**Moving pictures: teach speed, acceleration, and scale with photograph sequences**
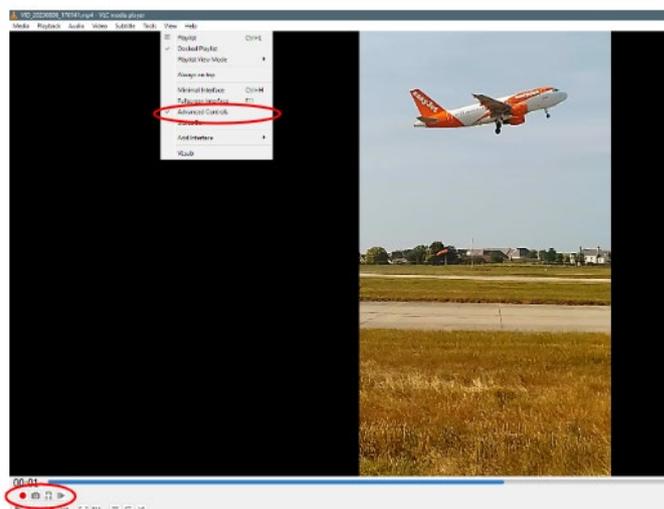
# Analysis of video recordings

## Introduction

Many smartphones are unable to record sequences of still images in rapid succession but offer instead a range of video-capture options. When recording videos for analysis, it is best to avoid both excessive zooming and high-speed capture ('slow-mo'), as these features normally decrease the number of pixels used: the resulting drop in image quality often goes unnoticed when viewing videos on a smartphone screen, but it becomes very obvious when examining still images extracted from the video. Nevertheless, and despite the fact that extracting stills from a video introduces an extra step into the process, video recordings can be used successfully, within limits, if a digital stills camera is not available.

## How to extract frames from a video

VLC Media Player, is a free video player and editor that offers two different methods for extracting still images from videos. Before reading on, it is worth saying that if you are daunted by what follows, you may find that staff in your school's IT or media departments are willing to extract the still images for you.



The manual method offered by VLC Media Player employs the software's single-frame advance and screenshot features, both of which are located in a second row of icons at the bottom of the screen when 'Advanced Controls' is selected from the 'View menu', as shown here.

The automated method uses the 'Scene Filter' settings provided within the 'Video' > 'Filters' menu, which is itself accessed by selecting 'All' in the 'Show Settings' panel at the bottom of 'Tools' > 'Preferences'. User-friendly instructions are available online at https://otechworld.com/extract-frames-from-video/ and https://www.technewstoday.com/extract-frames-from-video/.

Conventional video recordings usually have a capture rate of 30 frames per second (fps), so extracting every frame will produce a sequence of stills with an interval time of 1/30 s, and taking alternate images (setting a recording ratio of 2 in the Scene Filter settings) will give images that are 1/15 s apart. To avoid having a lot of images to analyze, it is often convenient to extract every sixth image (recording ratio of 6) to generate images with an interval of 0.2 s, which is equivalent to a still-camera burst setting of 5 fps. Mid-range digital stills cameras normally offer continuous capture at either 3 fps or 5 fps, although more sophisticated models can achieve faster capture rates without compromising image quality.

## Aircraft take-off velocity

The picture sequences shown below were recorded using a mid-range Nokia G11 smartphone and suit two slightly different approaches to analyzing the same situation.



Sequence 1: Alternate frames extracted from a nine-frame sequence when the whole of the aircraft was in full view. The interval between each of the images shown here is 1/15 s, giving a total time of 4/15 s.
*Image credits: Jon Tarrant, CC-BY-SA*



Sequence 2: In this sequence, every sixth frame has been extracted from the maximum time when a single feature (the nose wheel) remained in view. The interval between each image shown here is 1/5 s and the total time for the full 25-frame sequence is 4/5 s.
*Image credits: Jon Tarrant, CC-BY-SA*

Although sequence 2 makes full use of the frame area, some students prefer to see the whole aircraft in every picture, as is the case in sequence 1. In both cases, students need to measure the distance moved by the aircraft and use its actual fuselage length to convert this measurement into a real-life distance, which is then divided by the sequence time to calculate the take-off velocity. This is explained in detail in the [Activity 1 worksheet](#). Note that when pictures are arranged horizontally, as here, the distance moved by the aircraft is best found by choosing a specific feature and comparing its distance from the edge of the frame in the first and last images of the sequence. Example measurements and calculations are shown below.

|  | Sequence 1 (nose cone) | Sequence 2 (front wheel) |
|---|---|---|
| **Distance moved in the sequence (cm)** | 5.3 | 15.1 |
| **Length of fuselage in the frame (cm)** | 10.0 | 10.0 |
| **Fuselage length for Airbus A319 (m)** | 33.8 | 33.8 |
| **True distance moved by aircraft (m)** | 17.9 | 51.0 |
| **Total time for sequence (s)** | 0.27 | 0.80 |
| **Calculated take-off velocity (m/s)** | 66.3 | 63.7 |
| **Converted take-off velocity (km/h)** | 239 | 229 |

NOTE: These sequences were extracted from a recording made in winds gusting at force 5. The wind speed (about 20 knots) allows a slower ground speed for take-off than in calm conditions.