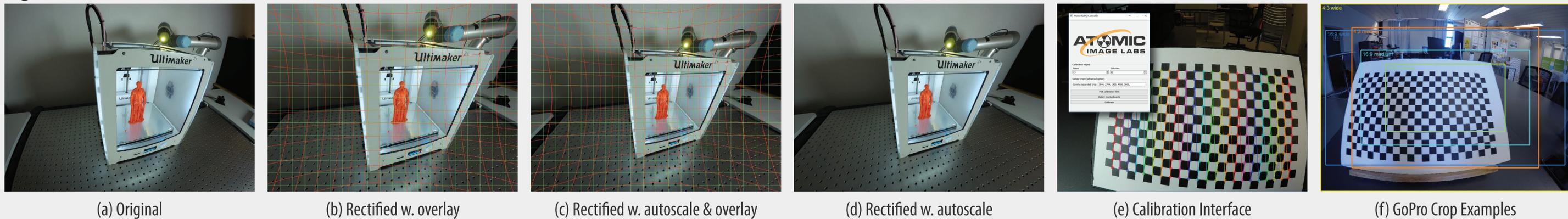


# Photon Rectify: *Undistort any footage on the timeline*

Figure 1



## Abstract

Photon Rectify is a plugin for your preferred Adobe video editing tool, providing accurate real-time camera rectification of lens-distorted video footage from any camera. The plugin provides a selection of pre-calibrated presets for popular action cameras, functionality for custom camera calibration for new cameras and lenses, automatic scaling of content to maximize valid sensor coverage, as well as blending controls for flexibility. Bridging a gap from computer vision to video production, it brings true lens correction to the timeline of your video editor.

## Introduction

Action cameras have allowed footage from previously unseen points of view, drones allow for innovative aerial shots, which a few years ago, were either impossible or required a helicopter, and finally DSLR video and lens adaptors have made *any* lens available for video production. These advances provide especially low-budget movie productions with completely new flexibility and potential.

Due to multiple factors such as: size-limitations, cost, and the desire for a wide field of view, footage might suffer from noticeable lens distortions (fig. 1a). To mitigate distortion proper lens correction must be carried out. Photon Rectify aids movie productions in doing so by enabling fast and accurate lens-correction right on the timeline in the industry standard video editing tools, Adobe After Effects and Adobe Premiere. While Adobe Photoshop provides tools and presets for rectification of photos acquired through *some* cameras and lenses, only primitive deformation tools are available for timeline video editing. Photon Rectify brings accurate camera calibration and such rectification to video editing following the computer vision de facto standard [Bradski and Kaehler 2008; Zhang 1999].

## Undistortion

Given an image center,  $(c_x, c_y)$  and a camera focal length,  $f$ , in pixel units, a pixel coordinate  $(x, y)$  may be represented in normalized, centered coordinates and have a (squared) radial distance by:  $\hat{x} = \frac{x-c_x}{f}$ ,  $\hat{y} = \frac{y-c_y}{f}$ ,  $r^2 = \hat{x}^2 + \hat{y}^2$

Iterating over the output image,  $(\hat{x}_{out}, \hat{y}_{out})$  undistortion can be achieved by sampling in the input image  $(x_{sample}, y_{sample})$  according to the lens distortion as shown in fig. 2:

$$\hat{x}_{sample} = \hat{x}_{out} \cdot dist_{radial} \quad \hat{y}_{sample} = \hat{y}_{out} \cdot dist_{radial}$$

Where  $dist_{radial}$  is a 6th order polynomial, which describes the radial distortion:

$$dist_{radial} = 1 + K_1 r^2 + K_2 r^4 + K_3 r^6$$

## Optimal Scaling

Depending on the type of radial distortion, content may either bulge outwards (barrel), bend inwards (pincushion), or a combination of both (mustache). As a consequence, pixels may be lost or empty regions may occur, if proper scaling of the footage is not applied (fig. 2). Scaling may be achieved by:

$$\hat{x}_s = \hat{x} \cdot s \quad \hat{y}_s = \hat{y} \cdot s \quad r_s^2 = r^2 \cdot s^2$$

Leading to a scaled distortion polynomial:

$$dist_{radial, scaled} = 1 + K_1 r^2 s^2 + K_2 r^4 s^4 + K_3 r^6 s^6$$

Where optimum scaling ( $s$ ) can be found when:

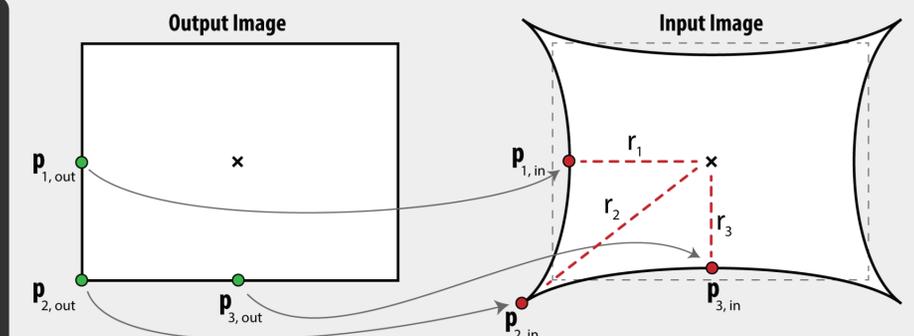
$$\begin{aligned} \hat{x}_{out} &= \hat{x}_{sample, s} \\ \hat{x}_{out} &= \hat{x}_{out} \cdot s \cdot dist_{radial, scaled} \\ 0 &= s \cdot dist_{radial, scaled} - 1 \end{aligned}$$


Figure 2 Sampling in the input image according to image distortion. An optimum scaling of sampling can be found such that no pixels outside the input image are looked up.

## Features

- Presets:** Holds a range of presets for popular action cameras.
- Scaling:** Automatic scaling of content to its optimum size (fig. 1c-d).
- Correction blending:** For artistic needs, a blending control allows smoothly turning on or off the effect.
- Calibration tool:** Easily add and share your own lens-profile to the plugin using the included calibration tool (fig. 1e-f).

## Get the plugin

Interested in using our plugin? Our plugin is supported by both Adobe Premiere and Adobe After Effects and is available for both Mac and PC users. Download the plugin at:

[www.AtomicImageLabs.com](http://www.AtomicImageLabs.com)

