

Case Study: the Bayer Colour Imaging Array

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Uncomfortable Truths

- sensors are colour blind
- Bayer sensors do not generate full RGB

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Let's experiment!

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Terminal — less · man movimenc
movimenc(1)                               The MovIm video codec                               movimenc(1)

NAME
    movimenc - MovIm encoder

SYNOPSIS
    movimenc [input_options] -i input_file [encoding_options]
    [output_options] -o output_file

    movimenc -h | -v

DESCRIPTION
    MovIm is a video codec specifically designed for both conservation and
    restoration of moving images.

    libmovim is a C library implementing MovIm. Its associated utility
    movimenc is a MovIm encoder.

    The openMovIm package includes the libmovim library and its associated
    movimenc, movimdec and movimplay utilities, as well as the openmovim
    Bash command-line interface.

OPTIONS
    GENERAL OPTIONS
    :
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Terminal — less - man movimenc
--demaosaic={BLI|BCI|LR|VNG|SI|PG|AMZE|HQLI|AHD|DLMMSEE}
demaosaic a Bayer-encoded input file into an RGB output file

This option allows to choose between different demosaicing
algorithms, because the results may vary a lot, depending on the
image content.

The following algorithms are implemented:
- BLI = bilinear interpolation
- BCI = bicubic interpolation
- LR = Lanczos resampling
- VNG = variable number of gradients
- SI = spline interpolation
- PG = pixel grouping
- AMZE = aliasing minimisation and zipper elimination
- HQLI = high-quality linear interpolation (Malvar, He and Cutler.
IEEE 2004)
- AHD = adaptive homogeneity-directed (Hirakawa and Parks. IEEE
2005)
- DLMMSEE = directional linear minimum mean square-error estimation
(Zhang and XiaoLin. IEEE 2005)

OTHER OPTIONS
-h, --help

```

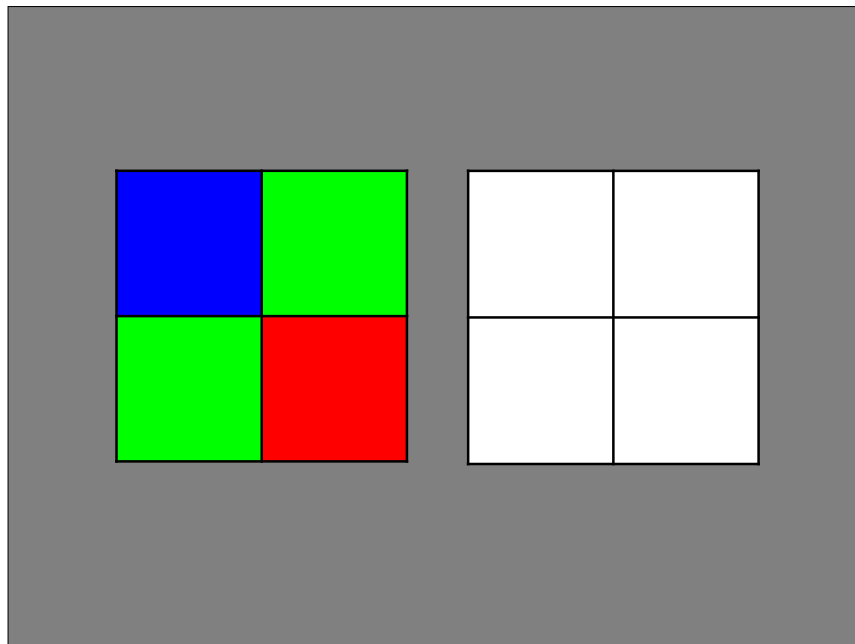
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```

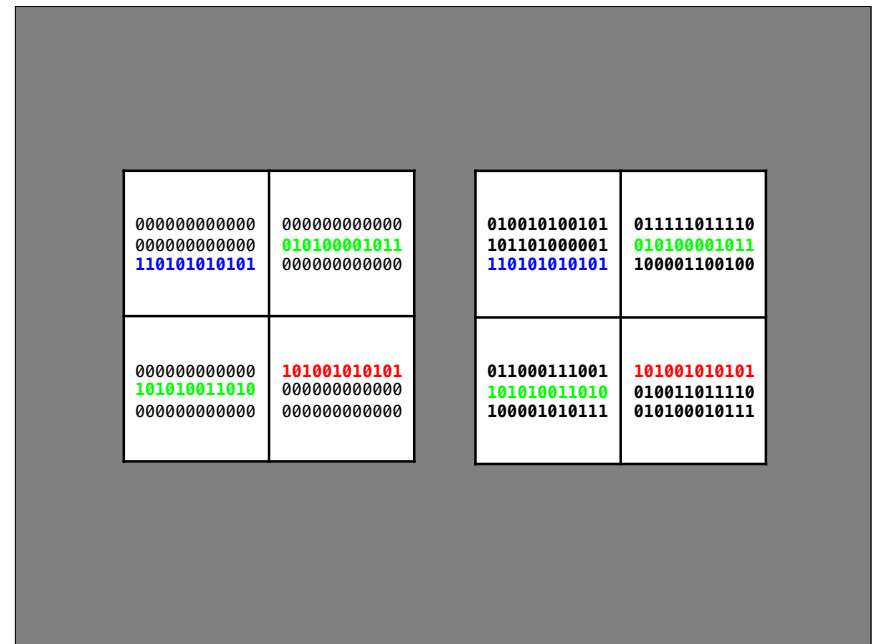
011101010010101010100010110101011110
01001101010101010101010100001011101010
011101010010101010100010110101011110
00011101010101010101010100001011101010
0110101010010101010100010111010101111
00101010101010101010000101110101010000
011101010010101010100010110101011110
01010101010101010101000010111010100110
100101110101001010101000101101010101
111001010101010101010000101110101010
011101010010101010100010110101011110
010101010101010101001101010100000001
0010100010101010101001010101010101

```

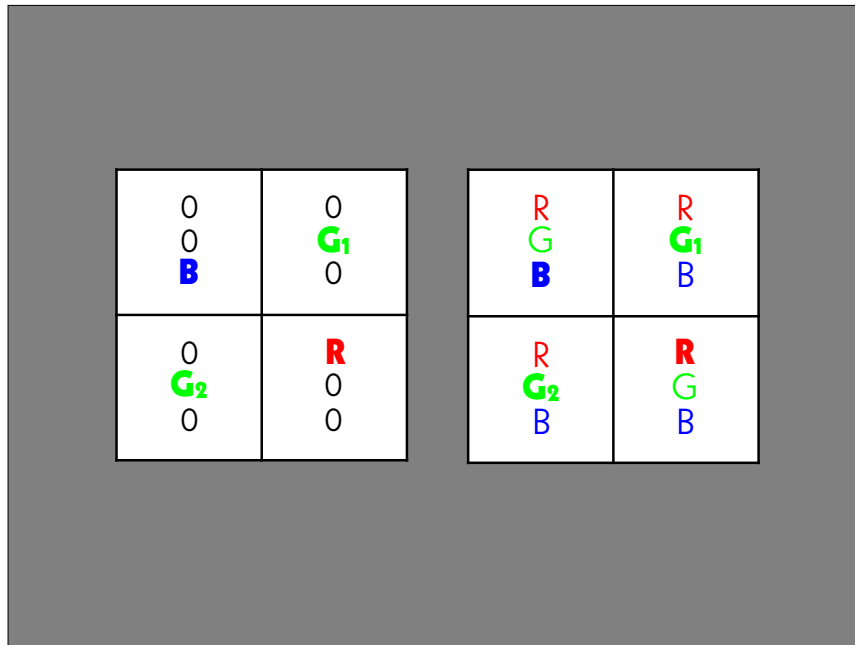
6



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Terminal — less - man movimenc

--bayer2rgb={bggr|rggb|gbgr|grbg}
transform a Bayer-encoded input file into an RGB output file with
half of the horizontal and vertical resolution

This option allows to generate a full RGB file at half pixel
resolution from the raw stream of almost any current camera. The
following four standard filter patterns are implemented:

      +-----+-----+
      | blue | green |
bggr = +-----+-----+
      | green | red  |
      +-----+-----+

      +-----+-----+
      | red  | green |
rggb = +-----+-----+
      | green | blue |
      +-----+-----+

      +-----+-----+
      | green | blue |
gbgr = +-----+-----+
      | red  | green |
      +-----+-----+

      +-----+-----+
      | green | red  |
grbg = +-----+-----+
      | blue | green |
      +-----+-----+

--demosaic={BLI|BCI|LR|VNG|SI|PG|AMZE|HQLI|AHD|DLMMSEE}
demosaic a Bayer-encoded input file into an RGB output file

This option allows to choose between different demosaicing

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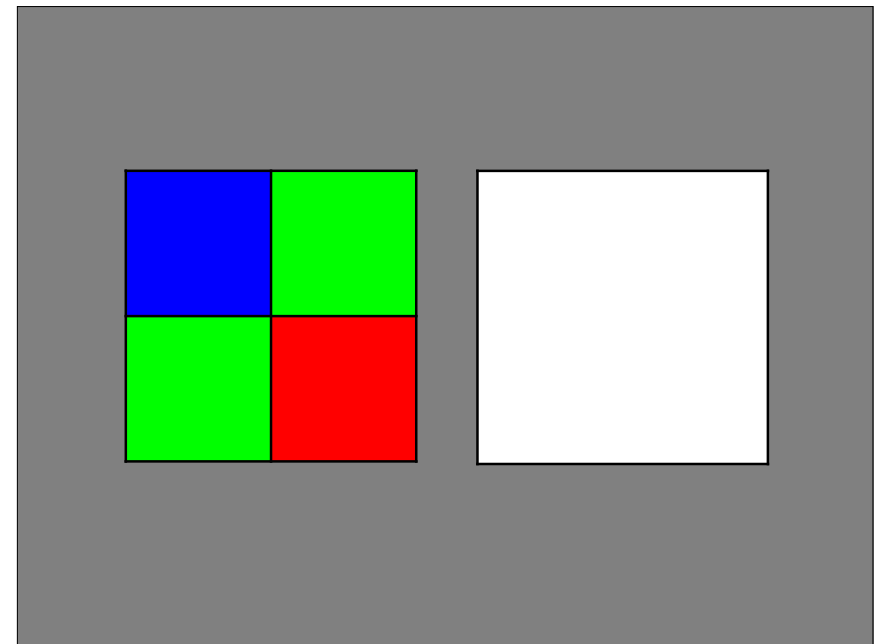
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```

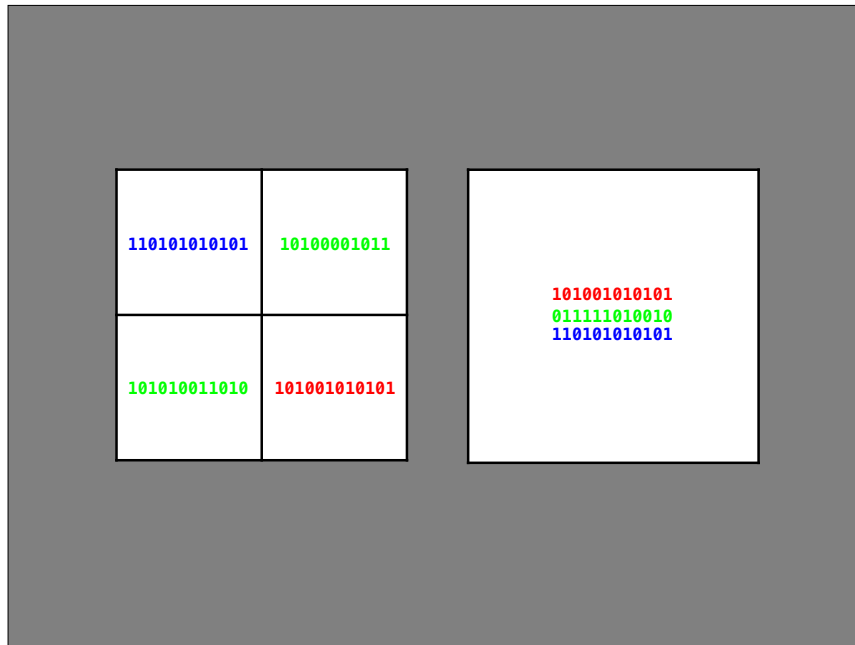
0111010100101010100010110101011110
010011010101010101010100001011101010
011101010010101010100010110101011110
0001110101010101010100001011101010
011010101001010101010001011010101111
001010101010101010000101110101010000
0111010100101010100010110101011110
010101010101010101000010111010100110
1001011101010010101010001011010101
1110010101010101010000101110101010
0111010100101010100010110101011110
0101010101010101001101010100000001
00101000101010101010010101010101

```

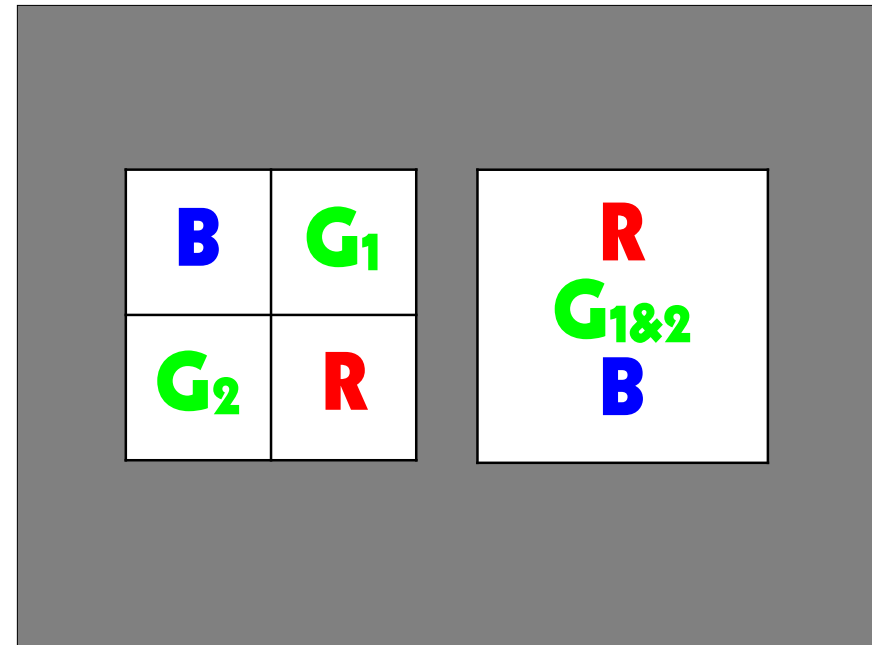
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```

Terminal — less · man openmovim
openmovim(1)          The MovIm video codec          openmovim(1)

NAME
  openmovim - Command-line interface to encode, decode, play and analyse
  moving images using 'libmovim'

SYNOPSIS
  openmovim (-e | -d | -p | -a | -m | -s) -i input_file [-o output_file]

  openmovim (-c | -u) -i input_file [-o output_file]

  openmovim -h | -v

DESCRIPTION
  MovIm is a video codec specifically designed for both conservation and
  restoration of moving images.

  libmovim is a C library implementing MovIm and movimenc, movimdec and
  movimplay are its associated utilities.

  openmovim is a Bash command-line interface to libmovim allowing to
  encode, decode, play and analyse virtually any moving images.

  The openMovIm package includes the libmovim library and its associated
  :

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Terminal — less · man openmovim
OPTIONS
GENERAL OPTIONS
  Select a mode:

  -e, --encode
  encoding mode: use movimenc to encode an input_file to an
  output_file

  -d, --decode
  decoding mode: use movimdec to decode an input_file to an
  output_file

  -p, --play
  playing mode: use movimplay to play an input_file

  -a, --analyse, --analyze
  analysing mode: use movimdec to analyse the validity of an
  input_file and write a report to an output_file if specified or to
  the Terminal otherwise

  -m, --metadata
  metadata mode: use movimdec to extract the technical metadata of an
  input_file (without analysing its validity) and write a report to
  an output_file if specified or to the Terminal otherwise
  :

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```
Terminal — less · man openmovim

-e, --encode
  encoding mode: use movimenc to encode an input_file to an
  output_file

-d, --decode
  decoding mode: use movimdec to decode an input_file to an
  output_file

-p, --play
  playing mode: use movimplay to play an input_file

-a, --analyse, --analyze
  analysing mode: use movimdec to analyse the validity of an
  input_file and write a report to an output_file if specified or to
  the Terminal otherwise

-m, --metadata
  metadata mode: use movimdec to extract the technical metadata of an
  input_file (without analysing its validity) and write a report to
  an output_file if specified or to the Terminal otherwise

-s, --scan
  scan mode: use movimenc to encode the input_file (i.e. the stream
  coming from a sensor) into an output_file
```

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Two ways to use Bayer data

digital blow-up to RGB

- 3 times the amount of the generated data
- the file has the full sensor resolution
- only $\frac{1}{3}$ of the data are real

digital reduction to RGB

- $\frac{3}{4}$ the amount of the generated data
- the file has $\frac{1}{2}$ of the sensor resolution
- all data are real

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