

**NAME**

**devas-filter** – simulate loss of acuity and contrast sensitivity

**SYNOPSIS**

**devas-filter** *preset-option* {*input.hdr* | -} {*output.hdr* | -}

or

**devas-filter** [*options*] *acuity contrast* {*input.hdr* | -} {*output.hdr* | -}

**DESCRIPTION**

Filter a RADIANCE picture to simulate the reduced visibility associated with loss of visual acuity and contrast sensitivity, writing the result to a new RADIANCE picture. The input picture must have a VIEW record indicating field of view. It can be in rgbe or xyze pixel format. The input can optionally be "-", indicating that the original picture should be read from standard input. The output picture will be in rgbe pixel format, regardless of the pixel format of input. The output can optionally be "-", indicating that the filtered picture should be written to standard output.

*acuity* is specified in terms of a Snellen ratio or a logMAR value. *contrast* is specified in terms of either the ratio of the desired Michaelson contrast sensitivity to normal vision contrast sensitivity or as a Pelli-Robson Chart score.

The modeling underlying **devas-filter** does not address small differences in visibility over the range of normal vision, i.e., from -0.3 to 0.3 logMAR. As a result, specifying an *acuity* value less than 0.3 logMAR (20/40 Snellen) normally results in a fatal error. The flag `--allow_normal_vision` overrides the behaviour, but at the peril of the user if things go bad. Missing contrast sensitivity values, which are common, are bad if you want calibrated results. Very small value of specified contrast sensitivity can also be bad, because the Pelli-Robson test and many other contrast sensitivity tests are inaccurate at low sensitivity levels. If the `--approxCS` flag is given, an estimate of contrast sensitivity based on *acuity* is used and the value is also printed to *stdio*. No contrast sensitivity value should be specified. `--approxCS` quiet the estimated contrast sensitivity to be used, but does not generate any output message.

**OPTIONS**

*preset-options*: `--mild` | `--moderate` | `--significant` | `--severe`

Specifies use of one of four predefined levels of acuity and contrast deficits, along with a corresponding loss in color sensitivity. A fifth preset is also available, `--legalblind`. This specifies the U.S. "legal blindness" acuity level along with appropriate contrast sensitivity and color sensitivity values. Note that this specifies a level of visual impairment right at the legal blindness cutoff point. It is not some sort of test of legal blindness. When any of the presets are specified, the *acuity* and *contrast* arguments are left off the command line. Only one of the preset flags can be specified. When presets are used, other options relating to acuity and contrast are disabled.

`--Snellen` | `--logMAR`

Specifies the format of the *acuity* argument. `--Snellen` is the default. Snellen ratios can be given as a single decimal value or in the common "n/m" (in the U.S., usually "20/m") fractional form. logMAR values are given in the conventional manner or as a single number.

`--cutoff` | `--peak`

Indicates that *acuity* is specified with respect to cutoff or peak contrast sensitivity. `--cutoff` is the default, and corresponds to the values usually reported in clinical eye examinations.

`--sensitivity-ratio` | `--pelli-robson`

Indicates that *contrast* is specified as a ratio of desired contrast sensitivity to normal vision contrast sensitivity (`--sensitivity-ratio`) or as a Pelli-Robson Chart score (`--pelli-robson`). `--sensitivity-ratio` is the default.

`--autoclip` | `--clip=level`

Large magnitude input luminance values are reduced to a lower level. This is most useful in reducing filtering artifacts due to small, bright light sources. For `--autoclip`, the level at which values are clipped is chosen automatically. For `--clip`, values larger than *level* are reduced to *level*, with *level* specified in  $\text{cd/m}^2$ . Default is no clipping.

**--approxCS | --approxCSquiet**

Often, the only available property for specifying a particular level of low vision is acuity. Low vision very often also involves a loss of contrast sensitivity. Including one of these option flags causes the program to estimate a level of contrast sensitivity loss appropriate to the specified loss of acuity given on the command line. It is important to note that this is just a rough estimate, and may be far from the actual contrast sensitivity of an individual with the specified acuity. The **--approxCS** flag causes a message to be written to stderr giving the value of contrast sensitivity that was chosen. **--approxCSquiet** skips this informative message. In either case, do not explicitly specify a contrast value.

**--approxSaturation | --approxSaturationquiet**

Significant loss of acuity and contrast sensitivity is often associated with color vision deficiencies, though there is little data on the correlation between the severity of acuity and contrast loss and the type and severity of color vision loss. Visibility judgments made by **devas-visibility** depend only on luminance and so are unaffected by color deficits. For simulation of low vision views produced by **devas-filter** and **devas-visibility**, we have chosen to reduce the color saturation as a function of acuity using an ad hoc formula that is not based on any empirical evidence and is only an aesthetic judgment made by the **devas-filter** software designer.

**--color | --grayscale | --saturation=value**

Indicates amount of desaturation. **--color**: no desaturation. **--grayscale**: full desaturation. **--saturation=value**: partial desaturation, scaled by value in range (0.0 - 1.0), with low values indicating more desaturation. **--color** is the default.

**--margin=value**

Add a margin around the input file to reduce FFT artifacts due to top-bottom and left-right wrap-around. *value* is a number in the range (0.0 -- 1.0]. It specifies the size of the horizontal and vertical padding as a fraction of the original horizontal and vertical size.

**--version**

Print version number and then exit. No other flags or arguments are required. (**-v** also works.)

**--presets**

Print out acuity, contrast sensitivity, and color saturation parameters associated with the presets **--mild**, **--moderate**, **--severe**, and **--profound**. No other flags or arguments are required.

**--verbose**

Print possibly informative information about a particular run.

**EXAMPLES**

To simulate moderate loss of acuity, contrast sensitivity, and color sensitivity:

```
devas-filter --moderate in.hdr out.hdr
```

To simulate 20/200 acuity without loss of peak contrast sensitivity:

```
devas-filter 20/200 1 in.hdr out.hdr
```

Equivalently, using logMAR notation for acuity:

```
devas-filter --logMAR 1.0 1 in.hdr out.hdr
```

To do the same filtering but output a grayscale image:

```
devas-filter --grayscale --logMAR 1.0 1 in.hdr out.hdr
```

To simulate a peak frequency sensitivity of 10% of normal vision and a peak contrast sensitivity at that frequency corresponding to 20% of normal vision:

```
devas-filter --Snellen --peak 0.1 0.2 in.hdr out.hdr
```

To simulate 20/400 acuity and a contrast sensitivity indicated by a Pelli-Robson Chart score of 1.0:

```
devas-filter --pelli-robson 20/400 1.0 in.hdr out.hdr
```

**AUTHOR**

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