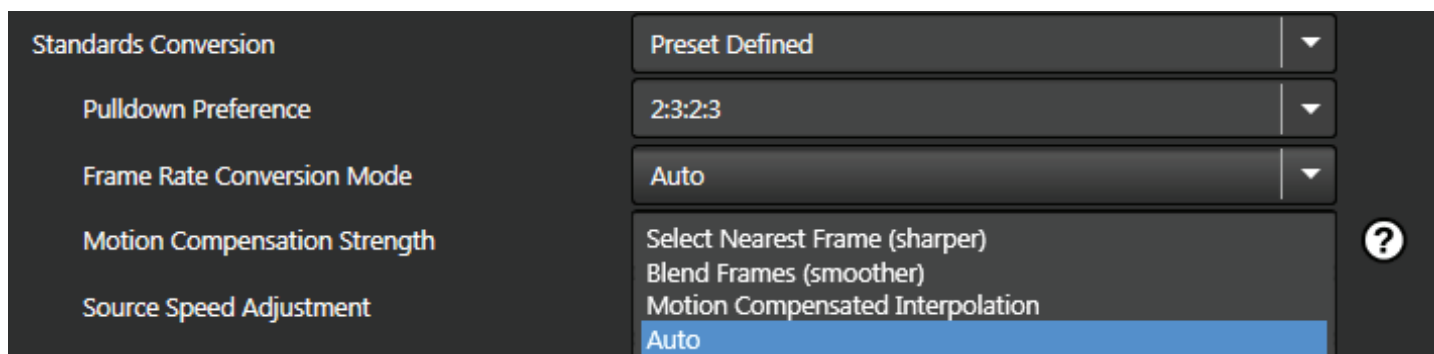


# Feature: Motion-Compensated Frame Rate Conversion



---

## Optimize the Quality of Standards Conversions (PAL to NTSC, 24p to 60p, etc.)

---

### In Brief:

**Product:** Cambria FTC Encoder

**Feature:** Motion-Compensated  
Frame Rate Conversion

**Description:** Optimizes the quality  
of frame rate conversions

**Works with:** All frame rate  
conversions.

Frame rate conversions are a fact of life for many video producers. Sometimes you're merging PAL footage into an NTSC project; sometimes you're adding 24p footage to a 60p project. As with all video processing, there's an optimal way to perform these conversions, and a suboptimal way. If you find yourself converting footage frequently for your Cambria FTC projects, you should consider licensing the Motion-Compensated Frame Rate conversion plug-in, which delivers the optimal approach every time.

As you'll read about in this document, the plug-in enables Motion-Compensated Frame Rate conversion (called Motion-Compensated Interpolation), which is the highest-quality conversion technique available. Even better, Cambria presets deploy this algorithm only when it delivers the best result, so you get the optimal result in all cases, with no user intervention.

## Controlling Frame Rate Conversions

Here's how it works. Once you enable the plug-in, you'll have three options for frame rate conversion available in the Standards Conversion section of the encoding preset, Select Nearest Frame (sharper), Blend Frames (smoother), and Motion-Compensated Interpolation (see above). If you choose Auto, Cambria will apply the technique selected for that preset.

Before defining how they work, let's discuss our demo project to add some context. For this document, we tested each method with a 24p file shot with an ALEXA SXT Plus camera and downloaded from the ARRI site. In our example, we're converting that 24p footage to 60p to add to a 60p project.



***Motion-Compensated Interpolation on the left; Blend on the right.  
Note the ghosting on the right.***

So, we currently have 24 frames per second, and we need 60. The three methods all use different techniques to create those extra 36 frames per second. Here's a brief description.

### **Select Nearest Frame (Sharper)**

In this example (adding frames, as opposed to deleting frames as when converting from 60p to 24p), this technique simply repeats frames in a 2/3 cadence, repeating frame 1 two times, then frame 2 three times, then frame 3 two times, and so on. The frames are the original frames from the video, so the result is very sharp, but since the frames are repeated, the motion isn't smooth.

### **Blend Frames (Smoother)**

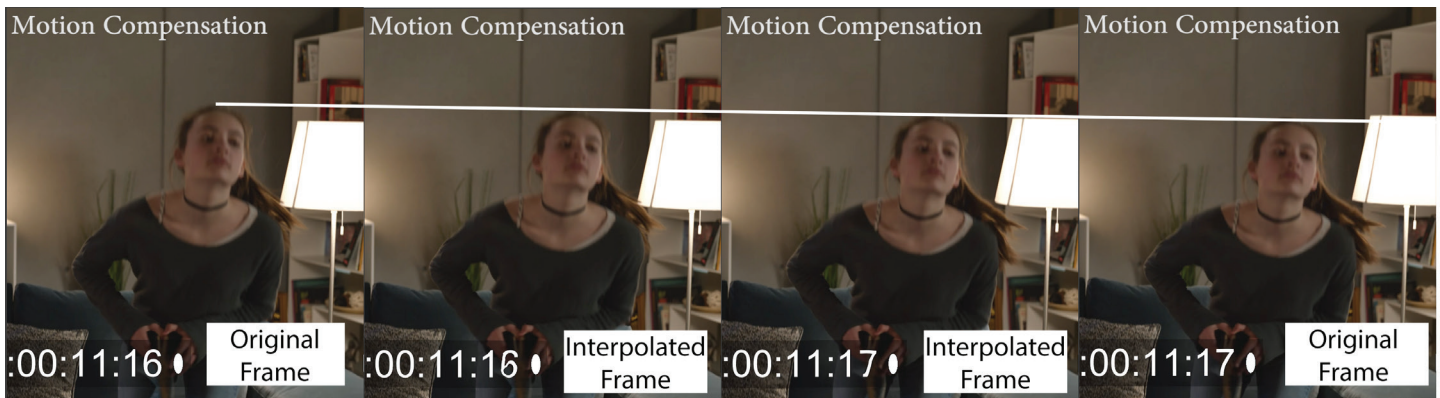
Blend frames is a simple algorithm that blends two frames together to create the necessary frames. Because it simply blends two adjacent frames, often you can get the ghosting shown on the right in Figure 2. Blending is faster than motion compensation,

and smoother than nearest frame, but can produce noticeable artifacts.

### **Motion-Compensated Interpolation**

This is the most sophisticated technique. Briefly, Motion-Compensated Interpolation tracks the moving objects in the frame, and separates them from the background. To create frames as needed for our project, it interpolates the position of the moving objects and combines them with the background. In the ALEXA video, it tracks the motion of the young woman in the video, and then inserts the woman against the background in the frames created by the technique.

This is shown atop the following page. The original frames are on the edges, which is obvious because the text in the timecode is clear. The two middle frames were created by the motion compensation engine, which caused the slight distortion in the time code.



***Original frames on the edges; interpolated frames in the middle.***

***By predicting the girl's motion, the interpolated frames make the motion smoother.***

Note how accurately the technology predicted the woman's motion in the two interpolated frames. This is shown by the white line that tracks the top of her head from slightly above the top of the lamp on the left to slightly below.

## See for Yourself

We created two YouTube videos demonstrating these alternatives side by side. For each video, we converted the frame rate with two techniques, and slowed the video to 25% so the operation of each technique is clear.

The first video (<https://youtu.be/wz9Ynjp1678>), compares Motion-Compensated Interpolation and Blend. In this video, you'll see that the former is both smoother and clearer than the latter. While not evident in all frames, you will see frequent examples of the ghosting shown on the right in the previous page.

The next video compares Motion-Compensated Interpolation and Nearest Neighbor. ([https://youtu.be/kiR\\_KhUZiJo](https://youtu.be/kiR_KhUZiJo)) Here, the major difference is smoothness, not sharpness. Nearest Neighbor is used by many video editing programs, producing a jerky, unappealing result.

## Using Motion-Compensated Interpolation

Clearly, in this case, Motion-Compensated Interpolation delivered the best result. Note, however, that Motion-Compensated Interpolation took about 6:30 (min:sec) to process, as compared to 25 seconds for both Blend and Nearest Neighbor. This is why Cambria uses Motion-Compensated Interpolation only where it can deliver significantly higher quality. For example, when converting from 60p to 24p, Nearest Neighbor delivers very similar quality to Motion-Compensated Interpolation in a fraction of the rendering time, so Cambria uses Nearest Neighbor for these conversions.

Also note that finding the optimal configuration can get tricky when performing frame rate conversions on interlaced formats and other specialized conversions. The bottom line is that once you enable the plug-in, you should let it run in auto mode unless you spot a problem, like jerky playback or blend-type artifacts. If these occur, contact your customer support representative for assistance.

**For more information:** <http://www.capellasystems.net/>  
**email:** [sales@capellasystems.net](mailto:sales@capellasystems.net)  
**Phone:** (408) 770-1850

