

Moving pictures: teach speed, acceleration, and scale with photograph sequences

Photographic distortion of moving objects

When a moving object passes a camera that is either stationary or moving, the image recorded may be distorted due to the relative motion of the object, the camera body, and the camera's shutter. This distortion can occur regardless of whether the shutter is mechanical, in a film camera, or the electronic read-out from a digital camera's sensor.

An early example can be seen in a photograph by Jaques-Henri Lartigue, [Grand Prix of the ACF, Dieppe, 1912](#), a copy of which is held in the Art Gallery of Yale University. The shutter appears to have moved downwards* as the camera was rotated right to track the passing car. As a result, the spectators appear on a slant and the car wheel looks oval-shaped. (* It may seem that the shutter was moving up, but images are recorded upside down inside a camera.)

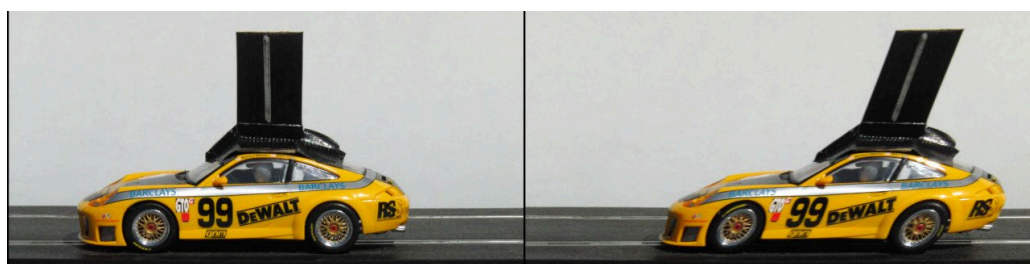
The pair of photographs on the right show the effect when the camera remains still as a vehicle passes by. In this case, the shutter has moved horizontally, parallel to the direction of the car's movement. If the shutter is chasing the moving car, then its length will appear extended (top picture), but, if the camera is inverted, then the shutter will run against the moving car and its length will appear compressed (bottom picture, taken on the next lap). The static background features have the same proportions in both photographs.



Image credits: Jon Tarrant, CC-BY-SA

A slightly different effect sometimes arises in digital photography when image data is read from the sensor's rows of pixels while the exposure is in progress. This is known as a rolling shutter and is used to provide faster burst rates for image capture.

Unfortunately, it introduces distortion. The example images below were taken using a digital camera that offers image capture at 40 frames per second and show that the slot car has become diagonally distorted.



The image on the left shows a stationary model car on a slot-racing track; on the right is the same car in motion, captured using a rolling-shutter sensor.

Image credits: Jon Tarrant, CC-BY-SA