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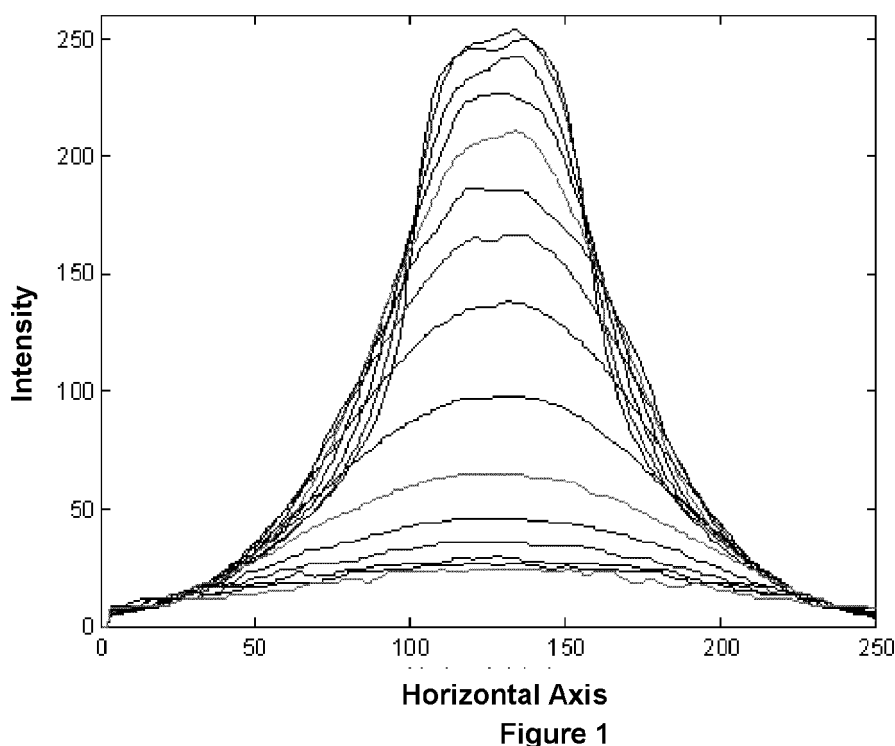
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(54) **Backlight compensation table approximation for displays**

(57) Present invention comprises an approximation method for backlight compensation tables and method and system for backlight compensation of displays. The invention further comprises method and system for local dimming in displays utilizing the approximation of the present invention. Within the methods and systems of

the present invention, it is possible to determine uniform backlight over an entire display by generating an approximate compensation table. The invention enables to further control backlight sources of both edge-lit and direct-lit displays for image enhancement operations such as local dimming for backlight sources.



Description**Technical Field**

5 **[0001]** The present invention is related to a backlight compensation table approximation method and system for displays.

Prior Art

10 **[0002]** LCDs (Liquid Crystal Displays) employ a plurality of backlights to illuminate display. Backlights may be positioned both under the thin film layer of the display, which is called as direct-lit displays, or along the edges of the display, which is called as edge-lit displays.

[0003] The direct-lit displays employ uniformly distributed light elements along the display. Hence, the display is uniformly illuminated by the backlight.

15 **[0004]** However, the edge-lit displays employ a limited number of backlights, which are positioned along the edges of the display. Since the light intensity has maximum value at a zero distance to the source and decreases as the distance increases, the display cannot be illuminated uniformly.

[0005] To obtain a uniform illumination, several light reflective or light transmitting elements are used within the display. However, those elements are not adequate to obtain uniformity, either. Therefore a further compensation for non-uniformity compensation is required.

20 **[0006]** Wide investigations on compensation methods led to the conclusion that, it is possible to compensate light distribution non-uniformity by adjusting thin film layer to altering light transmission. However, in practice, a compensation data requires complex calculations and furthermore large memory space to store compensation data.

25 **[0007]** For instance, a full HD (High Definition) (1920 pixels by 1080 pixels) display, having 16 bits colour resolution requires a compensation table of $1920 \times 1080 \times 16 = 33177600$ bits which is approximately 4 megabytes, for a single light source. Due to this large memory requirement, compensation is not considered as a practical solution and a fully uniform back-light cannot be realized.

30 **[0008]** Another drawback with the edge-lit displays are that since the backlight cannot be used for illumination of a definite region of the display, it is not possible to use local dimming methods as in the direct-lit displays. Instead, a combined illumination of backlights should be considered and to obtain uniformity, again complex operations and large memory space is required.

[0009] For the stated drawbacks of the edge-lit displays, the market is focused on direct-lit displays, which serves for quality picture but the production cost is relatively much higher than edge-lit displays.

35 **[0010]** Several solutions are proposed regarding the stated problems. One of these solutions is described in WO 2010/096269 A1 patent document in which a compensation panel is employed within the display and an image acquiring device is positioned in front of the display to detect backlight non-uniformities. The compensation panel is adjusted by a system controller based on the acquired non-uniformities. The proposed solution may compensate for non-uniformities. However utilization of a compensation panel and image acquiring device brings in both implementation difficulty and significant cost increase.

40 **[0011]** WO 2007/027539 A1 patent document discloses another solution for backlight compensation in which a concave transreflective panel to distribute emitted light uniformly is utilized. This method is well known and widely used in edge-lit displays. However the fact that the invention can be used with only one backlight source limits the scope of the solution. Furthermore it is known that trans-reflective panels do not provide a complete solution for uniformity since a perfectly light distribution surface cannot be obtained.

45 **[0012]** US 7717602 B2 patent document discloses another solution for backlight non-uniformity compensation. Stated solution comprises utilizing extra backlight elements in the display and controlling these backlight elements to compensate backlight non-uniformities. However, since all backlight sources known in the prior art provide a point spread light beam, extra backlight sources add new non-uniformities and it is not possible to fully compensate non-uniformities using the solution of this patent document.

50 **[0013]** Obviously, a method for eliminating implementation difficulties of edge-lit displays and determining high display quality is required.

Brief Description of the Invention

55 **[0014]** Present invention comprises a backlight compensation table approximation method by utilizing singular value decomposition of a matrix and approximation of matrix via determining a rank number and reducing matrix sizes using this rank number.

[0015] Since the distribution of light along a vertical and horizontal axis is highly correlated, a successful approximation

can be done for a compensation table and a bulky compensation table is compressed up to a ratio of 99%.

[0016] The invention also discloses utilization of this approximation in displays to obtain backlight uniformity along the whole display. The approximation value is utilized to adjust transmission values of display pixels and compensate backlight deviation all over the display.

[0017] Furthermore, within the teaching of the present invention, method and system are proposed for local dimming for both edge-lit and direct-lit displays wherein backlight uniformity is maintained while effective and smooth local dimming is achieved.

[0018] The scope of protection of the present invention therefore comprises;

[0019] A backlight compensation table approximation method for a display which comprises at least one backlight source and pixels of m rows and n columns and wherein a compensation table of said backlight source with respect to m rows and n columns of pixels as a table M is known, said method comprising the steps of;

- Determining a rank number R;
- Defining said m x n compensation table using singular value decomposition equation (1)

$$M = U \Sigma V^* \quad (1)$$

wherein U denotes an m x m unitary matrix, Σ is an m x n diagonal matrix with nonnegative real numbers on the diagonal and V^* denotes the conjugate transpose of V, which is an n x n unitary matrix;

- Obtaining a matrix Σ' by leaving largest R values of Σ and setting all other values to zero;
- Obtaining a matrix Σ'' diagonals of which are singular, by reducing the size of Σ' to R x R;
- Obtaining an m x R matrix U'' by reducing U such that columns of U'' are left singular vectors of U;
- Obtaining an R x n matrix V'' by reducing V such that columns of V'' are right singular vectors of V;
- Defining a matrix M' as an approximation of M by the approximation equation (5) as;

$$M' = U'' \Sigma'' V''^T \quad (5),$$

[0020] A backlight compensation method for a display which comprises at least one backlight source and pixels of m rows and n columns the method comprising the steps of;

- Storing a first matrix U'' having size of m x R, a second matrix Σ'' having size of R x R and third matrix V''^T having size of R x n for at least one backlight source of the display, wherein R denotes an approximation rank number;
- calculating a compensation value for at least one pixel by using an approximation equation (5);

$$M' = U'' \Sigma'' V''^T \quad (5)$$

- adjusting said pixel's light transmission value using said calculated compensation value,

[0021] A local dimming method for a display which comprises a plurality of backlight sources and pixels of m rows and n columns, the method comprising the steps of;

- Storing a first matrix U'' having size of m x R, a second matrix Σ'' having size of R x R and third matrix V''^T having size of R x n for at least one backlight source of the display, wherein R denotes an approximation rank number;
- Processing an input image to determine local dimming levels for each predefined region of the display;
- Adjusting backlight driving level of at least one backlight source to dim at least a portion of the display including at least one predefined region that is determined to have local dimming;
- Calculating a compensation value for at least one pixel by approximating illumination level originating from each backlight source using the equation (5)

$$M' = U'' \Sigma'' V''^T \quad (5)$$

and summing all approximated illumination levels;

- Adjusting said pixel's light transmission value using said calculated compensation value,

[0022] A display comprising at least which comprises at least one backlight source and pixels of m rows and n columns, further comprising;

- Means for storing a first matrix U'' having size of m x R a second matrix Σ'' having size of R x R and a third matrix V''^T having size of R x n for at least one backlight source of the display wherein R denotes an approximation rank number;
- Means for calculating a compensation value by using an approximation equation (5);

$$M' = U'' \Sigma'' V''^T \quad (5)$$

and

- Means for adjusting said pixels' light transmission value using said calculated compensation value.

and

[0023] A display which comprises at least one backlight source and pixels of m rows and n columns, further comprising;

- Means for storing a first matrix U'' having size of m x R, a second matrix Σ'' having size of R x R and third matrix V''^T having size of R x n for at least one backlight source of the display wherein R denotes an approximation rank number;
- Means for processing input image to determine local dimming levels for each predefined region of the display;
- Means for adjusting backlight driving levels of backlight sources to dim at least a portion of the display including at least one predefined region that is determined to have local dimming;
- Means for calculating a compensation value for at least one pixel by approximating illumination level originating from each backlight source using the equation (5)

$$M' = U'' \Sigma'' V''^T \quad (5)$$

and summing all approximated illumination levels; and

- Means for adjusting said pixel's light transmission value using said calculated compensation value.

Object of the Invention

[0024] The object of the invention is to provide a backlight compensation table approximation method for displays.

[0025] Another object of the invention is to provide a backlight compensation method and system for compensation of backlight non-uniformity on a display.

[0026] Another object of the invention is to provide a backlight compensation method and system which reduces the required memory for a compensation table.

[0027] Another object of the invention is to provide a backlight compensation method and system which enables utilization of local dimming in edge-lit displays.

Brief Description of the Drawings

[0028]

Figure 1 shows horizontal light intensity distribution of an edge-lit display comprising a single backlight source with respect to horizontal position.

Figure 2 shows vertical light intensity distribution of an edge-lit display comprising a single backlight source with respect to vertical position.

Figure 3 shows mean square error of method of present invention with respect to a rank parameter of the present invention

Detailed Description of the Invention

[0029] Edge-lit displays suffer from backlight intensity non-uniformity, which degrades perceived image quality on the display. To compensate this non-uniformity, the solution of the state of the art is to compensate non-uniformity by adjusting display thin film layer by utilizing a compensation table.

[0030] However for a full high definition display, having 1920 columns and 1080 rows of pixels with 16 bit resolution, a single backlight source requires a compensation table consuming approximately 4 megabytes of memory, which is large.

[0031] The aim of the method and system of present invention is to reduce the memory required by approximation of the compensation table by singular value decomposition and a mean square error (MSE) criterion.

[0032] A matrix M, having a size of m x n can be represented using singular value decomposition as shown in the equation (1).

$$M = U \Sigma V^* \quad (1)$$

[0033] In the equation (1), U is an m x m unitary matrix, Σ is an m x n diagonal matrix with nonnegative real numbers on the diagonal and V^* denotes the conjugate transpose of V, which is an n x n unitary matrix. For the matrix of concern, which is the compensation table, V can be assumed real and hence conjugate can be replaced by transpose.

[0034] The equation (1) can be decomposed into two equations (2, 3) to realize the point spread function.

$$U' = U \Sigma \quad (2)$$

$$M = U' V^T \quad (3)$$

[0035] The method of the present invention utilizes an approximate model matrix M' for matrix M using an R^{th} order approximation. The approximation is based on minimizing the frobenius norm of the difference between the matrix M and M' .

[0036] The approximation matrix M' is decomposed as in equation (4).

$$M' = U \Sigma' V^T \quad (4)$$

[0037] Here Σ' is obtained by leaving the largest R values of the matrix Σ and setting all other values to zero. This reduces the size of matrices which are composed to determine M' .

[0038] Since all but R values of Σ' are zero, M' is expressed with a new decomposition equation (5).

$$M' = U'' \Sigma'' V''^T \quad (5)$$

[0039] In the equation (5), matrices U'' V''^T are re-defined since size of Σ' is reduced. For the equation (5), U'' becomes an $m \times R$ matrix reduced from U such that columns of U'' are left singular vectors of U . Likewise, V''^T is reduced from V^T to an $n \times R$ matrix such that rows of V''^T are right singular vectors of V^T . Since Σ' is obtained by leaving the largest R values of the matrix Σ and setting all other values to zero, Σ'' is defined as an $R \times R$ matrix diagonals of which are singular. The resultant equation (5) compose the matrix M' having equal size to the M which is $m \times n$. However, since Σ matrix is reduced and U and V^T are reduced to conform to the equations, the values of M are approximated up to an error. In other words, an R^{th} order approximation is done by forming M' matrix.

[0040] The stated approximation method can be successfully used to determine the compensation table using singular value decomposition. Since an $m \times n$ table is reduced to multiplication of three matrices having sizes of $m \times R$, $R \times R$ and $R \times n$, practically speaking, a full definition display 16 bit compensation table, which is stated to consume 4 megabytes when uncompressed, is reduced to approximately $16 \times (1920 + 1080) \times 5 = 240000$ bits which is approximately 29 Kilobytes. The compression ratio reaches up to 99%. While the table size is reduced on one hand, since the reconstruction of the table requires additional R 16 bit multiplications and $R-1$ 32 bit additions, the computational processing power is required on the other hand. However, reduction of table size becomes very advantageous with almost no drawback since displays employ power microprocessors which are suitable to handle complex mathematical operations in order to use image enhancement algorithms.

[0041] The utilization of singular value decomposition and an R^{th} order approximation can be used since the vertical intensity distribution and horizontal intensity distribution of a light source is highly correlated. Figure 1 shows light intensity of a point light source (e.g. light emitting diode - LED) with respect to horizontal position. Figure 2 shows light intensity of the same source with respect to vertical position. The highly correlation characteristic of intensity distribution enables approximation of the compensation table easily.

[0042] In the application of the method of present invention, it is an important issue to determine rank number R to have an adequate approximation for compensation table. In an embodiment of the invention, the rank number R is determined by comparing approximate and real values using mean square error (MSE) criterion. MSE criterion gives true information of a practical perception error. Figure 3 shows MSE of approximation of present invention with respect to rank number R . As it can be seen on the figure, the MSE of the approximation decreases exponentially with the increasing rank number. Determination of rank number by means of visual observation as well as mathematical results is also important. Application of method and visual observation states similar results with mathematical results and those clearly state that, a rank number 5 is high enough to approximate compensation table adequately and no visual difference can be observed in visual observation.

[0043] Conclusively, the method of the present invention comprises the steps of;

- Determining a rank number R ;
- Defining the $m \times n$ compensation table using singular value decomposition equation (1)

$$M = U \Sigma V^* \quad (1)$$

wherein U denotes an $m \times m$ unitary matrix, Σ is an $m \times n$ diagonal matrix with nonnegative real numbers on the diagonal and V^* denotes the conjugate transpose of V , which is an $n \times n$ unitary matrix;

- Obtaining a matrix Σ' by leaving largest R values of Σ and setting all other values to zero.
 - Obtaining a matrix Σ'' diagonals of which are singular, by reducing the size of Σ' to $R \times R$
 - Obtaining an $m \times R$ matrix U'' by reducing U such that columns of U'' are left singular vectors of U
 - Obtaining an $R \times n$ matrix V'' by reducing V such that columns of V'' are right singular vectors of V
 - Defining a matrix M' as an approximation of M by the approximation equation (5)
- as;

$$M' = U'' \Sigma'' V''^T \quad (5)$$

[0044] The approximation technique of present invention can be used for backlight compensation in a display device comprising at least a backlight source and pixels of m rows and n columns. Said method comprises the steps of;

- Storing a first matrix U'' having size of $m \times R$, a second matrix Σ'' having size of $R \times R$ and third matrix V''^T having size of $R \times n$ are stored for at least one backlight source of the display, wherein R denotes an approximation rank number;

- calculating a compensation value for at least one pixel by using an approximation equation (5);

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$$M' = U'' \Sigma'' V''^T \quad (5)$$

- adjusting said pixel's light transmission value using said calculated compensation value.

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[0045] Present invention further comprises a display having a display resolution $m \times n$, utilizing the method of the invention in determining backlight compensation to obtain uniformity. The display comprises

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- Means for storing a first matrix U'' having size of $m \times R$, a second matrix Σ'' having size of $R \times R$ and a third matrix V''^T having size of $R \times n$ for at least one backlight source of the display wherein R denotes an approximation rank number;
- Means for calculating a compensation value for at least one pixel by using an approximation equation (5);

20

$$M' = U'' \Sigma'' V''^T \quad (5)$$

- Means for adjusting a pixel's light transmission value using said calculated compensation value.

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[0046] The display of the present invention utilizes the approximation method of the invention and adjusts pixels of the display by calculating a compensation value for each light source of the display. As a result, the whole display is compensated regarding light intensity non-uniformity. The compensation value may be calculated for each refresh of the pixels of the display. If the display device has adequate temporary memory to store the whole approximate matrix, the calculated compensation values may be stored in the temporary memory to avoid repeated compensation calculations. As long as light intensity parameters are not changed by means of other parameters of the display, for instance a brightness adjustment by the user, it may not be necessary to calculate compensation values repeatedly.

30

[0047] Now within the teachings of the present invention, backlight control based enhancements are possible since it is possible to determine uniformity around the whole display. In the state of the art, backlight control based enhancements such as local dimming or boosting backlight to increase contrast and picture dynamics can be only applied in devices with direct-lit displays. Within the known methods in the state of the art, it is almost impossible to utilize local dimming techniques since the locality principle does not apply to edge-lit displays, that is; each light source illuminates a wide area on the display and it is almost impossible to determine a correct illumination for regions of the display and maintain illumination uniformity.

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[0048] However, if the compensation method of the present invention is applied for each backlight source of the display, it is merely a matter of calculation and prediction to use local dimming since the result of a combination of different illumination levels on any pixel can be calculated and a desired local dimming can be determined in accordance with compensation calculations.

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[0049] Within the local dimming method of the present invention, following steps are followed;

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- A first matrix U'' having size of $m \times R$, a second matrix Σ'' having size of $R \times R$ and third matrix V''^T having size of $R \times n$ are stored for at least one backlight source of the display;
- An input image is processed to determine local dimming levels for each predefined region of the display;
- Backlight driving levels of backlight sources are adjusted to dim at least a portion of the display including at least one predefined region that is determined to have local dimming;
- A compensation value for at least one pixel is calculated by approximating illumination level originating from each backlight source using the equation (5)

50

55

$$M' = U'' \Sigma'' V''^T \quad (5)$$

and summing all approximated illumination levels;

- Said pixel's light transmission value is adjusted using said calculated compensation value.

[0050] Within the techniques in the state of the art, while dimming a light source to obtain local dimming, the rest of the display is also affected since no locality exists. However within the method of the present invention, it is possible to dim a backlight source and compensate degradation of image quality on the rest of the display by increasing the intensities of non-dimmed light sources to balance light intensity and obtain uniformity by calculating combined compensation values using the approximation method of the present invention. The applicability of local dimming using the method of the invention enables utilization of local dimming in not only direct-lit displays but also in edge-lit displays. Furthermore, the method can be used in direct-lit displays to reduce the number of backlight sources but maintain the effectiveness of local dimming.

[0051] Present invention further comprises a display device comprising a plurality of backlight sources and a plurality of predefined regions on the display comprising;

- Means for storing a first matrix U'' having size of $m \times R$, a second matrix Σ'' having size of $R \times R$ and third matrix V''^T having size of $R \times n$ for at least one backlight source of the display wherein R denotes an approximation rank number;
- Means for processing an input image to determine local dimming levels for each predefined region of the display;
- Means for adjusting backlight driving levels of backlight sources to dim at least a portion of the display at least including at least one predefined region that is determined to have local dimming;
- Means for calculating a compensation value for at least one pixel by approximating illumination level originating from each backlight source using the equation (5)

$$M' = U'' \Sigma'' V''^T \quad (5)$$

and summing all approximated illumination levels; and

- Means for adjusting said pixel's light transmission value using said calculated compensation value.

[0052] In the direct-lit displays wherein the local dimming known from the state of the art is used, another problem, which arises from the fact that each light source illuminates a certain region of the display, that is a locality exists, is possible occurrence of backlight transition discrepancies, since the boundary of each light source is discrete and if a region is boosted while a neighbouring one is dimmed, a huge light intensity difference may occur between these neighbouring regions and the perceived image creates visual disturbance. For this possible problem, further local dimming compensation techniques are used to obtain possible discrepancy regions and correct them by re-adjusting dimming levels.

[0053] However, since the necessity to obtain a discrete locality for backlights is eliminated and the continuous intensity deviation nature of the light is not disturbed within the method and system of the present invention, a smooth light transition is obtained on the whole display and the possibility of stated discrepancy disappears.

[0054] Since the approximation technique reduces the required memory size significantly, it is possible to store the matrices used for approximation separately for each backlight source. However, if the backlight sources have equivalent light intensity characteristics, it is possible to use same matrices for approximation of these equivalent backlight sources. Basic matrix operations are useful such as exchanging row indexes and column indexes, moving row indexes and column indexes, reversal of row indexes and/or column indexes, and limitation of row index and/or column index.

[0055] Present invention enables illumination uniformity and fully illumination control in both direct-lit and edge-lit displays independently from the number and positions of the backlight sources.

Claims

1. A backlight compensation table approximation method for a display which comprises at least one backlight source and pixels of m rows and n columns and wherein a compensation table of said backlight source with respect to m rows and n columns of pixels as a table M is known, **characterized in that** said method comprises the steps of;

- Determining a rank number R ;
- Defining said $m \times n$ compensation table using singular value decomposition equation (1)

$$M = U \Sigma V^* \quad (1)$$

wherein U denotes an m x m unitary matrix, Σ is an m x n diagonal matrix with nonnegative real numbers on the diagonal and V^* denotes the conjugate transpose of V, which is an n x n unitary matrix;

- Obtaining a matrix Σ' by leaving largest R values of Σ and setting all other values to zero.
- Obtaining a matrix Σ'' diagonals of which are singular, by reducing the size of Σ to R x R
- Obtaining an m x R matrix U'' by reducing U such that columns of U'' are left singular vectors of U
- Obtaining an R x n matrix V'' by reducing V such that columns of V'' are right singular vectors of V
- Defining a matrix M' as an approximation of M by an approximation equation (5);

$$M' = U'' \Sigma'' V''^T \quad (5)$$

2. A method according to claim 1 **characterized in that** said determining a rank number R comprises comparing an approximate value from M' and a real value from M using mean square error criterion.

3. A backlight compensation method for a display which comprises at least one backlight source and pixels of m rows and n columns **characterized in that** the method comprises the steps of;

- Storing a first matrix U'' having size of m x R, a second matrix Σ'' having size of R x R and third matrix V''^T having size of R x n for at least one backlight source of the display, wherein R denotes an approximation rank number;
- calculating a compensation value for at least one pixel by using an approximation equation (5);

$$M' = U'' \Sigma'' V''^T \quad (5)$$

- adjusting at least one pixel's light transmission value using said calculated compensation value.

4. A local dimming method for a display which comprises a plurality of backlight sources and pixels of m rows and n columns **characterized in that** the method comprises the steps of;

- Storing a first matrix U'' having size of m x R, a second matrix Σ'' having size of R x R and third matrix V''^T having size of R x n for at least one backlight source of the display, wherein R denotes an approximation rank number;
- Processing an input image to determine local dimming levels for each predefined region of the display;
- Adjusting backlight driving level of at least one backlight source to dim at least a portion of the display at least including at least one predefined region that is determined to have local dimming;
- Calculating a compensation value for at least one pixel by approximating illumination level originating from each backlight source using an equation (5)

$$M' = U'' \Sigma'' V''^T \quad (5)$$

- and summing all approximated illumination levels;
- Adjusting said pixel's light transmission value using said calculated compensation value.

5. A display which comprises at least one backlight source and pixels of m rows and n columns, **characterized in that** it further comprises;

- Means for storing a first matrix U'' having size of $m \times R$ a second matrix Σ'' having size of $R \times R$ and a third matrix V''^T having size of $R \times n$ for at least one backlight source of the display wherein R denotes an approximation rank number;
- Means for calculating a compensation value by using an approximation equation (5);

$$M' = U'' \Sigma'' V''^T \quad (5)$$

and

- Means for adjusting at least one pixel's light transmission value using said calculated compensation value.

6. A display which comprises at least one backlight source and pixels of m rows and n columns, **characterized in that** it further comprises;

- Means for storing a first matrix U'' having size of $m \times R$, a second matrix Σ'' having size of $R \times R$ and third matrix V''^T having size of $R \times n$ for at least one backlight source of the display wherein R denotes an approximation rank number;
- Means for processing input image to determine local dimming levels for each predefined region of the display;
- Means for adjusting backlight driving levels of backlight sources to dim at least a portion of the display at least including at least one predefined region that is determined to have local dimming;
- Means for calculating a compensation value for at least one pixel by approximating illumination level originating from each backlight source using the equation (5)

$$M' = U'' \Sigma'' V''^T \quad (5)$$

and summing all approximated illumination levels; and

- Means for adjusting said pixel's light transmission value using said calculated compensation value.

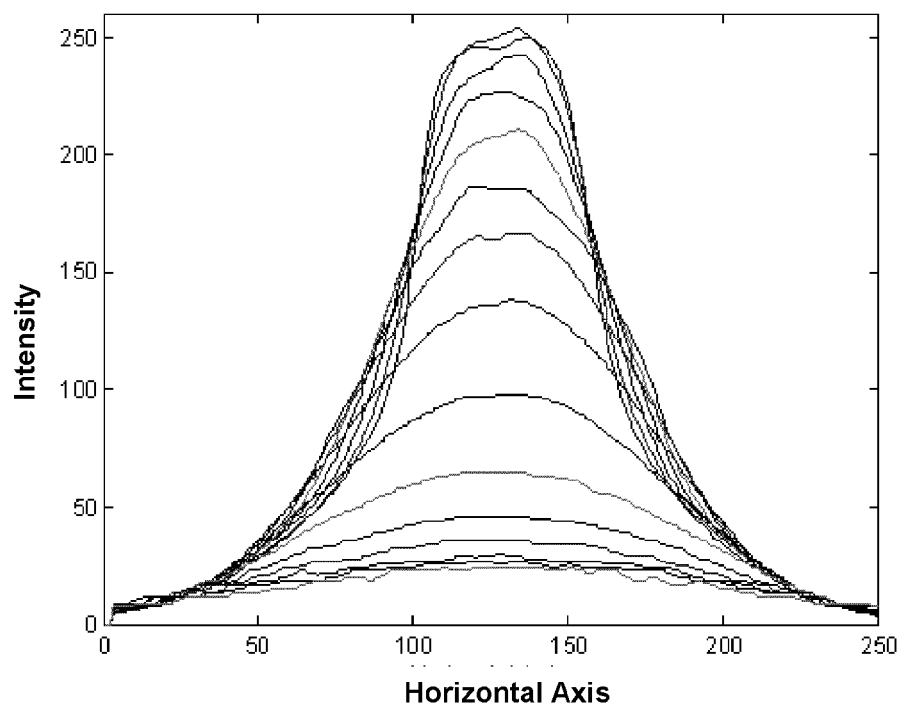


Figure 1

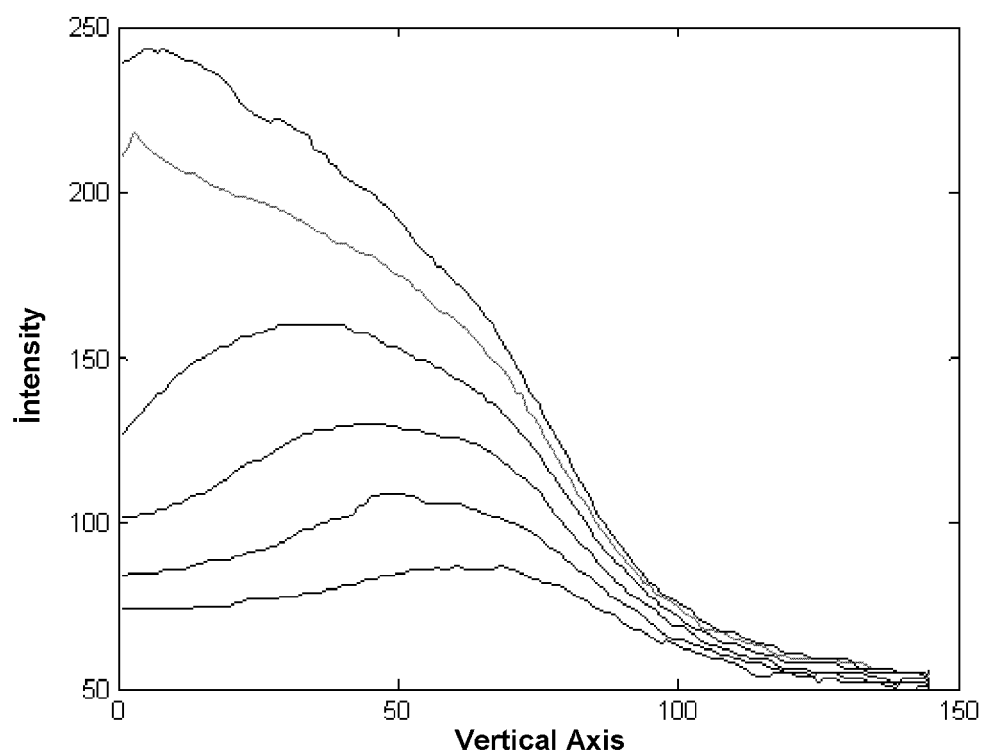


Figure 2

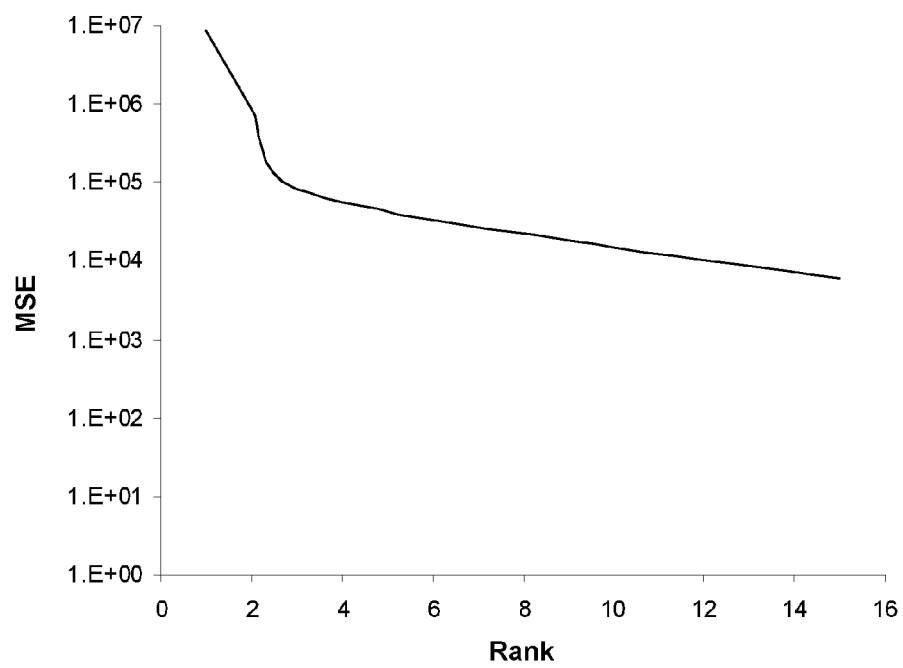


Figure 3



EUROPEAN SEARCH REPORT

Application Number
EP 12 15 1013

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 154 674 A1 (SAMSUNG ELECTRONICS CO LTD [KR]) 17 February 2010 (2010-02-17) * paragraphs [0041], [0043]; figure 4 * -----	1-6	INV. G09G3/34
A	"Singular value decomposition", Wikipedia , 10 January 2011 (2011-01-10), XP002671786, Retrieved from the Internet: URL: http://en.wikipedia.org/w/index.php?title=Singular_value_decomposition&oldid=407097783 [retrieved on 2012-03-19] -----	1-6	
			TECHNICAL FIELDS SEARCHED (IPC)
			G09G
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 March 2012	Examiner Giancane, Iacopo
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 4
EPO FORM 1503 03/82 (P04C01)

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