70th birthday series

On the term "Field of View Crop Factor"

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ABSTRACT

Starting in about 2002, it became fashionable in some parts of the photographic community to use the term "field of view crop factor" (or some condensation of that) to refer to the inverse of the ratio of a dimension of the format (frame size) of a certain camera to the same dimension of the format of a full-frame 35-mm still film camera. This ratio is most commonly used to allow determination of the "full-frame 35-mm equivalent focal length" of a certain lens as used on a certain camera, a metric that is used to compare the field of view given by various lenses as used on various cameras.

The author believes that the word "crop" has no business in the name of this factor, and in this article explains why.

BACKGROUND

Field of view

Field of view refers to the amount of the universe taken in by a camera and captured on its image. The field is a three-dimensional region of infinite "depth", typically in the shape of a rectangular pyramid. Its "size" can be expressed by giving its included angle in both directions, either in angular measure (for example, in degrees) or in terms of its height and width at some arbitrary range (another legitimate way of describing an angle).

Assuming a "rectilinear" lens, and focus at infinity, the field of view of a camera is determined by the focal length of the lens and the dimensions of the format (the size of the film frame or digital sensor).

Many photographers never come to grips with the various fields of view provided on their camera through use of different lens focal lengths in terms of the angular size of the field. Rather, they just come to learn, on their camera, which focal lengths provide a field of view suitable for various photographic tasks.

In light of this, there has developed the convention of speaking of the field of view that would be given by a lens of a certain focal length on a camera with a certain format size in terms of the "full-frame 35-mm equivalent focal length". This number is the answer to the question, "what focal length lens, used on a full-frame 35-mm still film camera, would give the same field of view that **this** lens gives on **this** camera."

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The full-frame 35-mm equivalent focal length can be calculated by taking the focal length of the lens of interest and dividing it by the relative size of the format of the camera of interest compared to the format size of a full-frame 35-mm still film camera (36 mm x 24 mm, in fact).

Since it is generally easier to multiply “in one’s head” than divide, most commonly we actually make this calculation by taking the focal length of the lens of interest and multiplying it by the **inverse** of the relative size of the format of the camera of interest. That inverse ratio is often called the “full-frame 35-mm equivalent focal length factor” of the camera (or format size) of interest.

Sometimes this matter has been misconstrued as meaning that the focal length of a lens is somehow multiplied when it is used on a camera whose format is smaller than that of the full-frame 35-mm camera. Of course, the focal length of a lens is not affected by the camera on which it is mounted (if any). An interchangeable lens with a focal length of 50 mm has that focal length when mounted on a full-frame 35-mm (FF35) camera, when mounted on a smaller format (SF) camera, or when in its carton. The “full-frame 35-mm equivalent focal length” is not a focal length of the lens—it is merely the answer to the question stated earlier.

“Crop factor”

Perhaps in part because of this misunderstanding,[1] some people came to be uneasy with the term “full-frame 35-mm equivalent focal length factor” (which is actually quite apt).

One reaction to this is the emergence, *ca*. 2002, in some quarters of the photographic community, of the term “field of view crop factor” (and various derivatives and condensations of it, such as “crop factor” or even just “crop”) to refer to the inverse ratio being discussed here, and thus generically to cameras having a certain format size.

The author believes that terms involving the word “crop” are inappropriate for this factor, and in fact can serve to stimulate or cultivate misunderstandings in this area of interest.

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[1] And perhaps partly because the factor does, infrequently, appear in photographic calculations involving comparisons with a full-frame 35-mm camera other than involving field of view and thus “equivalent focal length”.

DEBUNKING THE RATIONALES

The proponents of the “crop” term generally offer two rationales for it, which I will address here.

The “field of view is cropped” rationale

The phenomenon of most interest here is that the field of view of a “smaller format” (SF) camera equipped with a certain focal length lens is smaller than the field of view of an “FF35” camera equipped with a lens of the same focal length.[2]

The proponents of the “crop” term say that “the field of view given by a lens of a certain focal length on an SF camera is ‘cropped’ from the field of view given by a lens of that same focal length on an FF35 camera.”

But is isn’t cropped from anything. It is merely smaller. In photography, we use the term “crop(ping)” to refer to the extraction of a portion of an image for further attention, discarding the rest. It is not an apt term to describe a thing that is smaller than another thing. We would not say, for example, that a 5” X 7” picture frame is “cropped” from an 8” X 10” picture frame.

Defending their position, the proponents argue that, in the SF camera, the field of view that a lens of that focal length would produce on an FF35 camera is “cropped” in the SF camera. But that larger field of view does not exist in the SF camera to be “cropped”.

If the lens is, for example, a Canon EF-S series lens, the “potential” field of view it generates (based on the image generated “in midair”) is conical (“round”), and is larger than the field of view that actually results on that camera, but smaller than the field of view that actually results from a lens of the same focal length on an FF35 camera.

If the lens is a Canon EF series lens, the potential field of view it generates is conical (round), or perhaps approximately pyramidal (“rectangular”), and is larger than the field of view that actually results from a lens of the same focal length on an FF35 camera. So in the SF camera there is no field of view the size of the one of the FF35 camera that can be “cropped” to the size of the field of view we actually have in the SF camera.

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[2] Note that a lens never actually has a field of view—for one thing, it doesn’t capture an image. Only a camera has a field of view.

What we do have is a thing that is smaller than another thing that exists in a different place. The smaller thing is not taken from an instance of the larger thing. Thus this relationship is not an apt use of the word “cropped”.

The “image is cropped” rationale

Proponents of the “crop” term often say that the smaller field of view in an SF camera results from a “cropping of the image”. They argue that the frame of an SF camera “crops” a portion out of a 36 mm X 24 mm image that would be captured by an FF 35 camera.

But there is no 36 mm X 24 mm image formed in the SF camera. If the lens is, for example, a Canon EF-S series lens, the image it generates “in midair” is circular, and is larger than the format size of that camera, but smaller than 36 mm X 24 mm. If the lens is, for example, a Canon EF series lens, the midair image it generates is circular, or perhaps roughly rectangular, and is larger than 36 mm X 24 mm).

But there is no 36 mm X 24 mm image in the SF camera which its camera “crops” to the size it actually captures. What we have is a captured image that is smaller than another image that is captured in a different camera. The smaller image is not taken from the larger image. It’s just smaller. Thus this relationship is not an apt use of the word “cropped”.

SO WHAT SHOULD WE CALL IT

As in most situations, there is no simple name for this numerical factor that precisely explains what it is or what its significance is. In fact, the term “full-frame 35-mm equivalent focal length factor” is probably as good as we can get. Of course, just “35-mm equivalent focal length factor” would be unambiguous in most cases (since it is well recognized that it is the “full-frame” version of the 35-mm still film camera format that is used as our “reference” format), and in many cases, “equivalent focal length factor” would serve. [3]

But please, no “crop”. Let’s reserve that word for its normal photographic meaning.

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[3] I do not endorse the use of “full-frame equivalent focal length factor”, since that does not in any way denote or even suggest a specific format size. (There are many “full frame” formats—potentially one for each film size.)