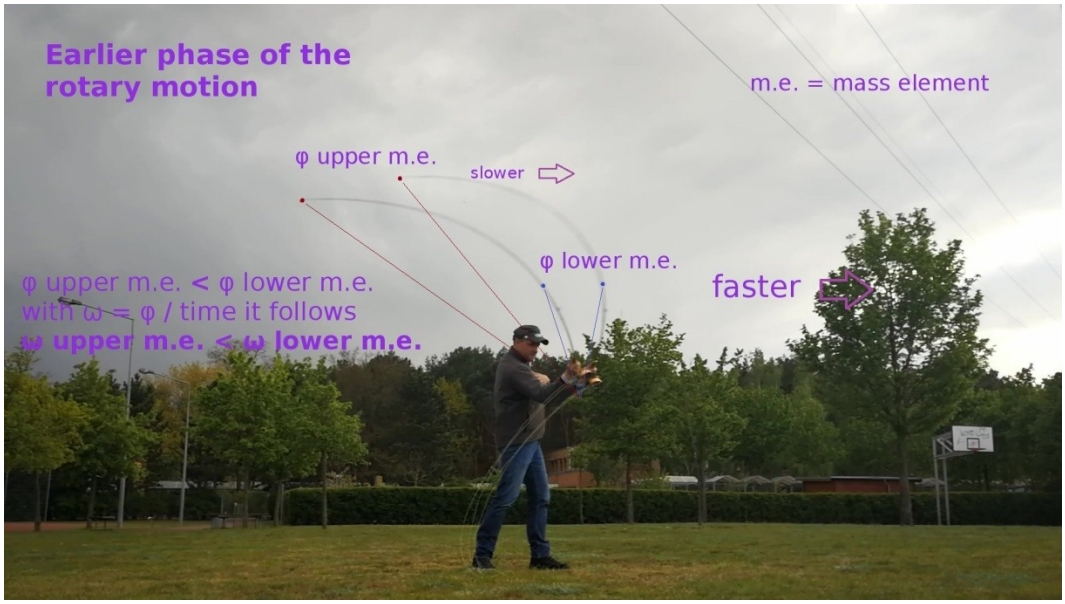
# Angular velocities of the mass elements on the fly rod shaft

Playing with the GIMP tool (GNU Image Manipulation Program) I superimposed some pictures taken out of a casting sequence of me. I liked the result since it visualizes how the angular velocities of the mass elements on the fly rod shaft vary over the entire casting stroke.

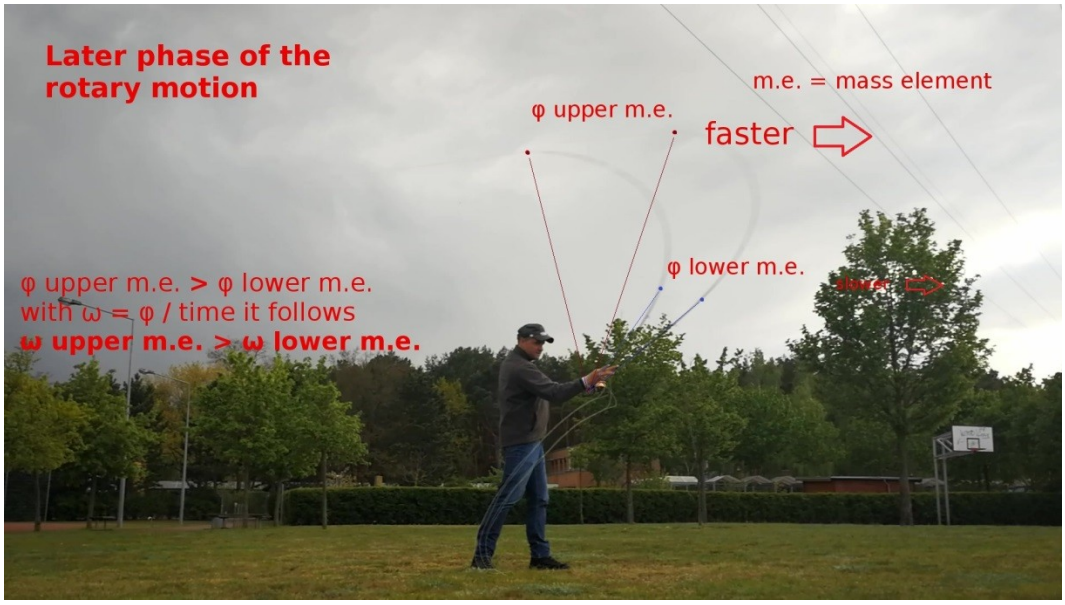
The angular velocity ω is determined by the angle φ divided by time t (ω = φ / t).

Due to the deflection of the fly rod during the earlier phase of rotation the lower mass elements are covering a larger angle than the upper ones (shown by the violet lettering, see picture 1). According to the relationship shown before they have the highest angular velocity ω.



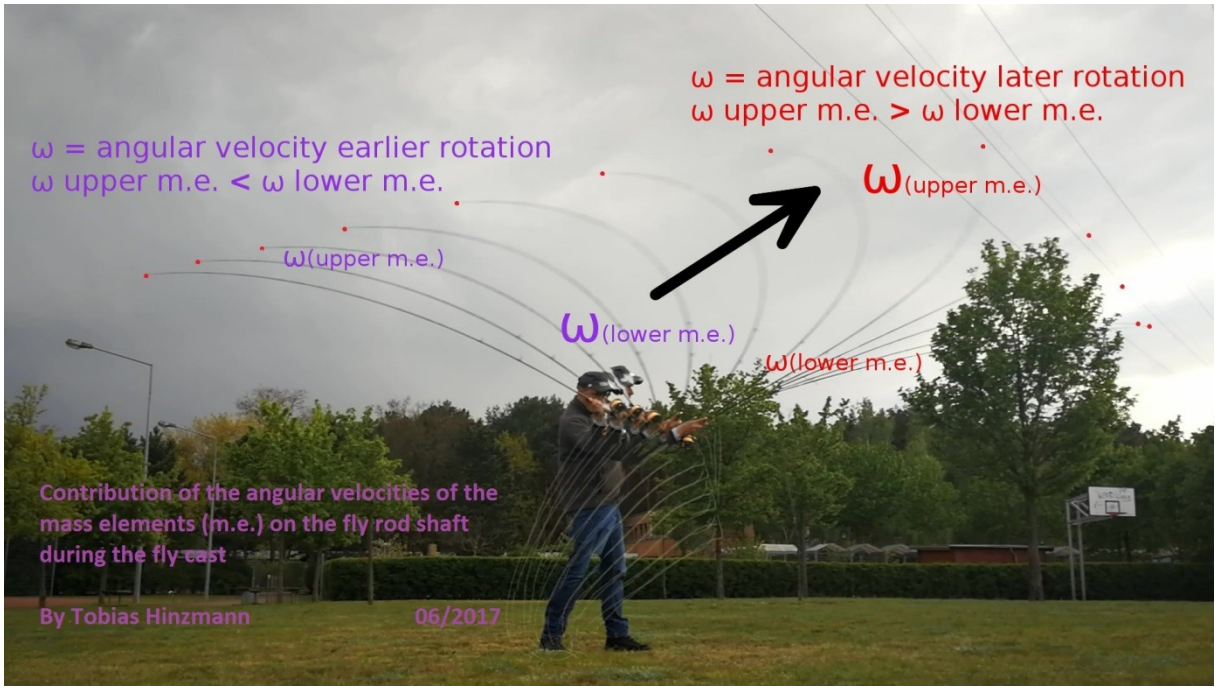

picture 1

During the later phase of rotation it is the other way round. Now the upper mass elements are covering a larger angle (shown by the red lettering, see picture 2), for which reason they have got the highest angular velocity ω.




picture 2

So what can be detected is a shift of the highest angular velocity from the lower mass elements towards the upper ones over the duration of the fly cast (see picture 3 – visualized by the black arrow), which correspond to the varying contribution of the angular velocities.




picture 3

The angular velocity (ω) multiplied by the moment of inertia (I) leads to the angular momentum (L). L = I * ω. Taking the modification of the moment of inertia caused by the deflection into account, this relationship points to a contribution of angular momentum, which shifts towards the upper mass elements like the angular velocities.

**Due to the energy conservation law the energy can't just disappear, thus the energy of the lower mass elements must contribute the accelerate the upper ones, resulting in a higher angular velocity, angular momentum respectively during the later phase of rotation (energy transfer).**

The towards the tip of the fly rod shifting contribution of angular momentum equals the shift of the center of the rotating mass shown in my "Experimental investigations on the fly rod deflection" (Rev. 2.0, November 2014 - section F1) and indicates, that some kinetic energy could climb up along the fly rod shaft towards the tip. This behavior benefits an efficient fly cast (ratio of the output and input energy).

It is obvious that the energy transfer from the grip towards the tip of the fly rod depends on the way the fly rod is deflected. The varying contribution of the angular velocities of the mass elements is a good indicator for that.

The pictures above are taken out of a video, which I produced in order to explain what I wrote before: http://vimeo.com/221011910

*Tobias Hinzmann, in June 2017*