KP-F100C pixel interpolation

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The KP-F100C pixel interpolation method is described below as reference.

According to the application, since the image interpolation may not be optimum, adequate care is recommended during use.

Numerous procedures can be considered.

1. Normal interpolation

The KP-F100C uses a Bayer arrangement CCD.

Fig. 1 illustrates the Bayer arrangement. The pixel addresses are shown in the squares.

Normal interpolation is indicated in Fig. 2. Ordinarily, colorizing by computer requires R, G and B components every pixel. Thus, since only R, G or B is obtained per pixel, the other picture components need to be interpolated from surrounding pixels. For example, pixel Gr11 R and B components are interpolated from surrounding pixels. The interpolation method is as follows (see Fig. 2).

a) RGR line Gr11 R component is interpolated from left and right pixel R components.

b) RGR line Gr11 B component is interpolated from above and below pixel B components.

c) RGR line R12 G component is interpolated from left, right, above and below pixel G components.

d) RGR line R12 B component is interpolated from the 4 obliquely adjacent pixel B components.

The Gr11 and R12 pixel components obtained in this manner can be expressed as follows.

Gr11 = ((R10 + R12)/2, GR12, (B01 + B21/2))
R12 = (R12, (Gr11 + Gr13 + Gb02 + Gb22/4, (B01 + B03 + B21 + B23)/4)

The resulting pixel interpolation map is shown in Fig. 3.

The CCD edges (terminals) are interpolated as follows.

Gb00 = (R10, Gr11, B01)
R10 = R10, Gb00 + Gr11 + Gb20)/3, (B01 + B21/2))
Gb20 = ((R10 + R30)/2, Gb20, B21)
B01 = ((R10 + R12/2, (Gb00 + Gb02)/2)
Gb01 = (R12, Gb02, (B01 + B03)/2)

Other edges are interpolated in the same manner.

2. CCD G channel filter

Interpolation in the above manner introduces a G channel level difference every line resulting in vertical and horizontal stripes. Also, correction can produce horizontal stripes.

A new interpolation system has been added for correcting this problem. The system uses oblique interpolation for the G channel and is indicated in Fig. 4.

For example, Fig. 4A shows an additional average of two pixels, Gr11 and Gb22.

Gr11 G component = ((Gb00 + Gr11)/2)
Gb22 G component = ((Gr11 + Gb22)/2)

The RGB components of Gr11 and Gb22 are as follows.

Gr11 = ((R10 + R12/2, (Gb00 + Gr11)/2, (B01 + B21)/2)
Gb22 = ((R12 + R32)/2, (Gr11 + Gb22)/2, (B21 + B23)/2)

Fig. 5 indicates the G channel oblique interpolation map.

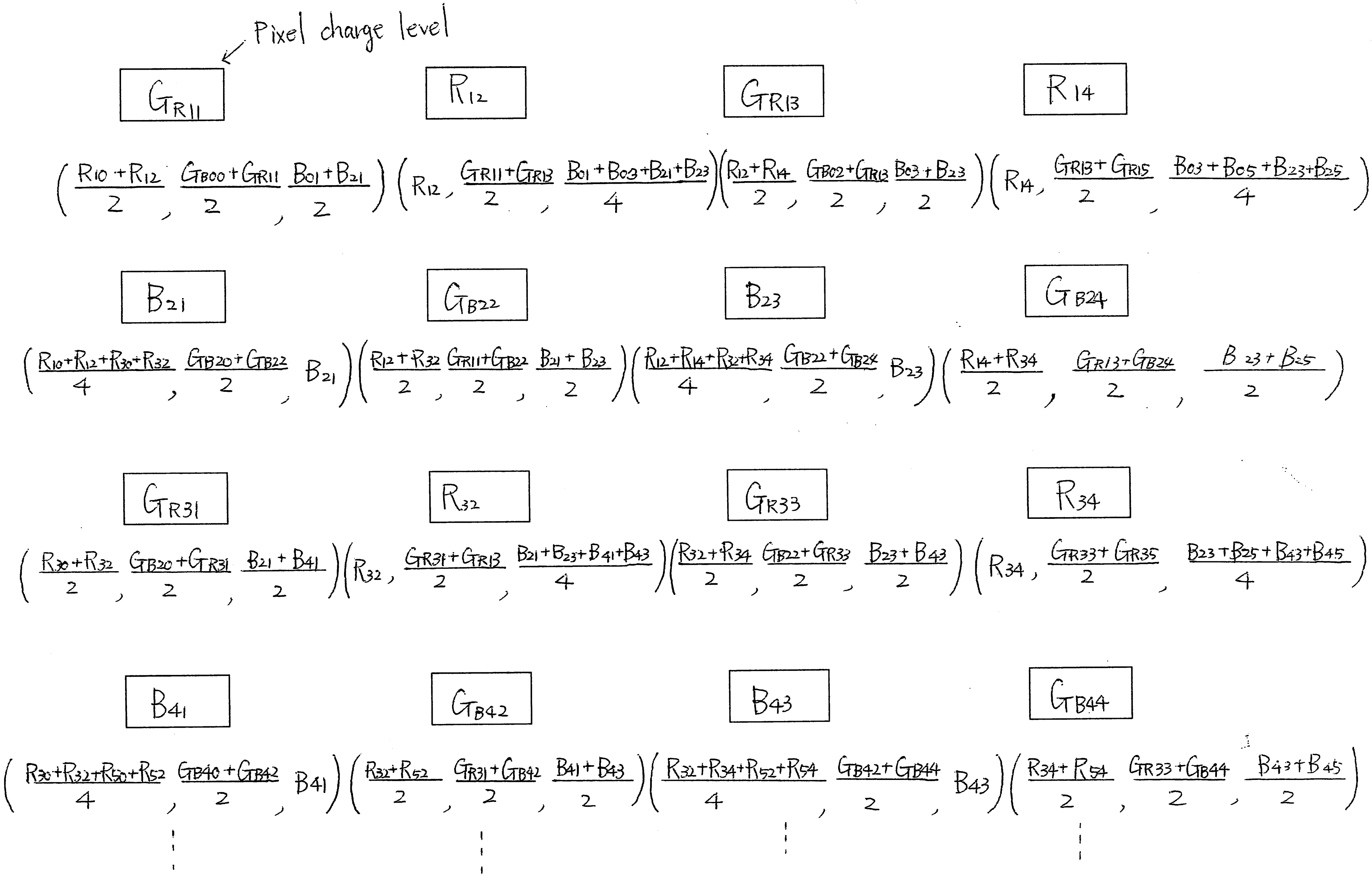
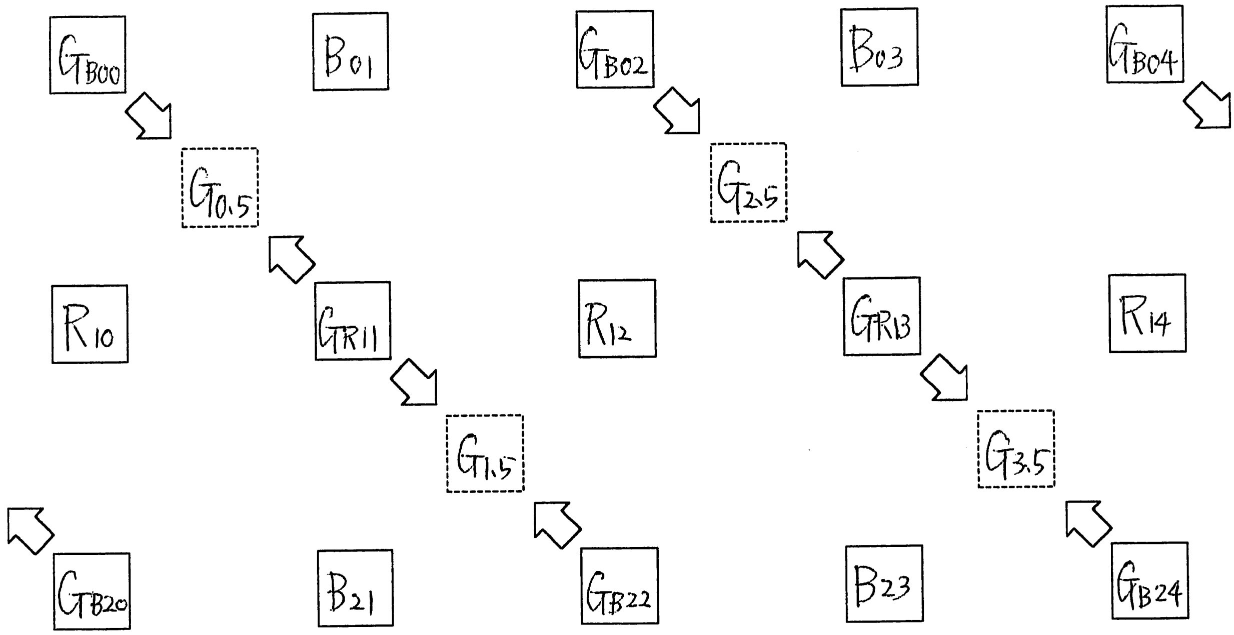
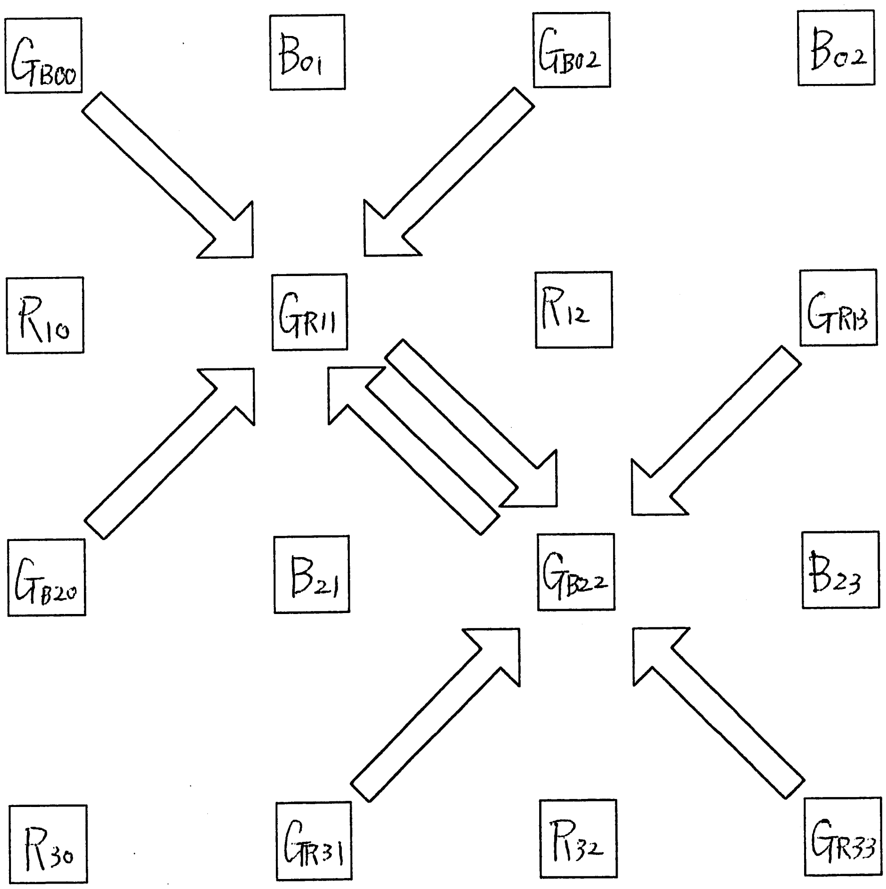


Fig. 5 G channel oblique interpolation map


G_{B00}
B_{01}
G_{B02}
B_{03}
G_{B04}
$G_{0.5}$
$G_{2.5}$
R_{10}
G_{R11}
R_{12}
G_{R13}
R_{14}
$G_{1.5}$
$G_{3.5}$
G_{B20}
B_{21}
G_{B22}
B_{23}
G_{B24}

(A)


G_{B00}
B_{01}
G_{B02}
B_{02}
R_{10}
G_{R11}
R_{12}
G_{R13}
G_{B20}
B_{21}
G_{B22}
B_{23}
R_{30}
G_{R31}
R_{32}
G_{R33}

(B)

Fig. 4

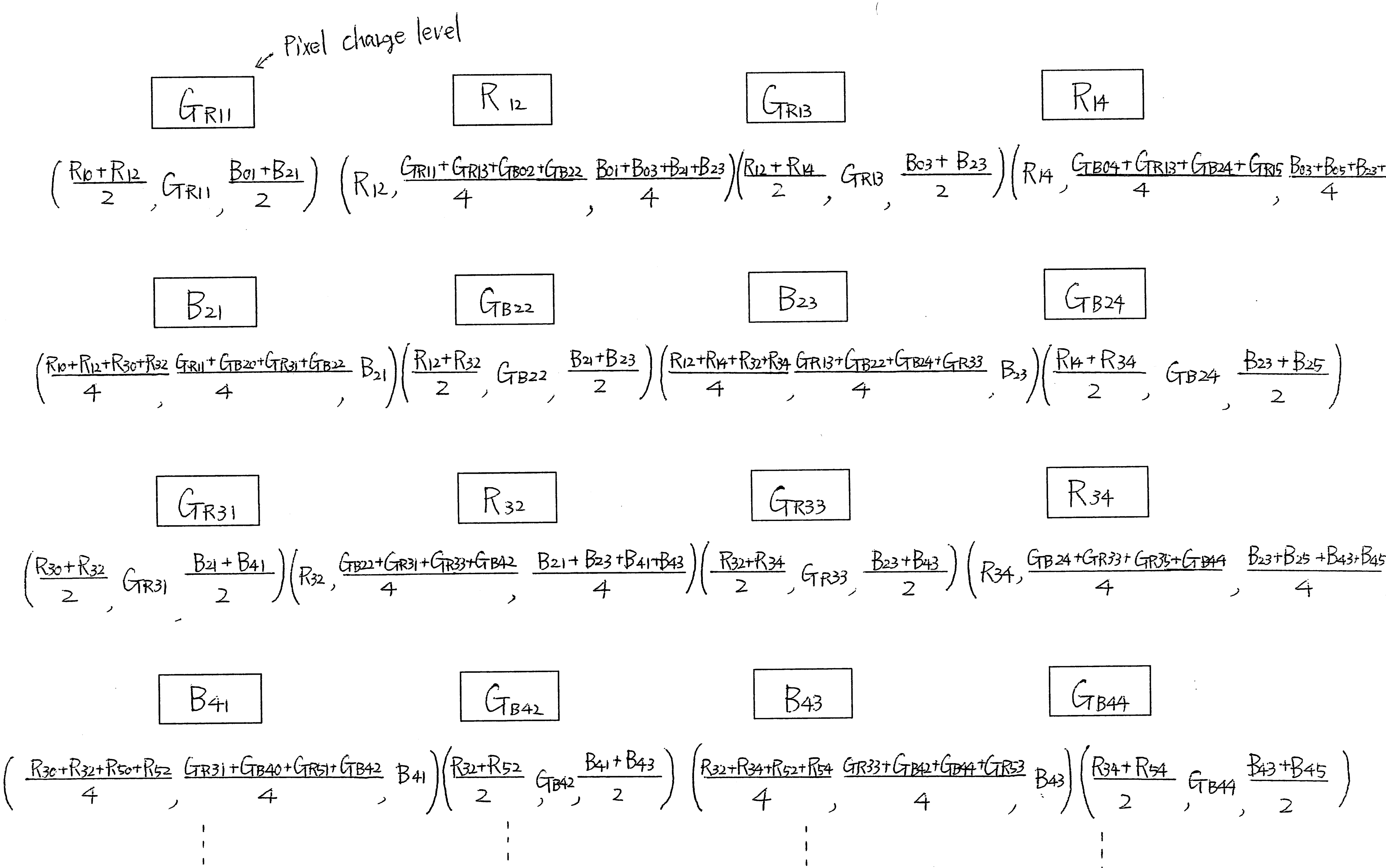
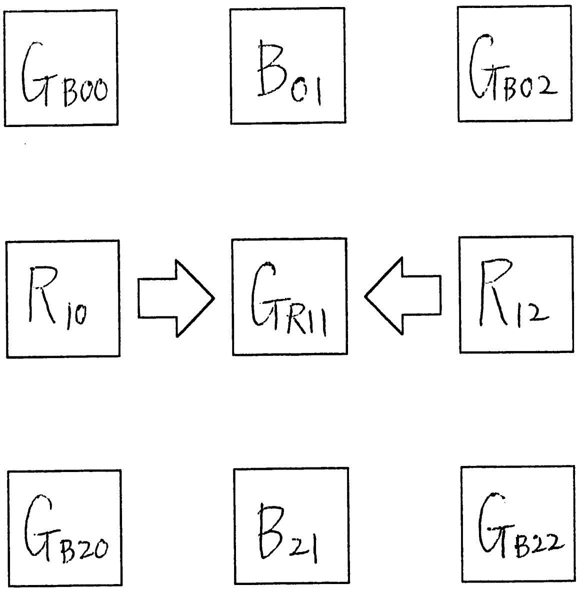
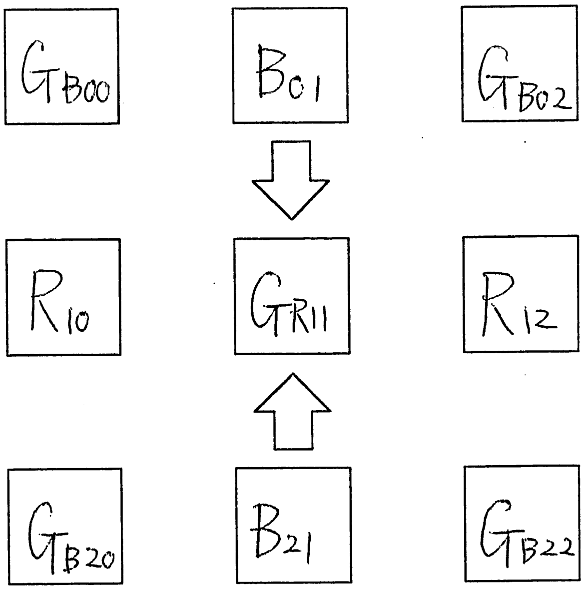


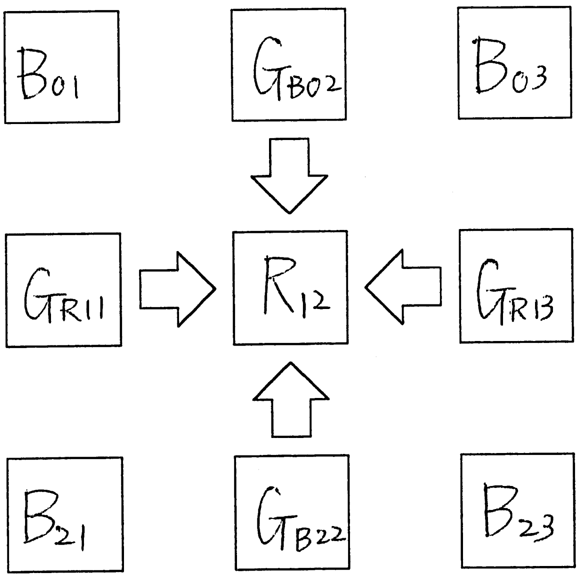
Fig. 3 Pixel interpolation map



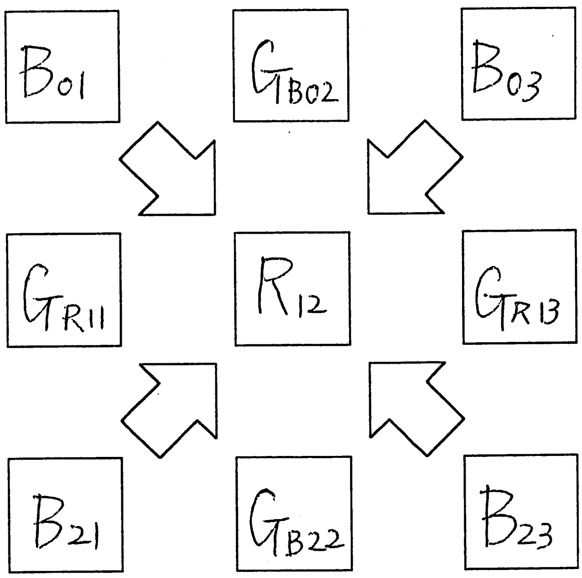
a) Pixel GR11 R component interpolation



b) Pixel GR11 B component interpolation



c) Pixel R12 G component interpolation



d) Pixel R12 B component interpolation

Fig. 2 Pixel interpolation examples

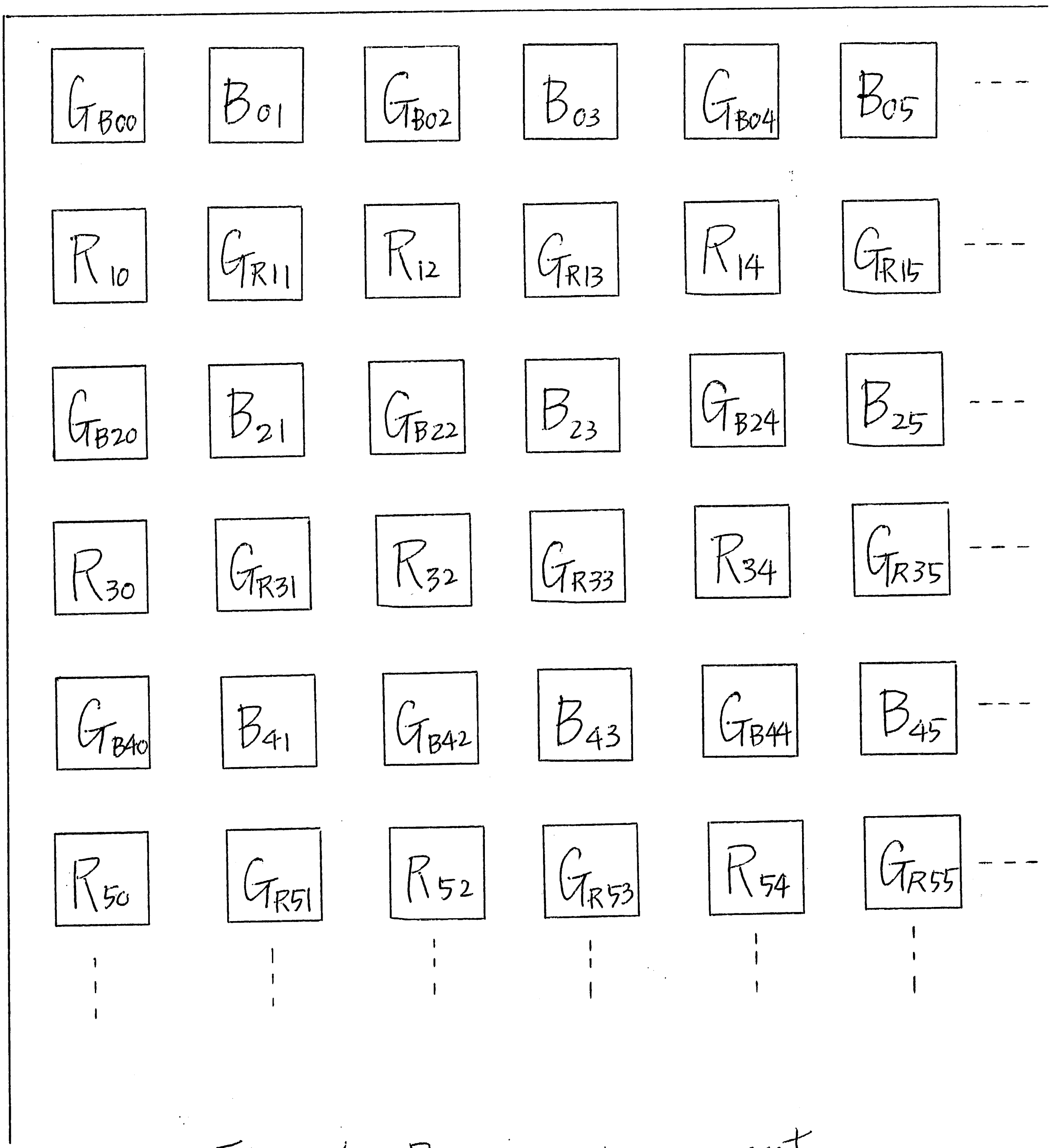


Fig. 1 Bayer arrangement

By using this system in addition to normal interpolation, the above mentioned disadvantages can be resolved with virtually no loss of resolution.

By keeping the G channel level difference at 2%, the color temperature tolerance is about 3% in the range below 5000 K.

(Reference)
Fig. 4B indicates G channel interpolation by overlapping from surrounding pixels.

The pixel address R11 G channel component is as follows.

$$GR11 = (\alpha\ G_{R11} + \beta\ G_{B00} + \gamma\ G_{B20} + \delta\ G_{B22} + \varepsilon\ G_{B02})/5$$

Likewise, the G channel component at scanning line B pixel address GB22 is as follows.

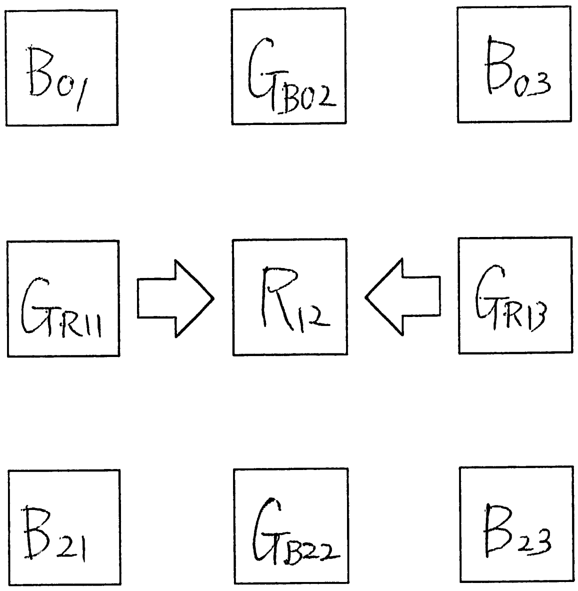
$$GB22 = (\eta\ G_{B22} + \theta\ G_{R11} + \iota\ G_{R31} + \kappa\ G_{R23} + \lambda\ G_{R13})/5$$

In the above, $\alpha\ \beta\ \gamma\ \delta\ \varepsilon\ \zeta\ \eta\ \theta\ \iota\ \kappa\ \lambda$ are coefficients.

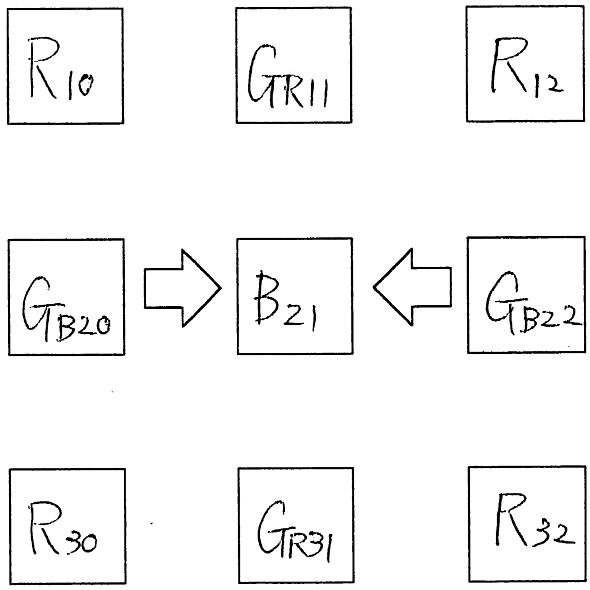
3. Horizontal interpolation
In addition to the above, an another approach is horizontal interpolation only. For example, as indicated in Fig. 6, Gr12 and Gb21 are expressed as follows.

Gr12 = (Gr11 + Gr13)/2
Gb21 = (Gb20 + Gb22)/2

The pixel map is indicated in Fig. 7. With this system, if the level differs with each G channel line, horizontal stripes appear on the monitor screen.



e) Pixel R12 G component interpolation



f) Pixel B21 G component interpolation

Fig. 6 Additional interpolation

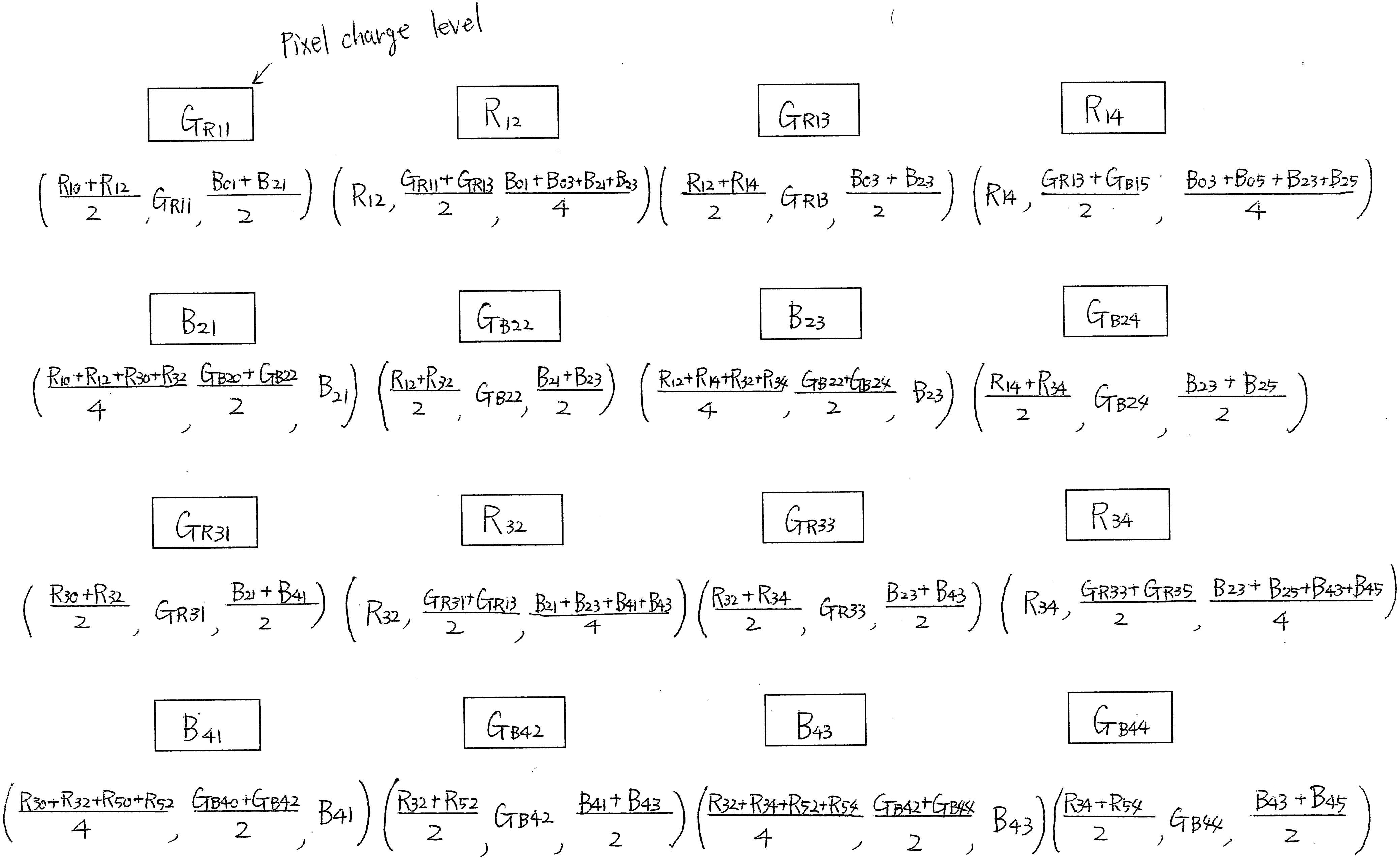


Fig. 7 Additional interpolation pixel map