that they therefore should be added.

In the first line of Claim 5 the word "and" has to be replaced by "any".

The prior art according to the documents cited in this decision has still to be acknowledged in the introductory part of the description before a patent can be granted. This concerns the documents D1(1), D1(2) and D2.

**Order**

**For these reasons, it is decided that:**

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a patent on the basis of Claims 1 to 7 as indicated in paragraph VII above and to adapt the description accordingly and to remedy the deficiencies mentioned in paragraph 9 above.

**The Registrar:**

**The Chairman:**

**M. Kiehl**

**P.K.J. van den Berg**