Physics Club Camera Manual

In order to use the 120-fps function of the camera, you need to use additional software (the standard Microsoft camera app can only get you to 60 fps).

0.0.1 Preparing/Installing Software

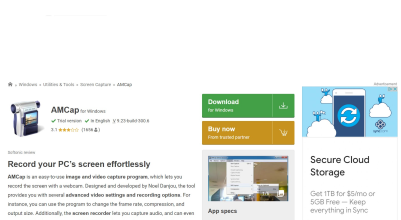
There are probably multiple different camera programs that will work with this camera. The one that has been previously used (and I think is recommended in the manual that came with the camera) is AMCap.

You can download it from ***here*** (or just google AMCap download. Website provided works fine as of summer 2021).

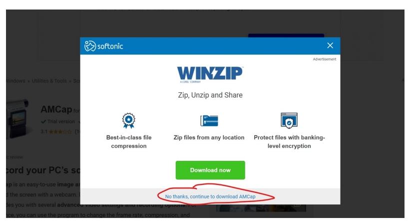
Please look through the download section to avoid accidently installing WinZip

0.0.1.1 Download

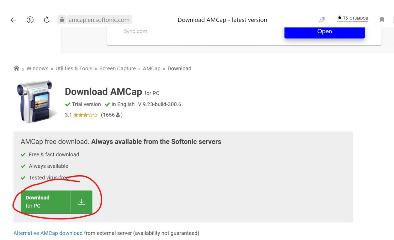
Begin by visiting the website from the section above. Follow the following three steps.



(i) Hit Download (the green button).



(ii) Now DO NOT click the green button. Click the blue text under it.

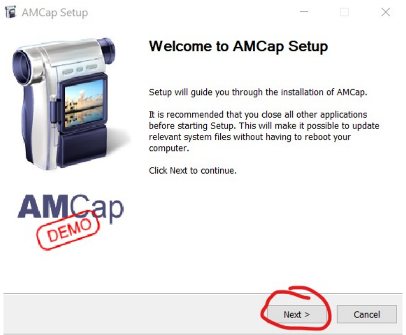


(iii) Click Download again

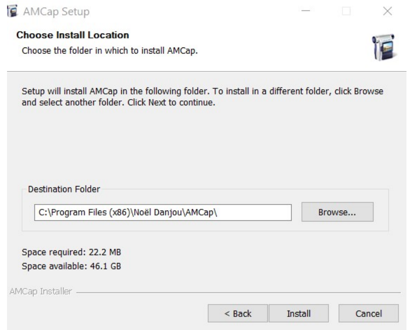
Figure 1: After completing these three steps the " AMCapSetup.exe" file should start downloading.

0.0.1.2 Setup

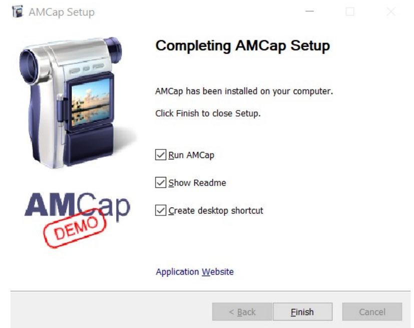
To start the setup, run the .exe file you downloaded in the previous section. Then complete the following three steps.



(i) Hit next



(ii) Choose where you would like to download the AMCap program



(iii) Wait for it to unpack and hit finish.(It doesn't matter if you select/deselect checkboxes. It will just open the readme file and auto run the program.)

Figure 2: After completing these steps, you are ready to record videos at 120 fps

0.0.1.3 Using AMCap and the Camera

Begin by placing the camera in such a way that the experimental setup is clearly visible.

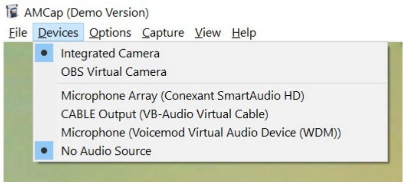
Keep in mind the following limitations when designing your experiment:

- The camera cannot record sound. You will need a separate microphone if you wish to do so.
- This camera can only save files to the computer (does not have internal memory). It must therefore always be connected to a computer through a USB-port.
- While this camera is great for motion tracking due to its 120 fps capabilities, distances cannot be accurately measured directly from the video due to a pincushion effect.
- Camera does not work too well with bad lighting (or what even sometimes seems as "ok" lighting). Getting a table lamp can prevent this issue.

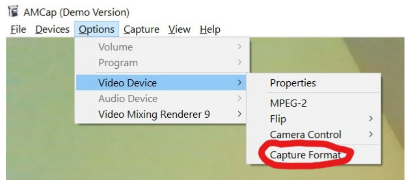
Make sure your camera is tightly secured (can't fall). No pressure should be applied to any moving parts (the lens & adjusting mechanisms of the camera). Ideally, you would use some kind of tripod/camera holder. If you do not have access to such equipment, you can attach the camera to a retort stand with elastics to the same effect.

When you are sure the camera is safely placed, plug it into the USB-port of a a computer with the AMCap software installed.

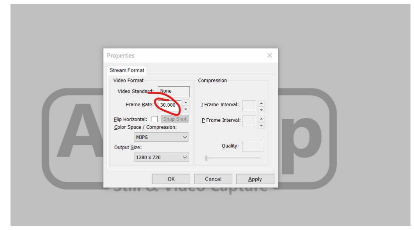
To begin recording, follow the following steps.



(i) First we have to select this as the active camera we will take pictures with.(We can also add an audio source here).



(ii) We now have to setup the 120 fps mode. Go to the capture format section in Video Device Options.

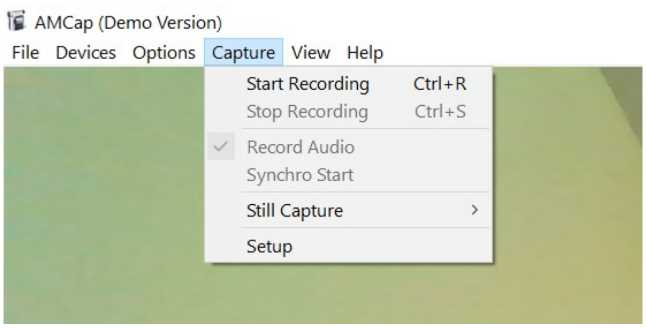


(iii) Change the frame rate value to 120 (by typing). This will automatically reduce the quality of the image. Hit "ok" when you are done.

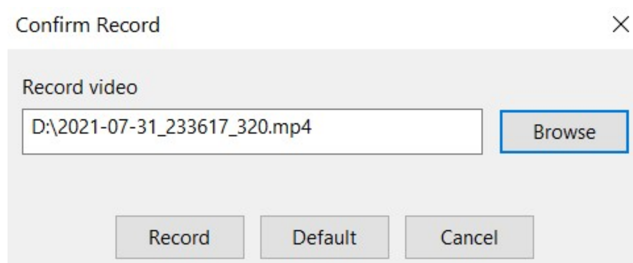
Figure 3: After completing these three steps you will see the output of the camera on your screen. Not that the 120 fps function only works for a low quality image.

Make sure to adjust focus & lighting to get a good image. You may also need to reposition your camera bit, since the field of view will change as you decrease the output size by increasing the fps.

Now you can begin recording & collecting data.



(i) To start recording, hit "Start Recording" in the "Capture" section.



(ii) This window will pop-up where you will be able to directly tell the computer where to save your video.

Figure 4: The camera will begin recording immediately.

0.0.2 Achieving 120

As you start recording, AMCap will display the average fps of the video in the bottom right corner.

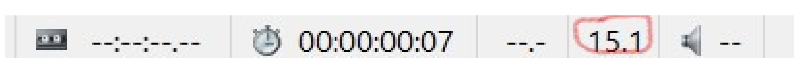


Figure 5: A laptop camera was used for this example, causing the fps to be as low as 15.1

You are likely to find, that the camera will rarely output 120 (or close to that fps) consistently. You will have averages ranging anywhere from 70 to 119. This is probably caused by the computer's inability to save information as fast as the camera is providing it. The final file, will be "missing" certain frames. Simply put, better computer might lead to slightly better performance. Despite this loss, the video will still perfectly represent the time intervals it recorded. You will still be able to use logger pro and other software to mark points etc. with correct time stamps. Due to the large number of points that can be taken with the camera, this should not be a significant issue.

Here is an example of what this might look like:

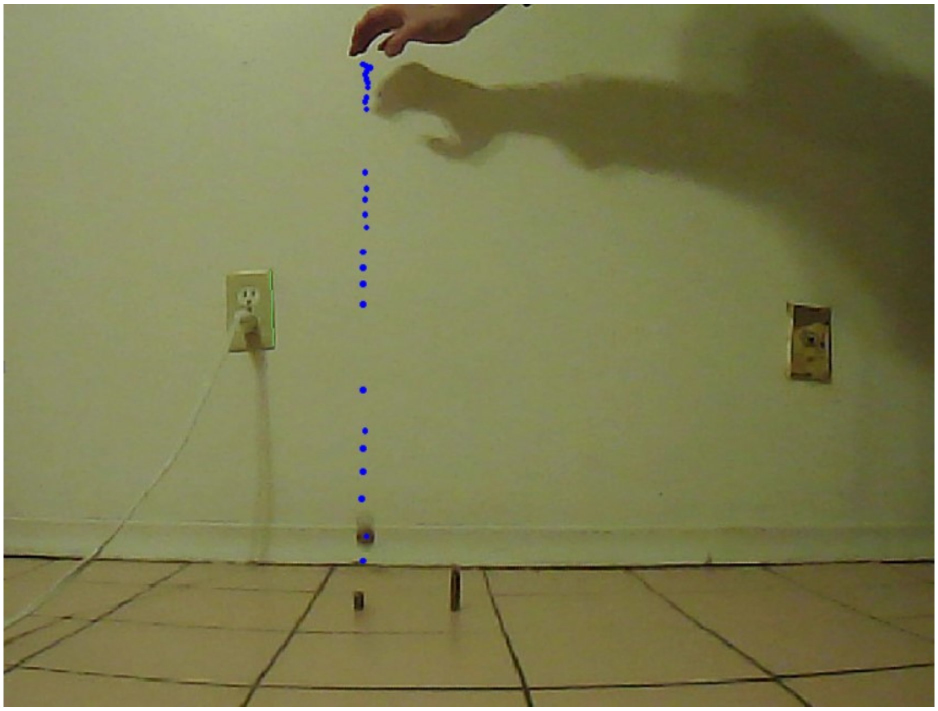


Figure 6: Each point represents the falling bouncy ball at a different point in times. As we can see there are two considerable gaps. The ball doesn't "magically move faster" for two stretches of time. It is just that the video (presumably) failed to record those points.

0.0.3 Pincushion Effect

While this camera has excellent fps output, its image perspective suffers from the pincushion effect.

This is a distortion of the image caused by its zoom lens. It causes the scaling on the edges of the picture to be different from the center.

Let's consider an example. Let's say that 1 cm on the image in its center, scales to 10 cm of whatever is on the image in real life. If we were to make a measurement of 1 cm on the edge of the image, that would scale to less than 10 cm in real life.

Here is a visual representation of this effect.

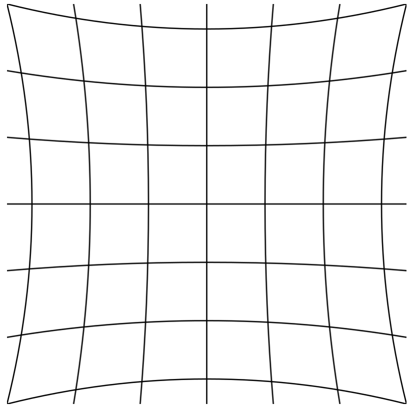


Figure 7: This is what an image of a square grid would look like, through the lens of a camera with the pincushion effect. One unit of distance on the edge of the distorted grid is “less” of the grid than on unit in the center.

Let’s look at a past example of a past experiment to see how this translates to our camera.

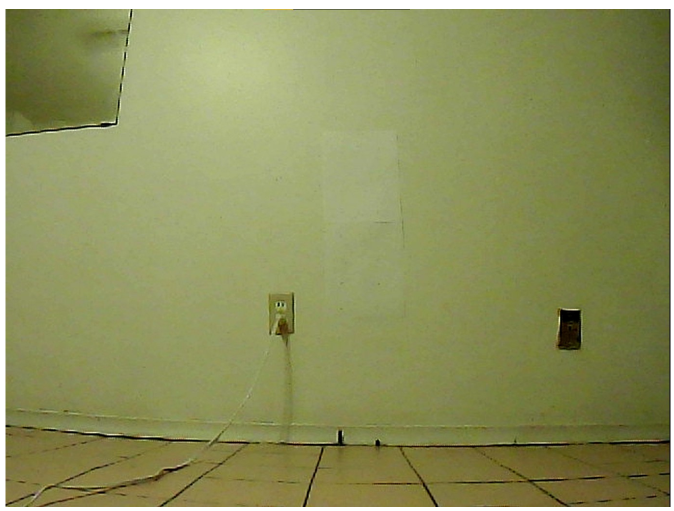


Figure 8: If you look in the top left corner, you will see that the mirror has a slanted edge. In reality, that has a 90°angle. It is difficult to notice this distortion without such an object.

Now let’s see how this can affect the accuracy of measurements if we simply set a linear scale and ignore this effect.

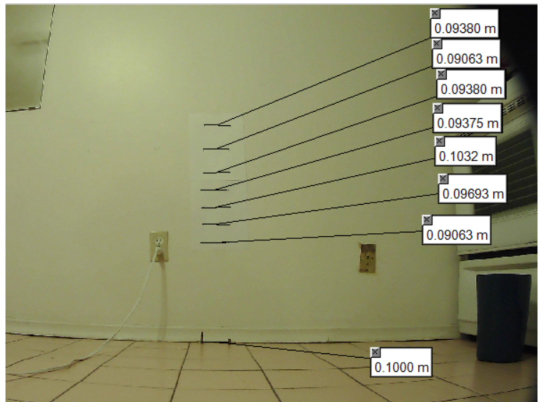


Figure 9: Two casings were placed on the ground 10 cm apart. A piece of paper with pairs of dots horizontally 10 cm apart was placed on the wall above the casings. Each pair of dots was drawn around 10 cm above the previous. The wall was around 1.5 m away from the camera. The distance between the casings on the ground was set as the scale of 10 cm for the entire image. The distance between the other dots was then measured using this scale, directly on the image. Moving up, the distortion was greater and greater, to the point where the measurement on the image, was 1 cm shorter than the actual distance between the points.

0.0.4 Accounting for the Pincushion effect

0.0.4.1 Reference Points

The easiest solution to this problem, is adding reference points in your experimental setup, to help you track changes in distance. This way, you are matching where the object is relative to another object in the image, rather than comparing distances to an arbitrary scale. Consider the following example:

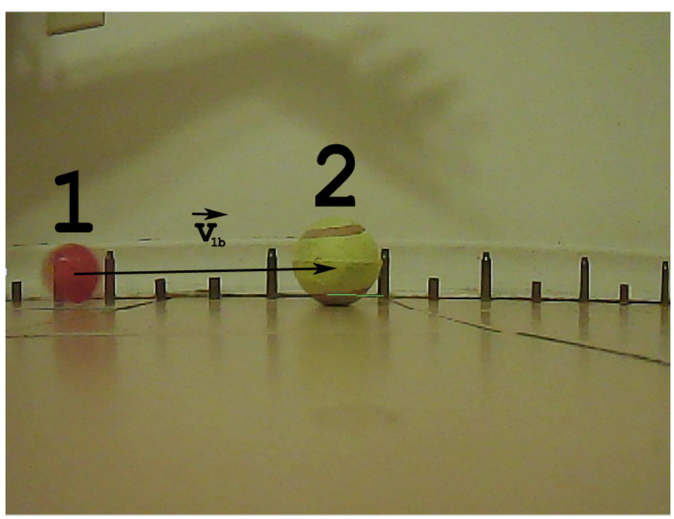


Figure 10: Ball 1 is Stationary. Ball 2 collides into Ball 1 making the latter move.

Make sure your reference points are as far away from the camera, as the objects that you are tracking (so there are no other perspective issues).

0.0.4.2 Making a Map

Instead of having to constantly think of ways to add reference points to your experiment, you can spend some time to make a grid (such as in Figure 8), that you can later use for any image.

Simply draw a square grid (make sure all the squares are identical and preferably as small as possible), and take a picture of it. Make sure that the center of the grid is directly opposite of the camera lens and the quality setting is the same as the one you will be taking a video in.

You can then overlay this grid on any video, introduce a scale for the center few squares and then use the grid to measure distances.

0.0.4.3 If you really have too much time

Finally, you could always figure out the coordinate transformation formulas for a pincushion effect, and calculate the coefficients for our camera specifically. Then you could probably create some software that would transform points of the image, to points on a flat plane.

This is something that would require quite a bit of research and experimentation. If you do do this, please make sure you write that up in some way shape or form and share it with the Physics Club. (This might be a good Physics/Math IA topic).