Sensor Design and Video Codec Design

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Open Isn't Enough (= No Time to Wait 5)
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Summary

- Bayer sensors
- lessons learned with MovIm
- suggestions for FFV1

United States Patent [19]
Bayer

[11] 3,971,065
[45] July 20, 1976

[54] COLOR IMAGING ARRAY

[75] Inventor: Bryce E. Bayer, Rochester, N.Y.
[73] Assignee: Eastman Kodak Company, Rochester, N.Y.

[22] Filed: Mar. 5, 1975
[21] Appl. No.: 555,477

[52] U.S. Cl. ..... 358/41; 350/...; 350/... 358/...
[51] Int. Cl.[2] H04N 9/24
[58] Field of Search ..... 358/44, 45, 46, 47, 358/48; 350/317, 162 SF; 315/169 TV

[56] References Cited
UNITED STATES PATENTS

2,446,791	8/1948	Schroeder	358/44
2,508,267	5/1950	Kasperowicz	358/44
2,884,483	4/1959	Ehrenhaft et al.	358/44
3,725,572	4/1973	Kurokawa et al.	358/46

Primary Examiner—George H. Libman
Attorney, Agent, or Firm—George E. Grosser

[57] ABSTRACT

A sensing array for color imaging includes individual luminance- and chrominance-sensitive elements that are so intermixed that each type of element (i.e., according to sensitivity characteristics) occurs in a repeated pattern with luminance elements dominating the array. Preferably, luminance elements occur at every other element position to provide a relatively ... sampling pattern which is uniform in ... ticular directions (e.g., horizontal and vertical ... chrominance patterns are interlaid therewith and fill the remaining element positions to provide relatively lower frequencies of sampling.

In a presently preferred implementation, a mosaic of selectively transmissive filters is superposed in registration with a solid state imaging array having a broad range of light sensitivity, the distribution of filter types in the mosaic being in accordance with the above-described patterns.

11 Claims, 10 Drawing Figures

Bayer

Past Presentations Include

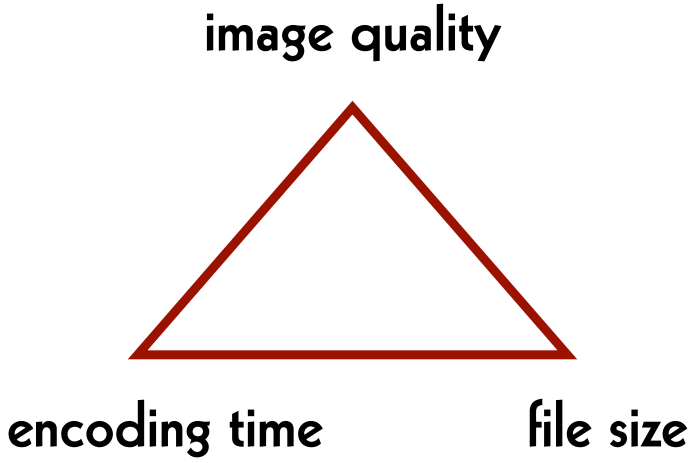
2015-04-02
- The Colour Model Y′CoCg

2018-06-22
- Y′CoCg for Fun and Profit

2019-02-27
- Working Beyond RGB

Digital Video

- resolution
- bit depth
- linear, power, logarithmic encoding
- colour model
- chroma subsampling and compression
- illuminant



Uncomfortable Truths

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

Bryce E. Bayer (1929–2012)

United States Patent [19]

Bayer

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[45] **July 20, 1976**

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In a presently preferred implementation, a mosaic of selectively transmissive filters is superposed in registration with a solid state imaging array having a broad range of light sensitivity, the distribution of filter types in the mosaic being in accordance with the above-described patterns.

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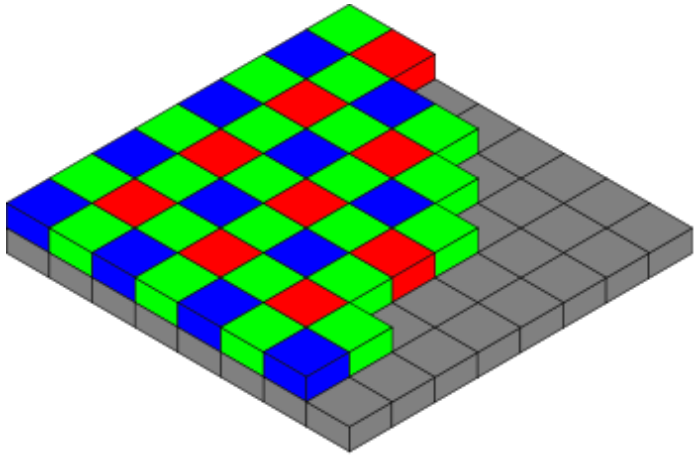

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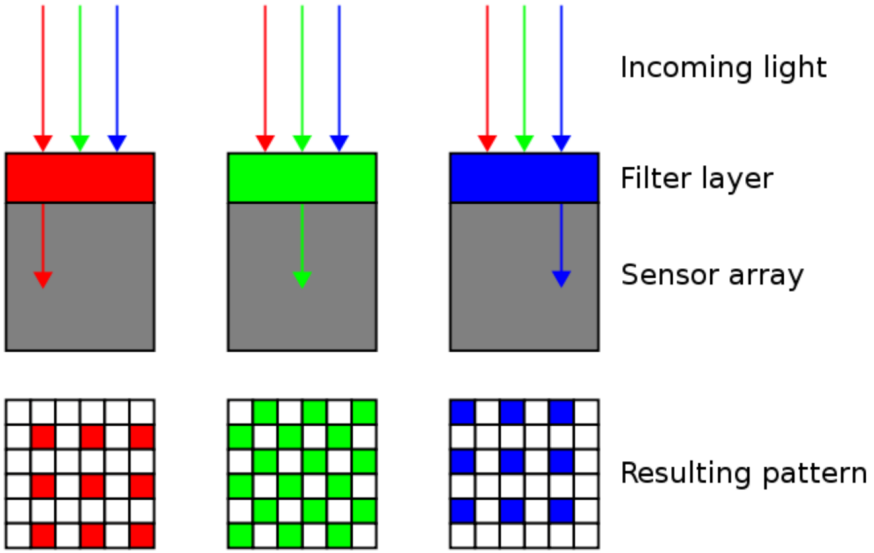

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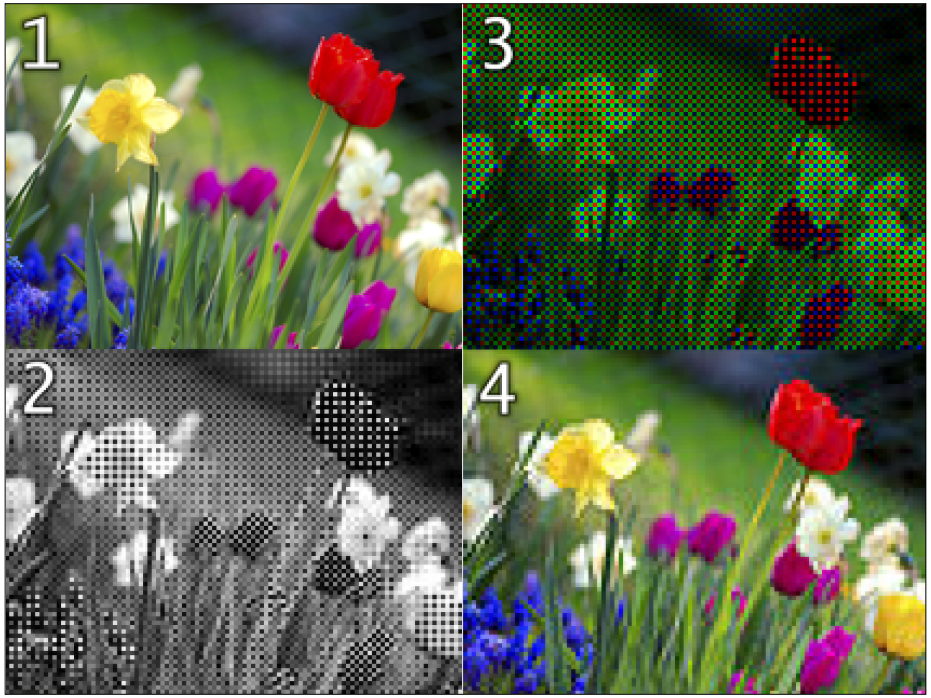

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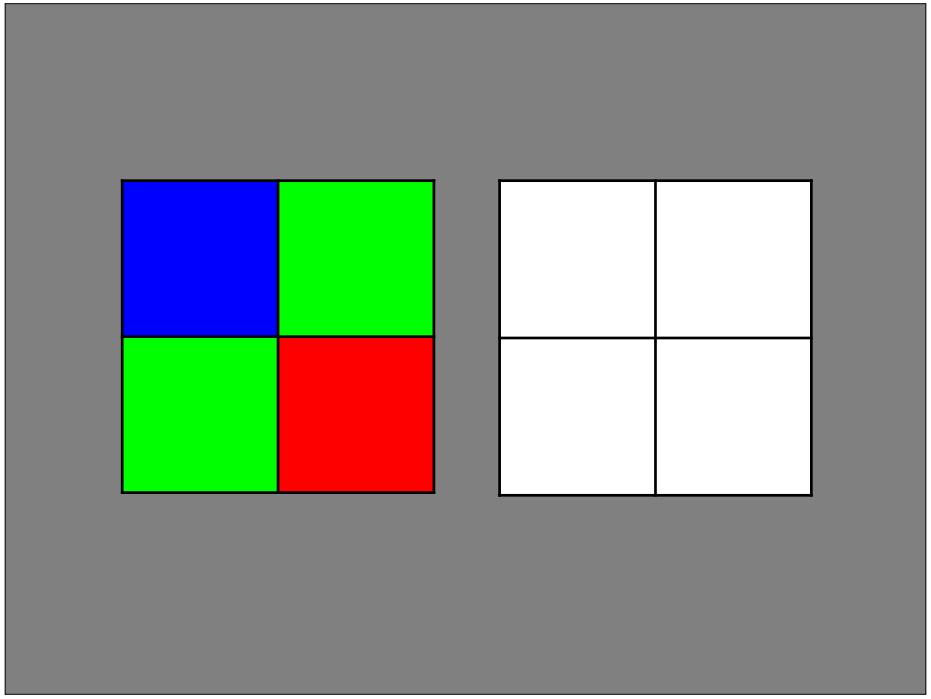

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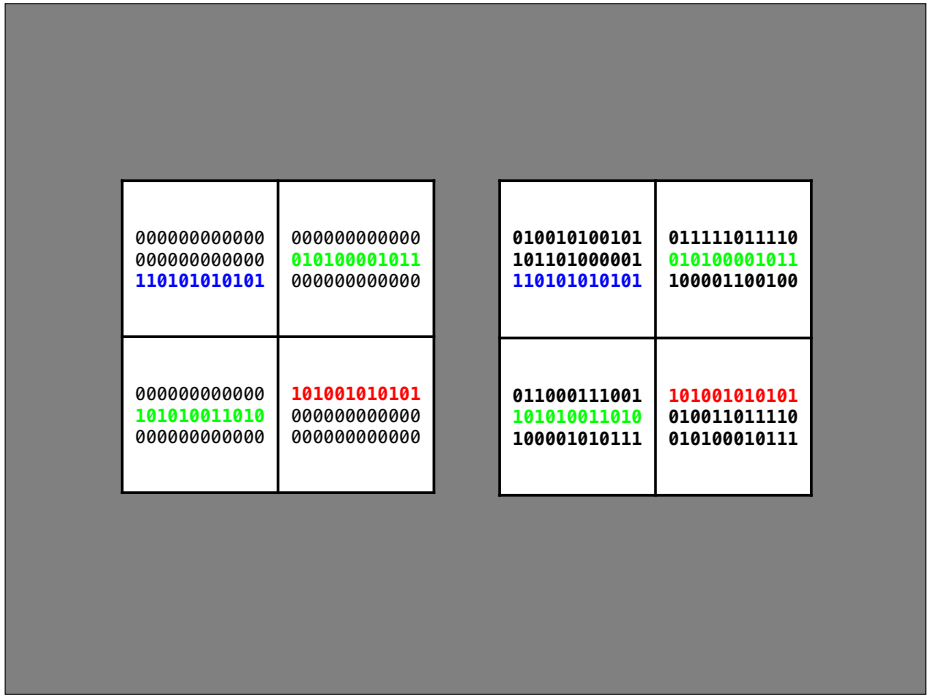

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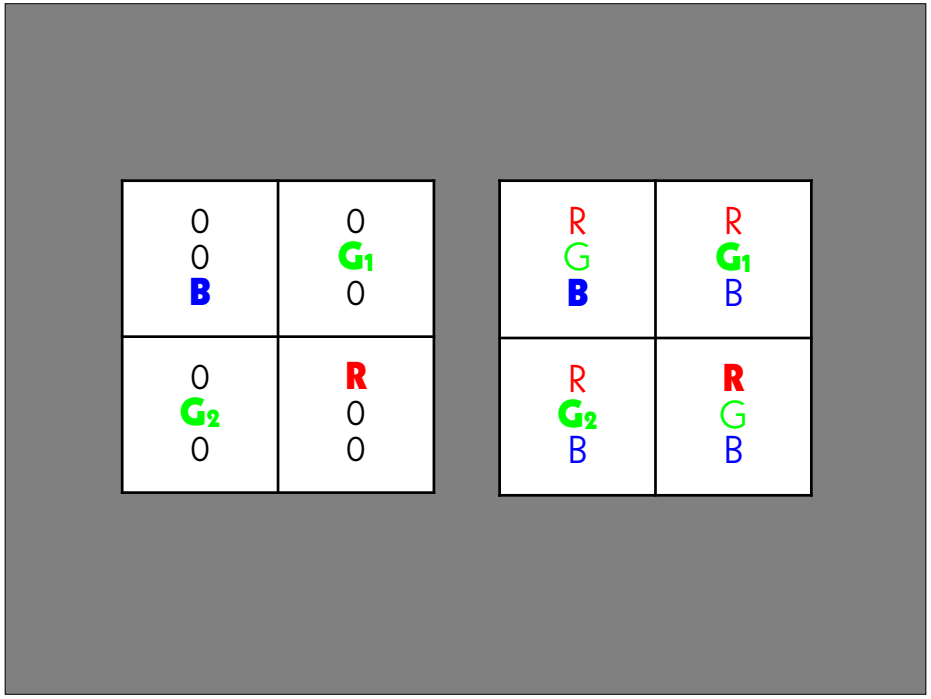

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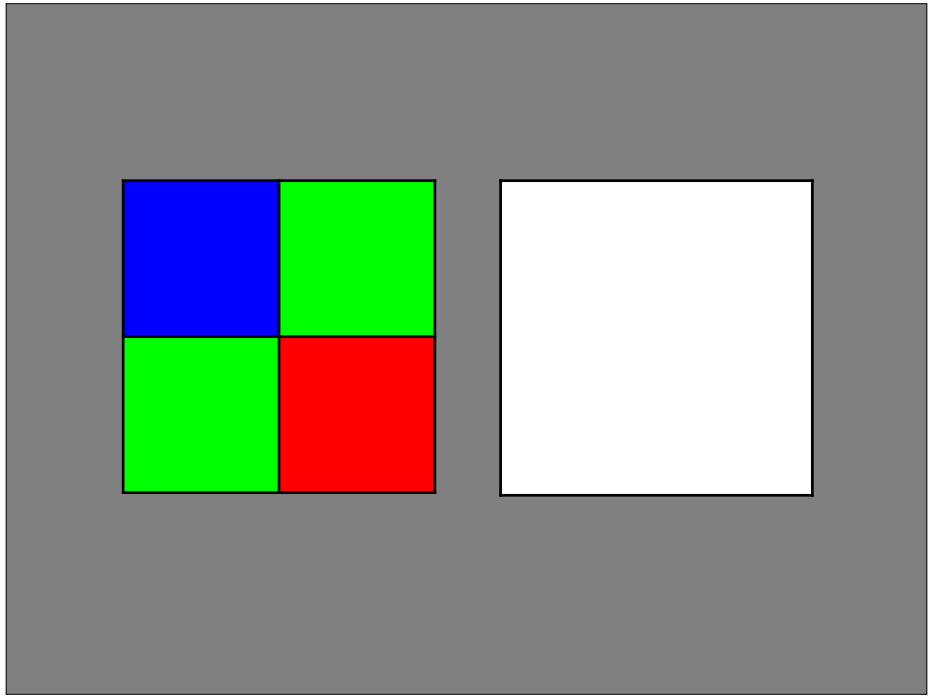

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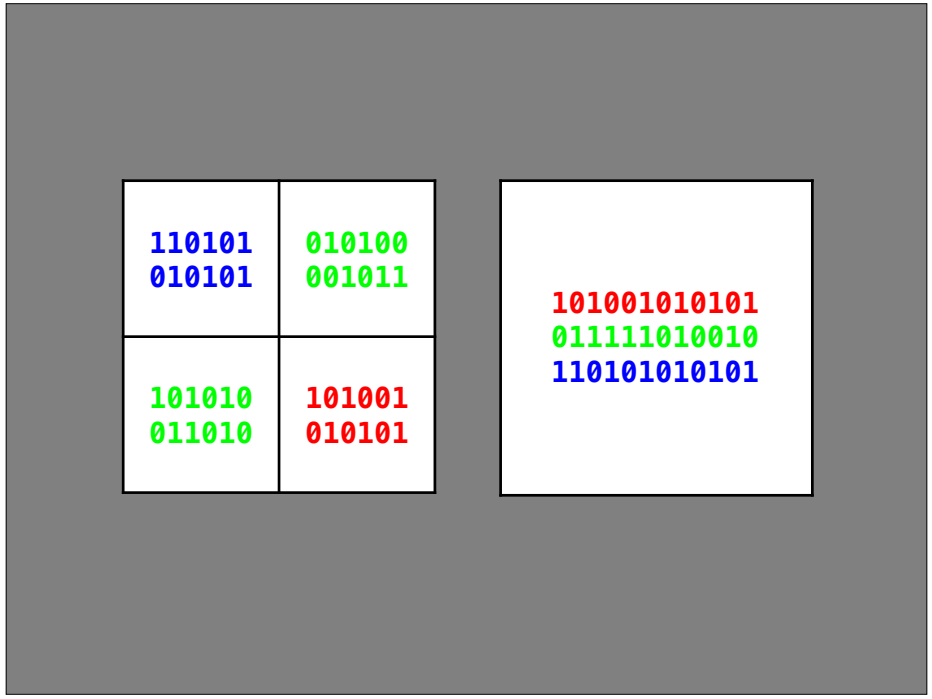

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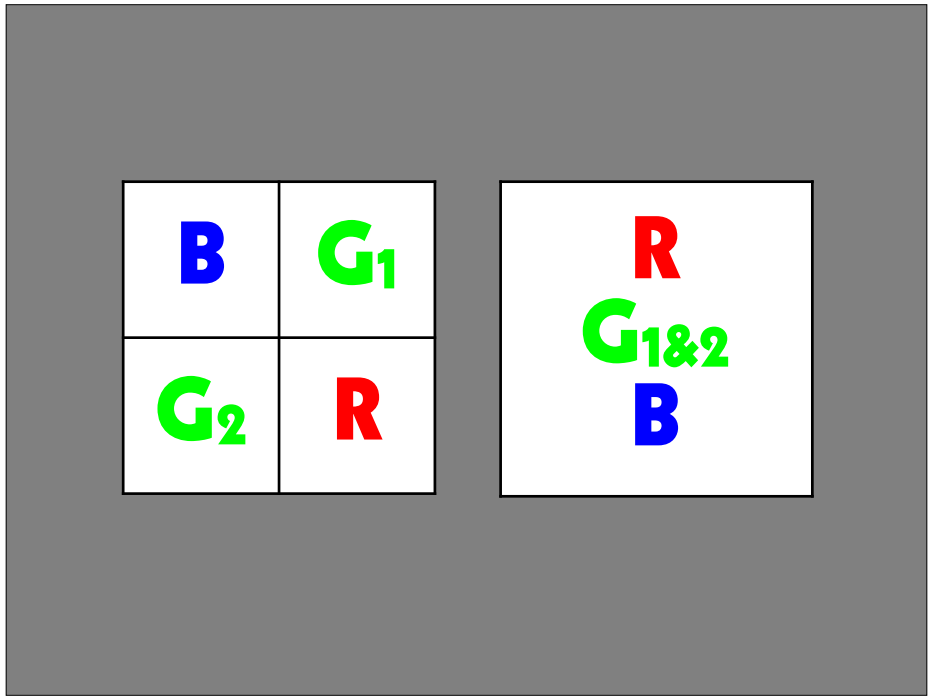

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Two ways to use Bayer data

digital blow-up to RGB

- 3 times the amount of the generated data
- the file has the full sensor resolution
- only ⅓ of the data are real

digital reduction to RGB

- ¾ the amount of the generated data
- the file has ½ of the sensor resolution
- all data are real

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Terminal

~/Desktop — 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 [illegible]sampling
    - VNG = variabl[illegible]m of g[illegible]ers
    - SI = spline [illegible]terpola[illegible]
    - 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)

INFORMATIVE OPTIONS
    -h, --help
:
```

MovIm

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Fast Dump Gate Trailing Delay	T_{FDT}	0.5			µs	
VCCD Line Clock Leading Edge Delay	T_{VL}	0.2	0.3	0.4	µs	
VCCD Line Clock Trailing Edge Delay	T_{VT}	0.0	0.2	0.4	µs	

MAIN TIMING – CONTINUOUS MODE

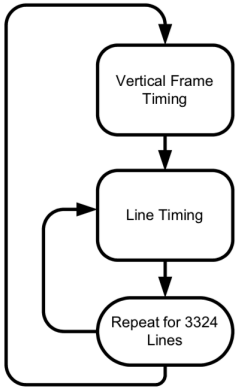

Figure 8: Main Timing - Continuous Mode

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Stream: Internet Engineering Task Force (IETF)
RFC: 9043
Category: Informational
Published: August 2021
ISSN: 2070-1721
Authors: M. Niedermayer D. Rice J. Martinez

RFC 9043
FFV1 Video Coding Format Versions 0, 1, and 3

FFV1

Abstract

This document defines FFV1, a lossless, intra-frame video encoding format. FFV1 is designed to efficiently compress video data in a variety of pixel formats. Compared to uncompressed video, FFV1 offers storage compression, frame fixity, and self-description, which makes FFV1 useful as a preservation or intermediate video format.

Status of This Memo

This document is not an Internet Standards Track specification; it is published for informational purposes.

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EBML: Directions

- support of Gray code (in addition to regular binary)

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Frank Gray (1887–1969)

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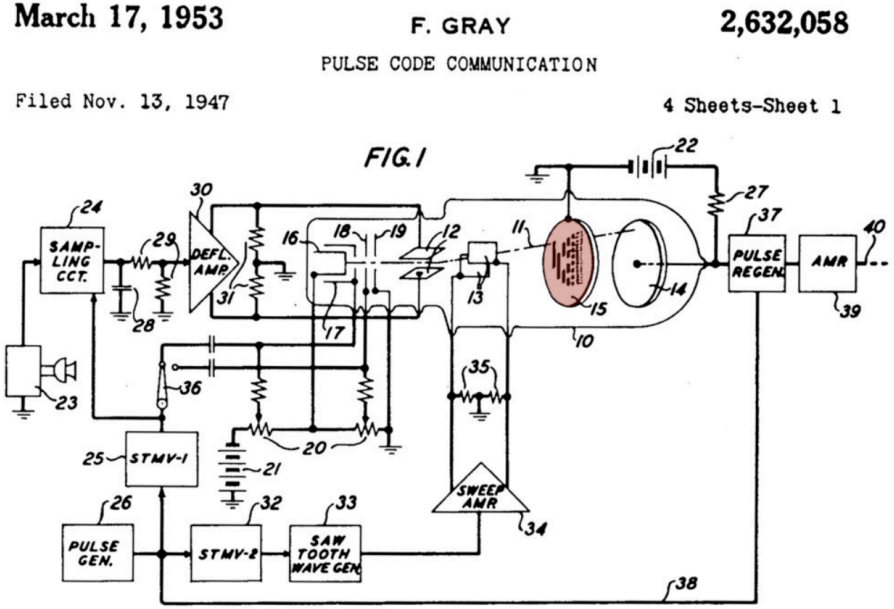

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FFV1: Directions (1)

- support of the Y′CoCg colour model
- support of any channel
- support of Bayer-type data

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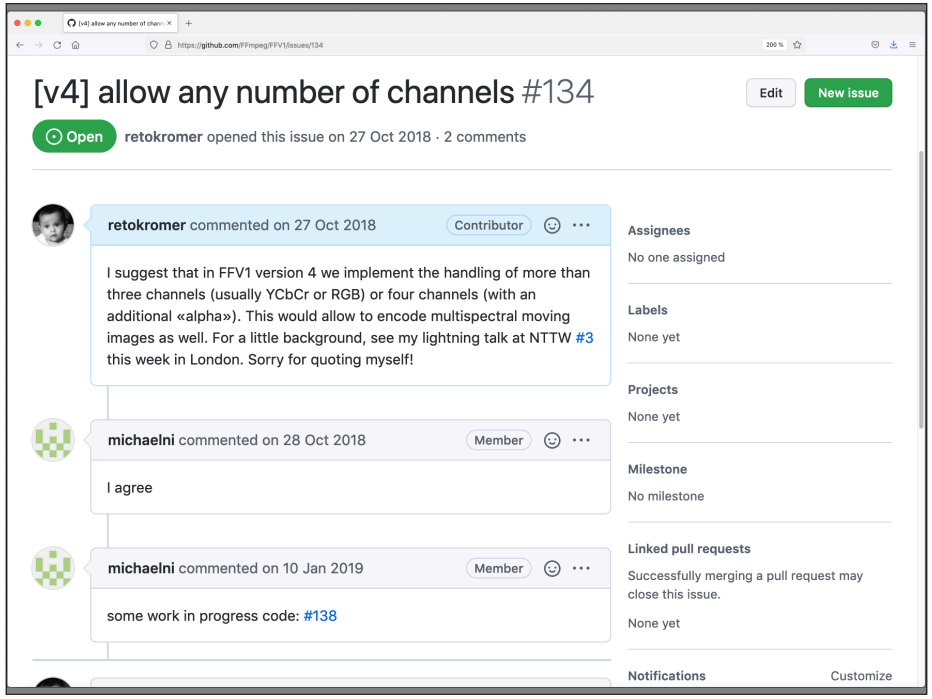

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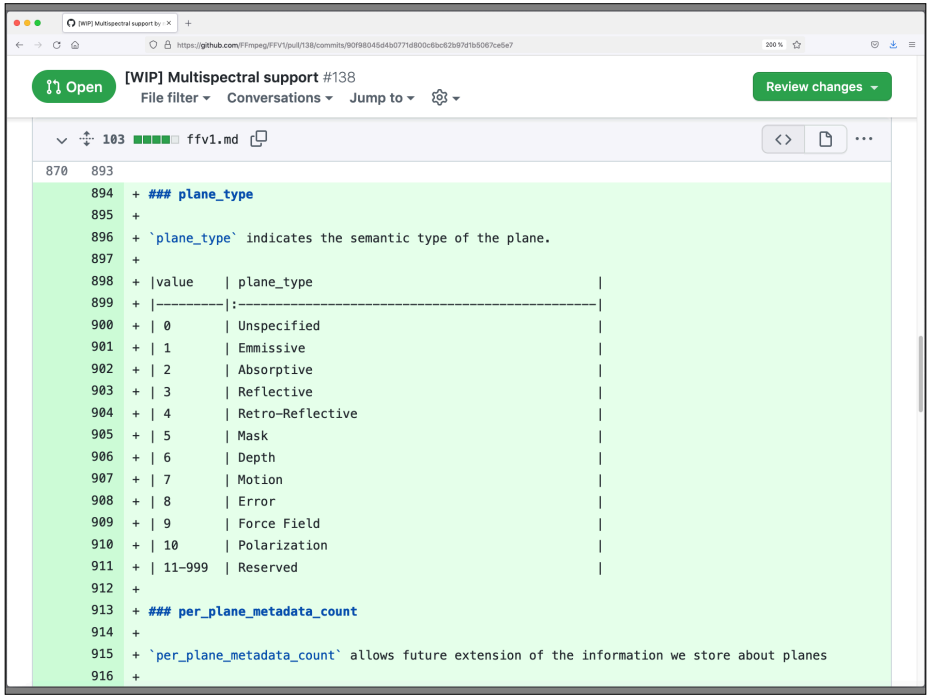

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FFV1: Directions (2)

- support of 1D and 3D LUTs
- support of HDR
- revision of the bit stream
- tuning of the compression algorithm (speed and rate)

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