

Case Study: the Bayer Colour Imaging Array

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Hochschule der Künste Bern
Digital Files
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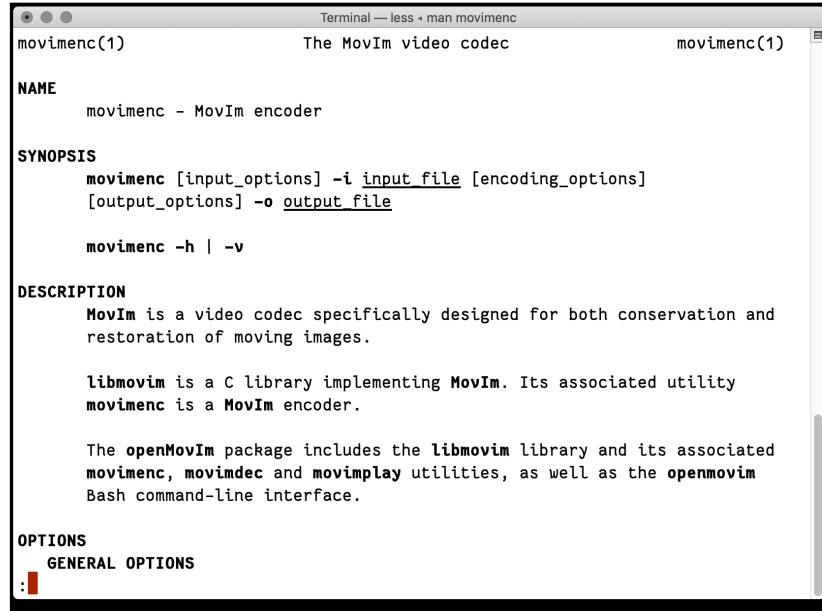
Let's experiment!

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Uncomfortable Truths

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

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The screenshot shows a terminal window with the title "Terminal — less - man movimenc". The content of the window is the man page for the "movimenc" command. The page starts with the NAME section, which describes "movimenc" as a MovIM encoder. It then moves to the SYNOPSIS section, which shows the command syntax: "movimenc [input_options] -i input_file [encoding_options] [output_options] -o output_file". Below this is the DESCRIPTION section, which states that "MovIM is a video codec specifically designed for both conservation and restoration of moving images." It also mentions "libmovim" as a C library and "movimenc" as its associated utility. The OPTIONS section includes a "GENERAL OPTIONS" header with a colon and a red square symbol.

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Terminal — less - man movimenc

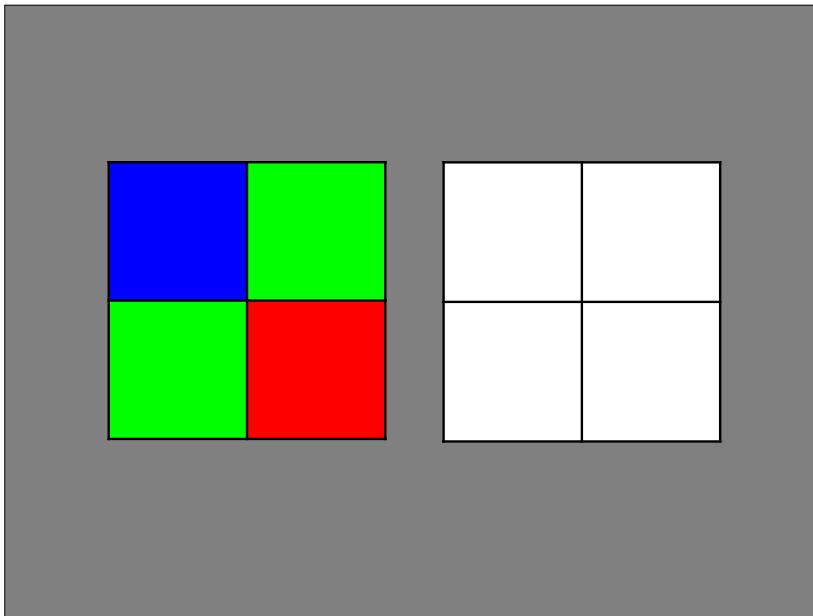
--demosaic={BLI|BCI|LR|VNG|SI|PG|AMZE|HQLI|AHD|DLMMSEE}
    demosaic a Bayer-encoded input_file into an RGB output_file

This option allows to choose between different demosaicing
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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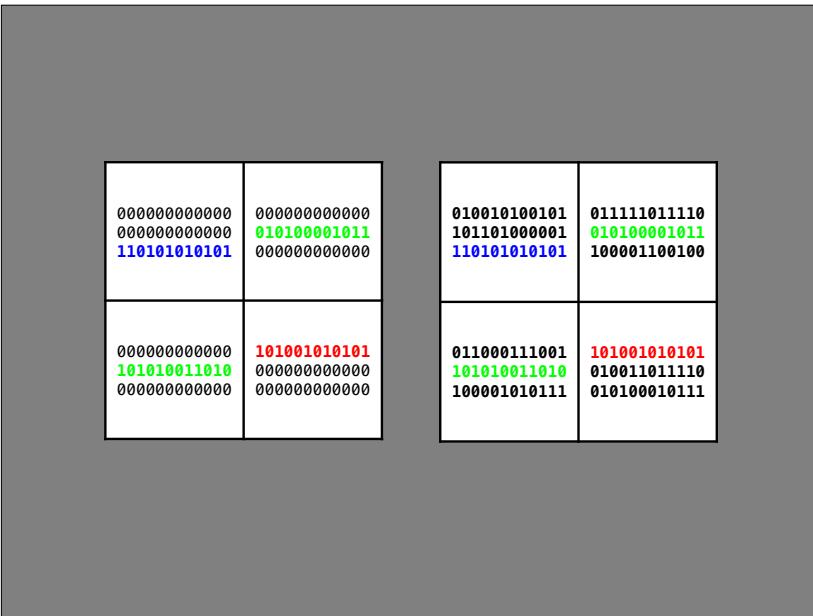
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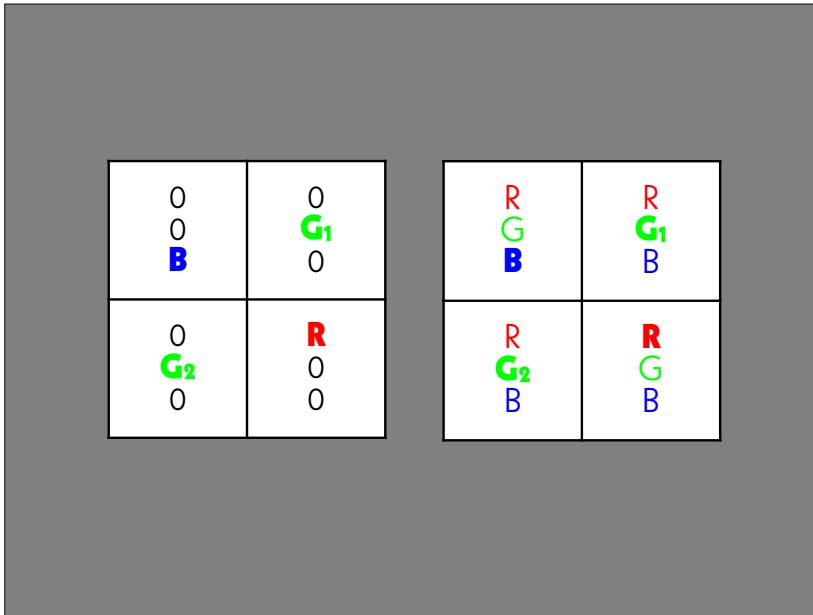
0111010100101010100010110101011110
01001101010101010100001011101010
0111010100101010100010110101011110
0001110101010101010100001011101010
011010101010101010100010111111111
0010101010101010000101110101010000
01110101001010101000101110101011110
0101010101010101000010111010100110
100101110101001010101010001011010101
11100101010101010000101110101010
0111010100101010100010110101011110
010101010101010011101010100000001
0010100010101010101001010101010101

```

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0111010100101010100010110101011110
01001101010101010100001011101010
0111010100101010100010110101011110
00011101010101010100001011101010
01101010100101010001011010101111
001010101010100001011101010000
011101010010101000101110101011110
010101010101000010111010100110
1001011101001010101000101101010101
11100101010101010000101110101010
0111010101010100010110101011110
010101010101001101010100000001
0010100010101010100101010101010101

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Terminal — less - man movimenc
--bayer2rgb={bggr|rggb|gbrg|grbg}
transform a Bayer-encoded input_file into an RGB output_file with
half of the horizontal and vertical resolution

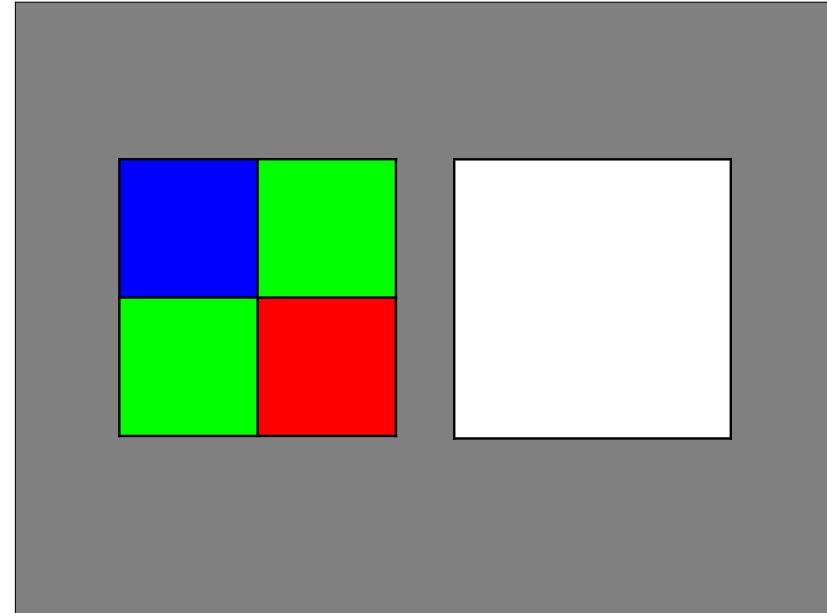
This option allows to generate a full RGB file at half pixel
resolution from the raw stream of almost any current camera. The
following four standard filter patterns are implemented:

bggr = +-----+
| blue | green |
+-----+
| green | red |
+-----+
rggb = +-----+
| red | green |
+-----+
| green | blue |
+-----+
gbrg = +-----+
| green | blue |
+-----+
| red | green |
+-----+
grbg = +-----+
| green | red |
+-----+
| blue | green |
+-----+

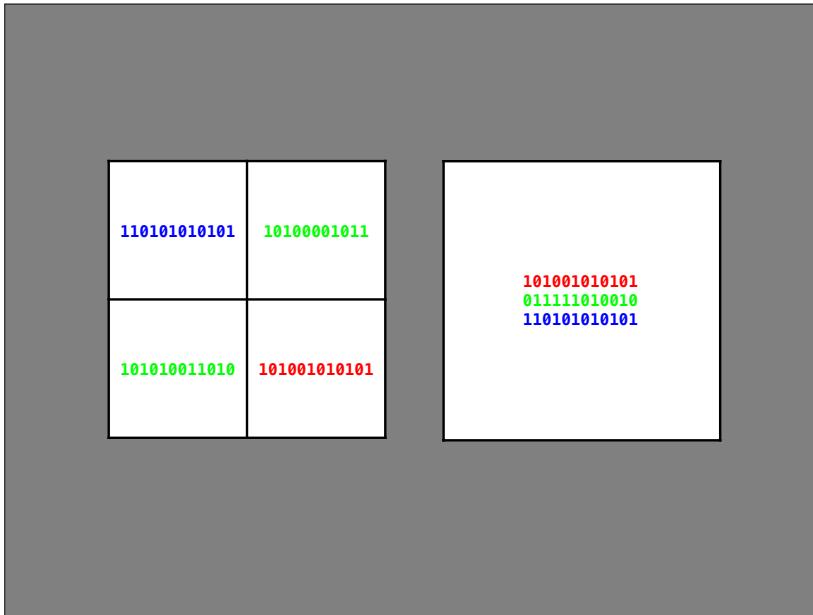
--demosaic={BLI|BCI|LR|VNG|SI|PG|AMZE|HQLI|AHD|DLMMSEE}
demosaic a Bayer-encoded input_file into an RGB output_file

This option allows to choose between different demosaicing
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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

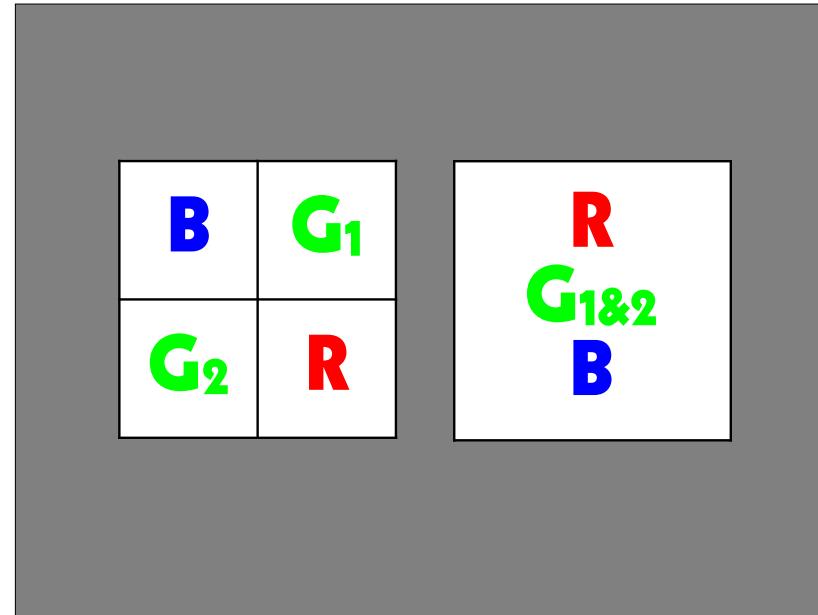
DESCRIPTION
  MovIm is a video codec specifically designed for both conservation and
  restoration of moving images.

  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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Acknowledgements

- Tommy Aschenbach
- Claudio Weidmann
- Jim Lindner
- Carl Eugen Hoyos
- Peter Bubestinger-Steindl
- Jérôme Martinez
- Michael Niedermayer

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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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