

Biomechanics: discrete and continuous approaches

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Editorial

At the beginning of teaching biomechanics I am asking students to think: is the world continuous or discrete? The most frequent answer is ... no answer. Then I near my hand to the table and show obvious situation – I can't move my hand through the plate of the table, also I can't move my pen, needle etc. So, it looks like a world is continuous. But on the other hand if I would use a hammer and a nail I can move a nail through the plate, and some radiation can move through the plate of the table, e.g. x-rays. Also planets are far away from each other, far away from the sun. Atoms are far away from each other and subatomic particles are far away from each other. As an illustration of that one can imagine a nucleus of atom is at the centre of the soccer pitch and electrons are at the track. Here, we can say the world is discrete. The conclusion is as it is often within the science: whether the world is discrete or continuous – it depends. All depends on the level of observation. So the matter is discrete. Only our perception and level of observation gives us a continuous approach.

The above statement deals with morphology, i.e. building of the matter. Another situation is with the function. Here, for example the movement is continuous. And only for the purpose of analysis we divide the movement onto discrete portions of information, i.e. positioning of moving objects according to the reference system and usually use iteration according to time. We use here differentiation approach taking into account very small amounts of time. So, for the morphology, what we see with our naked eyes, we have discrete/continuous approach and for the function we have continuous/discrete approach.

But taking into account control we have again discrete/continuous approach, e.g. muscles are stimulated for contraction in some frequency which is a discrete way of steering. Here the first stimulus from the nervous system begins the action, e.g. a movement, and the next stimuli maintain the movement continuously in order to act against inertia, friction, drag and other forces, e.g. force of opponent in wrestling.

An example of continuous/discrete approach is a ruler (Figure 1) or a measuring tape. For the naked eye it is continuous. But the description using centimetres and millimetres is discrete. Human body and the same is for animals and plants, is continuous. But presenting a body for anthropological purpose one gives dimensions of body parts in discrete manner. Also, when drawing a reference system (Cartesian system) one gives at the horizontal line usually a time (independent variable). The time is continuous but the description of the coordinate axis is made in discrete manner – (Figure 2).

Within the science or within some applied situations there is a need to say what was the value when it was not measured at the proper instant. For example, a temperature is measured every one hour. And a car accident happened at a half of an hour. The judge at the court asks an expert what was the temperature at the time of an accident. An expert would say that the temperature was not measured at that time, but using an interpolation one can obtain almost exact value. This could be important to know whether temperature of the time of an accident was below or above zero Celsius (zero is the freezing point). Here from discrete values recorded by meteorology specialist one can obtain continuous values (Figure 3). The same applies to the film or video recording of a continuous phenomenon (time).

The recording takes place in a given frequency and frames (discrete problem) are obtained every, e.g. one hundredth of a second. But if something happened in between two adjacent frames one needs to make interpolation, i.e. obtaining a continuous variable.

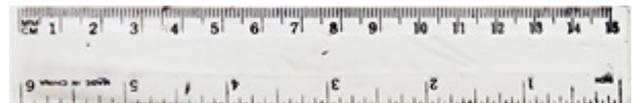


Figure 1 Continuous ruler and discrete description.

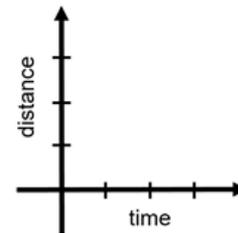


Figure 2 Reference system with time as a continuous variable and discrete description.

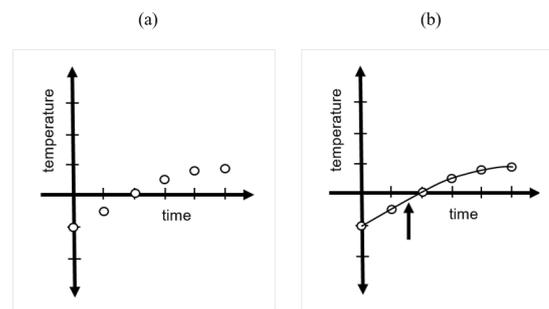


Figure 3 Measurement of temperature: (a) in discrete manner; (b) by interpolation one can obtain knowledge on temperature in continuous manner, e.g. at the time where an arrow indicates.

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Conflict of interests

Author declares that there is no conflict of interest.