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Datasheet for the decision of 17 January 2013

Case Number: T 0088/09 - 3.5.04

Application Number: 00311643.1

Publication Number: 1120745

IPC: G06T5/20

Language of the proceedings: EN

Title of invention:
Extended dynamic range system for digital X-ray imaging detectors

Applicant:
GENERAL ELECTRIC COMPANY

Headword:

Relevant legal provisions:
EPC 1973 Art. 56

Keyword:
Inventive step - (no)

Decisions cited:

Catchword:

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Case Number: T 0088/09 - 3.5.04

D E C I S I O N
of the Technical Board of Appeal 3.5.04
of 17 January 2013

Appellant: (Applicant)	GENERAL ELECTRIC COMPANY 1 River Road Schenectady, NY 12345 (US)
Representative:	Pedder, James Cuthbert London Patent Operation, General Electric International, Inc., 15 John Adam Street London WC2N 6LU (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted 3 June 2008 refusing European patent application No. 00311643.1 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: M. Paci
Members: R. Gerdes
C. Vallet

Summary of Facts and Submissions

I. The appeal is against the decision of the examining division to refuse European patent application No. 00 311 643.1, published as EP 1 120 745 A2.

II. The patent application was refused under Article 97(2) EPC because the subject-matter of claims 1 and 3 was found to lack an inventive step in view of the prior-art document

D1: US 5471987 A.

III. With the statement setting out the grounds of appeal, the appellant submitted a new set of claims to replace the claims underlying the decision under appeal. The appellant also requested oral proceedings in the event that the board was minded to issue an adverse decision in the case.

IV. In the communication annexed to the summons to oral proceedings, the board expressed its provisional opinion that *inter alia* the amended claims did not involve an inventive step (Article 56 EPC 1973).

V. With a letter dated 21 August 2012 the appellant withdrew the request for oral proceedings and requested a decision according to the state of the file.

VI. Claim 1 reads as follows:

"A method for processing digital image data in a discrete pixel imaging system, the method comprising the steps of:
accessing a set of input data having a first dynamic range including a plurality of input data values for a

corresponding plurality of pixel locations (54) in an image matrix (60);
smoothing the input data values with adjacent input data values of the image matrix (50);
generating an unsharp masking value for each pixel by multiplying the smoothed data value for each pixel by an unsharp masking parameter (96, 98, 100) and determining a difference between the resulting value for each pixel and a corresponding pixel value from the image data set; and
generating an output value for each pixel based upon the unsharp masking values and a set of brightness control parameters (118, 120) and conforming to a second dynamic range, in accordance with the relationship:
*Out = GAMMALUT(In - BOOSTLUT(Smooth) * Smooth*)
where *In* is the value of an input pixel,
Out is the output value for the same pixel,
Smooth is a set of image values smoothed via a boxcar smoothing technique,
BOOSTLUT is a lookup table which controls the amount of unsharp masking as a function of signal level, wherein the function (96, 98, 100) is such that the unsharp masking value is zero below a threshold pixel value and increases monotonically above the threshold, and
GAMMALUT is a lookup table which rolls off the bright portions of the image, in which the values of *GAMMALUT* define a linear function (118, 120) defined by the relationship:

$$y = \begin{cases} mx & x < b/m \\ b(1-\gamma^{\gamma/(1-\gamma)} + (\frac{mx}{b} - 1 + \gamma^{1/(1-\gamma)})^{\gamma}) & b/m < x < 255 \end{cases}$$

where *y* is the value of *GAMMALUT*, *x* is the input pixel value, *m* and *b* are empirical parameters such that the function is linear with a slope *m* below a threshold of

b/m and rolls off smoothly to a maximum value at a value of *x* which depends on *γ* and
wherein the input data values have a first dynamic range and the output values have a second dynamic range smaller than the first dynamic range, and wherein the unsharp masking parameter and the brightness control parameter map the first dynamic range onto the second dynamic range."

VII. The appellant essentially argued in the statement of grounds that D1 disclosed pure frequency processing (unsharp masking). The gradation conversion of D1 served solely to compensate for the non-linearity of the display device and was not part of the dynamic range compression. Contrary to D1, the present invention considered both grey level processing and spatial frequency processing as a means of reducing dynamic range, which provided good contrast to darker regions of the resulting image, while avoiding saturation of brighter regions.

Reasons for the Decision

1. The appeal is admissible.

2. It is common ground that D1 can be considered as the closest prior art for the present application.

2.1 D1 relates to a method of compressing the dynamic range of digital radiation images, which may be obtained by illuminating a fluorescent layer by X-rays. The radiation images are acquired in a discrete pixel imaging system composed of a scanning device and a photomultiplier, the output signal of which is converted to a voltage signal and digitised by an A/D

converter (see figure 1 and column 9, line 53 to column 10, line 33). To adapt the dynamic range of the original radiation images (Sorg) to a dynamic range of a display, the original image intensity values are averaged in a predetermined mask around each pixel to obtain a smoothed image (Sus). D1 discloses that averaging may be effected by calculating a "simple mean value" in a rectangular area, i.e. by using a boxcar smoothing technique. Dynamic range compression is carried out by transforming the discrete pixel values Sorg to compressed pixel values Sproc (see column 10, line 65 to column 11, line 42 and column 32, lines 1 to 35). The processed signal values are subsequently converted by means of a lookup table so as to be displayed on the screen (see figure 8a and column 14, lines 28 to 46 as well as column 15, lines 6 to 30).

2.2 According to D1 the processed image signal Sproc is generated according to the following equation (see column 32, lines 1 to 12):

$$Sproc = Sorg + f1(Sus)$$

with

$$f1(Sus) = \begin{cases} \beta(Sus1 - Sus)) & for\ (Sus \geq Sus1) \\ 0 & for\ (Sus < Sus1) \end{cases}$$

which is equivalent to

$$Sproc = \begin{cases} Sorg & for\ (Sus < Sus1) \\ Sorg - \left(\beta - \beta \cdot \frac{Sus1}{Sus}\right) \cdot Sus & for\ (Sus \geq Sus1) \end{cases}$$

and hence

$$Sproc = \begin{cases} Sorg & for\ (Sus < Sus1) \\ Sorg - f(Sus) \cdot Sus & for\ (Sus \geq Sus1) \end{cases}$$

with f(Sus) being equivalent to BOOSTLUT(Smooth) for Sus ≥ Sus1. The above representation of Sproc having two separate segments can be replaced by a single function fboost which consists of two segments

$$Sproc = Sorg - fboost(Sus) \cdot Sus$$

with fboost being a function which controls the amount of unsharp masking as a function of signal level, wherein the function is zero below the threshold pixel value Sus1 and increases monotonically above the threshold.

Hence, D1 discloses unsharp masking values generated in accordance with the relationship

$$In' = In - BOOSTLUT(Smooth) \cdot Smooth$$

with fboost(Sus) pertaining to a specific choice of the BOOSTLUT-function.

2.3 As a consequence, D1 discloses all features of claim 1 except for the generation of the unsharp masking value using a lookup table and the specific choice of the gamma correction function.

2.4 The usage of a lookup table for computations results in a reduction of the computational load. Due to the fact that neither the empirical parameters b and m nor the value of γ are specified in claim 1, GAMMALUT encompasses a huge variety of gamma correction functions each having different characteristics and, potentially, having different effects. Hence, with respect to the second distinguishing feature the board sees no advantageous technical effects which may be due

to the specific choice of the gamma-correction function and which may be achieved over the whole range of allowable parameters. The board also notes that such effects are neither derivable from the application as filed nor did the appellant provide arguments in this respect.

2.5 Hence, the technical problem can be formulated as how to improve the method of D1 such that computational load is reduced and to choose a specific gamma-correction function.

2.6 Using a lookup table to reduce computational load was well known to the skilled person at the effective date of the application. Moreover, D1 explicitly refers to a "gradation conversion table LUT" which is "established in advance" (see column 14, lines 6 and 7). Hence, depending on the circumstances such as available computing power and available memory the skilled person would have implemented the computation of the unsharp masking value using a lookup table.

With respect to the specific choice of a gamma correction function, the examining division stated that "such curves are well known to the person skilled in the art" and that the function "can only be considered to be an arbitrary implementation choice, in particular as it is not apparent which technical problem is being solved thereby in a non-obvious manner" (see decision under appeal, point 3.4 re ii). The board sees no reason to disagree with this conclusion.

2.7 The appellant argued that the claimed subject-matter was additionally distinguished from D1 by the fact that "both the grey level and the frequency processing

contribute to the dynamic range compression", which was clarified by the last feature of claim 1.

The board is not convinced by this argument. From the amended wording it can only be inferred that dynamic compression is effected by both steps when taken together. In other words, the option that the input data to the GAMMALUT-relationship are already confined to the second dynamic range is not excluded by the amended wording. Actually, the fact that the GAMMALUT input range is only defined for x < 255 according to claim 1 (see claim 1, page 15, last line), i.e. that the input to the GAMMALUT only has 8 bits of dynamic range, indicates that - also according to claim 1 - dynamic compression is only effected by unsharp masking.

2.8 It follows from the above that the set of claims submitted as the appellant's only request cannot be allowed because the subject-matter of claim 1 lacks an inventive step (Article 56 EPC 1973).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

K. Boelicke M. Paci

Decision electronically authenticated