Summary of the main criticism of my „experimental investigations on the fly rod deflection"
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In the following I take up the criticism which I observed after the first publication of my "experimental investigation on the fly rod deflection" in february 2014. In the revision 2.0 of my investigations, published in november 2014, all the following criticism is considered. My comments refer to my revision 2.0. With pleasure I anticipate that all the criticism can't question my investigations.

Criticism: "the mass of both fly rods was not considered. By considering the mass the calculated difference between the efficiencies of both fly rods will drop."

Without doubt the assumption of massless fly rods could influence my calculations most (see section A). With this assumption I kept the calculations simple in order to reach more people who are able to understand my investigations.

Because the mass of the fly rod is significant higher than the mass of the fly line the caster has to apply the most energy to accelerate the fly rod. But with my comparison calculations in annex 2 I show that my calculated difference of the efficiencies is influenced only insignificant by the mass of both fly rods. Further more the fabrication of a rigid fly rod needs more mass towards the direction of the tip, which effect an additional effort for the caster. So my calculated difference of ~2 (see section E) lies absolutely in the range of possibility.

Criticism: "there is no need to customize the fly line and the fly rod. With a stiff tarpon fly rod a class 5 fly line could be casted longer than a customized class 5 fly rod could do."

I do not question that the tarpon fly rod could cast a class 5 fly line longer than a customized fly rod. But this fact alone doesn't mean the tarpon fly rod is more efficient, because a look on the casters effort ("energy input") is necessary too. This argumentation lacks this view, because there is only a look on the result and a look on the effort is missed. My following answers show, that the tarpon fly rod generates a higher effort to cast a fly line in relation to a customized fly rod.

Criticism: „the angular momentum is only conservated in isolated energy systems. Because the fly rod doesn't represent an isolated system the angular momentum can't have a significant effect."

That's not correct. Surely the effect of the conservation of angular momentum is shown for isolated energy systems, because it could be watched clearly. In annex 3 Dr. Schmitt disproved his criticism. Due to the shift of the turning point (= center) of the rotation mass towards the tip the angular momentum with is present in the fly rod can't disappear and must be conservated. This effect could also be called as redistribution of angular momentum. However, the angular momentum can provide positive effects in not isolated systems, like a fly rod represents, too.

Criticism: “Over the path of the retraction of the fly rod positive effects of the conservation of angular momentum will be eaten up, hence a positive effect can’t be left over the whole cast.”

The impact of the conservation of angular momentum could be watched on a figure skater, who runs a pirouette. As he is bringing in his arms, he shortens the radius between the rotating mass of his body and the rotation center so the rotation speed increases significantly. As he sticks out his arms, he decelerates the rotation speed of the pirouette.

Transferred on the fly cast it means, the conservation of angular momentum initiates an additional rotation speed into the tip of fly rod as long as its deflection increases. As the deflection decreases over the path of retraction the angular momentum causes a deceleration. This coherence I pointed out in figure XIII by the shifting turning point (= center) of the rotating mass.

But over the whole cast the deceleration can only eat up a little part of the advantage, the conservation of angular momentum provides in transmitting the energy significantly better. On the one hand the velocity of the tip of the fly rod is about 80% of its final value as the angular momentum starts to decelerate. That means the positive effects of the conservation of angular momentum are already within the most velocity of the tip as well as in the fly line. On the other hand the beginning conversion of the stored potential energy into kinetic prevents decelerating the tip immediately. Due to both effects the advantages coming from the angular momentum are still significant predominant. This is shown by the significant higher efficiency of the flexible fly rod.

Criticism: “the fly cast and the whip don’t have any parallelisms.”

In annex 3 Dr. Schmitt shows the effect of the conservation of angular momentum by pointing out some similarities between the deflected fly rod and a whip as they exist for my investigated cast.

For the whip the turning point of the rotating mass shifts into the loop, which appears right after the whip is lashed and which becomes faster and faster till it the end of the cord sounds. Similar to a whip the turning point of the rotating mass of the fly rod shifts into the “loop”, which lies in the area of the maximum deflection. As a difference to the whip the turning point of the rotating mass can’t shift completely into the tip of the fly rod (because the tip section can’t deflect as much as required to do so), but moves back towards the grip as the fly rod is retracting. For this reason the velocity of the tip of the fly rod doesn’t “run to infinite” like the end of the cord of the whip does, but it gains an additional, finite velocity. So the flexible fly could use a big part of the positive effects of the whip. Due to the lacking deflection the rigid fly rod can’t activate such positive effects at all. So there are obviously some parallelisms between a whip and the fly cast I investigated. Further more this comparison shows why the turning point of the rotation mass could leave the grip of the flexible fly rod (see section F1 and figure XIII) and why the efficiency depends on the shape of the deflection too (see section E4).

Criticism: “if the tip of a rigid fly rod is guided on a straight path, the rigid fly rod becomes significant more efficient.”

That’s not correct. Surely the horizontal velocity of its tip will increase, but on the other side a significant higher effort developes. In annex 1 I disprove this criticism by calculating this case (comparative calculation).

The rigid fly rod works similar a connection rod. A connection rod transmits an energy feeded in the one end (grip) to the other end (tip) only “one by one”. For this reason it doesn’t matter on which angle / length / velocity and so on the rigid fly rod is moved. In the case of masslessness it can’t reach an efficiency higher than 1.0 (see section F3). On the other side the flexible fly rod could transmit the energy significant better, because it concentrates / “pumps” kinetic energy towards its tip. In the case of masslessness the flexible fly rod could lift up its efficiency significantly over 1.0 ! The difference of efficiencies could be proved by physical laws. Up to now I didn’t hear any physical law which helps the rigid fly rod transmitting the energy.

Further more the caster of the rigid fly rod must handle a vertical down- and upwards movement (“swing”) to keep the tip on a straight path. The longer the rigid fly rod and the casting arc become, the more this vertical down- an upwards movement restricts the caster. The caster must especially give up more and more the rotation movement the longer the rigid fly rod becomes. A common rigid two handed fly rod can’t be casted for this reason.

As the rigid fly rod is rotated, it can’t get rid of an important disadvantage: the part of a vertical movement ! A pure rotation movement at the grip (how I investigated in my paper) forces the tip to travel on a convex instead of a straight path, so the part of the vertical movement lies at the tip. To keep the tip on a straight path the part of the vertical movement lies at the grip (the down- and upwards movement, see figure XVI). Both parts of the vertical movement reduce the efficiency of the rigid fly rod. On the other side for the tip of the flexible fly rod there is no need to go through a vertical movement, for which reason the effort of the caster could be reduced significantly.

Criticism: “the rigid fly rod is intuitively casted by a movement, which benefits its rigid behavior. The movement the rigid fly rod is casted in my investigations is not optimal.”

That’s correct. With the rigid fly rod the caster is able to shape tight loops and he will automatically use a movement which is the best for the rigid behavior. But even the “optimized” movement can’t offer a better transmission of the energy to the rigid fly rod. The rigid fly rod doesn’t possess any movement, which improves to transmit the energy feeded into the grip up to the tip (see section F3). If every fly rod is casted under its best condition, the rigid fly rod will never reach a better transmission of energy (efficiency) than the flexible one !

Surely the shape of the loop could benefit on an optimized movement – but in relation to a flexible fly rod a higher effort and many other disadvantages must be borne (e.g. very high force to decelerate the fly rod, disharmonic distribution of the force the caster must apply, limited rotation arc). In the meaning of a ‘cost benefit analysis’ the rigid fly rod will never reach the possible value of the flexible fly rod.

It is important to say the efficiency of the flexible fly rod varies much on the amount and the shape of the deflection. On short casting distances there will be not a significant difference between the efficiencies of both fly rods.

Criticism: “due to the flexible behavior the fly rod can’t transmit the whole potential energy on the fly line and the loop widen.”

That’s correct. Experts estimate the flexible fly rod is not able to transfer about 1/3 of its potential energy to the fly line. Saying this sometimes it is overseen that the much higher part of the kinetic energy is transferred without a lost. Over the whole cast the part of the potential energy is about ¼ (see section D1), so the lost is small. It is 1/3 * 1/4 = 1/12 ~ 8% and lies below 10 %. Looking on all the advantages of the flexible fly rod this disadvantage could be neglected.

Due to the counterflex the loop widen a bit as the fly line begins to launch. Saying this the positive effect of the counterflex is often overseen: it damps the flexible fly rod significantly, so the caster could reduce his effort to decelerate. As the rigid fly rod doesn’t bend it can’t possess a damping effect at all. For this reason the caster needs to apply a high pulse of force to accelerate and decelerate the mass of the rigid fly rod (**disharmonic behavior**). On the energy equation “force = work(energy) / path(arc)” follows that the pulse of force becomes the higher the shorter the path of deceleration becomes. For a very short path of deceleration the force runs even to infinite. For this reason casters of rigid fly rods report of a “colored forearm” (see section F4). Healthy risks are included too by casting a rigid fly rod (see annex 2).

The caster of the flexible fly rod can avoid pulses of force. The potential forces enable a continuous rise and reduction of his effort (**harmonic behavior**).

Incidentally I know some superb fly casters, who cast tight loops even though they use a high deflection. They have learned to control the damping of the flexible fly rod. So a tight loop is not only a result of stiff / rigid fly rods. And those tight loops require less effort and don’t cause a “colored forearm”.

Criticism: “the deflection of the fly rod doesn’t deepen till the beginning of retraction.”

This opinion might be true for some casts, but definitely not for the cast I investigated.

Criticism: “there is no exact moment for the ‘stop’, a clear separation between the phase of loading and unloading is not possible.”

I’m not going to contradict. But in the cast I investigated a separation is quite good to see, because the deflection clearly increases respectively redistributes till the retraction / unloading begins. This increasing / redistribution of the deflection causes the “kick” to the tip, which enables the fly line to sizzle away (see section D1 and F1).

Criticism: „my calculations and estimations are too simple, hence they can't mimic the complex fly cast."

More complex models need assumptions and estimations too in order to mimic the fly cast. Such a more complex model is a driven harmonic oszillator. This model needs differential equations and only a few people with a high scientific knowledge are able to calculate and to understand them. Because I wanted to open my investigations as much people as possible such a model was not an option to me – quite apart from the fact that first I had to renew my studies about differential equations. As even Dr. Schmitt as a physicist share the concept of my investigations they can't be wrong. I refer to his nice preface.

As the result of differential equations varies much on the assumptions and estimations, they are not more exact in general. But I know that such a model certifies a significant higher efficiency for the flexible fly rod – even though this model refers to a smaller deflection than in my investigations and though it is one-dimensional. So the conclusions of my investigations are confirmed in general.

Because my conclusions are coherent and proven by physical laws I think over all this criticism is not applicable.

Criticism: "the meaning of the load of the fly rod is absolutely overrated."

This is one of the oldest criticism. In fact the "load" of the fly rod in the meaning of the stored potential force doesn't propel the fly line. It is just the conservation / redistribution of angular momentum, which is stimulated by the deflection of the fly rod (see section F1). For this reason I use (since my investigations) rather the term "deflection" instead of "load" in order to avoid misunderstandings. The deflection of the fly rod enables a significant better transmission of the energy from the grip towards the tip.

But it seems the potential energy gets an important meaning in relation to the casting movement: because over the path of retraction the turning point of the rotating mass runs back towards the grip (which equals a re-redistribution of the angular momentum - see figure XIII), the velocity of the tip should decelerate immediately – similar a figure skater who ends his pirouette by sticking out his arms. But over the path of retraction the velocity still increases a bit. This effect must (also) be caused by the transformation of the stored potential energy into kinetic.

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