First studies of movements

When we want to study the motion of an object, we are only interested in the point with the simplest trajectory in the reference frame of study. If we want to study the motion of the hammer in the ground reference frame, only the trajectory of its centre of gravity is relevant. The movement of point M relative to point G is then of no interest.

Document 1: The flapping of a butterfly's wings

To steer itself through the air, a butterfly flaps its 5 cm wings at a frequency of 10 Hz while repeatedly undulating its body.

The chronophotograph above shows one and a half wingbeats of this butterfly.

1. **Determine the duration of a wing beat for the butterfly in Figure 2.**
   Deduce the duration of the interval between 2 images.
2. **Define the scale of document 2.**
   Deduce the distance travelled by the butterfly between 2 images.
3. **Determine the speed at which the butterfly moves.**

Document 2: A jogger's stride

Jogging is a physical activity consisting of running at a moderate speed, less than 10 $km.h^{-1}$, for a fairly long time. It's a great way to keep fit and clear your head.

The chronophotograph above, taken over a period of 2.0 seconds, shows the posture of a female jogger, measuring 1.60 m, as she jogs.

4. **Is the sportswoman in document 3 really jogging?**
   Explain the process for answering this question