

## Training – Transmitter “Exponential”

Last month we discussed a bit of history of RC transmitter development as it pertains to today’s purchase options and some criteria new pilots might use in transmitter selection. Back in February we explored the possible (and preferred) ways of actually working the sticks of the transmitter. So this month, let’s continue with some other transmitter-related discussion which might be helpful to student pilots.

New pilots will soon discover a number of terms relating to radio control that they probably are not familiar with. One of those terms might be “Exponential”. In listening to the conversations of a lot of new (and some more experienced) pilots, it is apparent that the basic concept and purpose of “Expo” is not immediately clear to all. So this month we will try to make a very simple explanation for students and other new pilots.

Those who have some background in mathematics will recognize the term “Exponential” and know immediately that it refers to a type of relationship that is non-linear. What does that mean? Well a linear function is one that offers a constant relationship (or amount of motion) between the input and output. Think of a standard, old single-speed bicycle. Every turn of the pedals results in exactly the same amount of forward motion of the bicycle. Another example would be a standard chain-fall. In this case, each foot you pull the chain might result in only one inch of motion of the lift, but every foot you pull the chain results in exactly that one inch of motion of the lift. These are examples of linear functions, although in each case there is a ratio between the input and output. In the bicycle example the high ratio provides for higher speed of the output (number of turns of the wheel as compared to the pedals), while the chain-fall provides a low ratio (much slower movement of the load) to allow us to lift something heavy. What matters is that each unit of motion of the input results in exactly the same amount of output. It is thus a linear function and provides for linear output motion as compared to the input motion.

Non-linear motion involves a relationship that changes as the input motion occurs or grows. Think of something that starts small and then grows in a hurry. The steering gear on many new cars is non-linear (although many people don’t realize it). It has a very “slow” ratio near the center for precise control at highway speeds and much faster action away from the center for ease of turning and parking where speeds are slow. Note here that an exponential function is simply a special or particular type of non-linear function. There are many others.

So why do we even want to think about “non-linear functions” or this “Exponential” stuff when we fly RC anyway? The simple answer is that it can be very helpful! That is the reason the transmitter manufacturers provide it for us RC pilots.

Some of the control surfaces of an aircraft can be quite effective and control of the plane becomes quite sensitive or “touchy”. This means that you only have to move the stick a little to get a BIG result. Think of a plane that when you move the elevator stick, it either jumps into a climb or it snaps into a dive, but is very hard to keep on a level course. You could attempt to

correct this by changing the linkage ratios on the servo arm and elevator horn, but then you might lose the amount of total throw that you need or want for aerobatics. **This is where exponential comes to the rescue.** It is possible using exponential to make the output move slowly near the center of the stick's motion and much more aggressively near the ends. Like the steering gear example, you can have a "slow" ratio near center and a "fast" ratio away from center. You can thus have the best of both worlds. Note that "Expo" is not a substitute for proper linkage geometry, but is another "tool" to use along with the correct geometry to achieve the "feel" you like along with the total throw you need.

So "Expo" then is really about "feel". It lets you have a good feel at small amounts of deflection of the control surfaces as well as plenty of motion near the end of the control surface's travel for more radical flight maneuvers. The transmitter manufacturers generally provide for the use of "Expo" for control of the ailerons, elevator and rudder.

There is one caution we need to mention, however. The radio manufacturers apply a sign (+ or -) to the exponential. This designates whether the adjustment will make the resulting motion near center less aggressive (generally what you want) or more aggressive (generally harder to control). The problem is that the major manufacturers do not use the same sign convention for the same result. So, as you start to use "Expo" be sure to test it on the ground to be sure you are going in the right direction. Also experiment with lower and higher percentages of exponential. If you experiment with high percentages while you are on the ground and watching the control surfaces move, you can actually "see" the result. It is also better to start flying with low percentages and then work up so that you don't make a mistake which could make the plane difficult to control once in the air. Finally, make use of the graphical representation on the screen of your transmitter. It makes more sense than the above mentioned + or - signs.

If this explanation does not make clear what expo is all about and how to start using it, feel free to seek help from the club's training staff or any of the more experienced pilots in the club. Once you understand how to use expo, you will realize what a powerful tool it can be.

Until next time; remember to try something new each time you fly.

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