Mixing Full House Sailplanes

By Rick Eckel (Copyright 1995, printed by permission)

Let's admit it. The simple two channel 'floater' type sailplane are the most relaxing and enjoyable planes to fly. They look graceful in the sky, practically fly themselves, and land so slowly you can walk beside them. On a beautiful, calm, sunny, summer Sunday there is no better way to spend time than guiding a floater beneath billowy clouds suspended in a deep blue sky. But…..

There are some of us who can't leave a good thing alone. We must have speed…… Or "performance"….. Or a thousand little switches sticking out of our transmitters. We want launches to the moon, thermal searches that cover at least three states and landings on the head of a nail every time. For us there's no fun like the good adrenaline rush of a high speed pass low across the field!

So we opt for the full house sailplane. Fiberglass, carbon fiber, Kevlar, foam, obechi, and servos in every nook and cranny. Beasts that are inherently unstable, fast as the dickens and prone to landing like lawn darts. And then we are faced with trimming the dang things, getting them to fly in a civilized (or at least somewhat controlled) manner, and landing 'em without cutting off our own legs. The key to all this is a computer radio and that most dreaded of all procedures:

MIXING

Many newcomers to our wonderful sport have approached me and asked about computer radios, how to choose one and what it is that you really do with one when you have it. Nosy and full of questions as they are, they are seldom satisfied with "mixing" as an answer. So here is the lowdown on what 'real' sailplane pilots do with a computer radio.

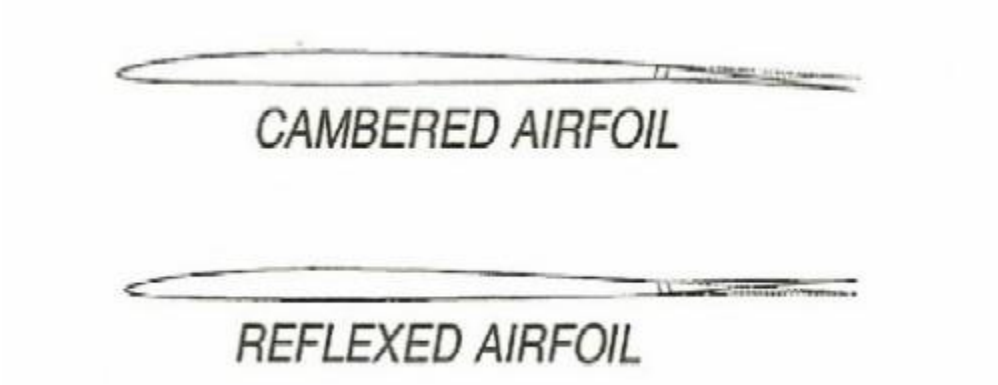
Let the mixing begin:
Setting up, or 'mixing', a full house sailplane with a computer radio can be a pretty intimidating task for the uninitiated. There seem to be so many possibilities, so many control surfaces, so many switches and so many terms and nomenclatures. Actually… there really are too many. But they're manageable if we first understand the basics of what we need to accomplish. Then we must translate that into the terminology and control functions provided by our particular computer radio manufacturer.

Sailplanes have three distinct flight requirements:
Launching, landing and the flight task. Mixing is used to enhance the flight characteristics of the plane for each of these requirements. In launching we want to obtain the highest possible altitude. For landing we require slow speed with the most control possible in order to land very precisely. The flight task requirements vary with the task (I'm most familiar with the thermal duration task but there can also be speed and distance tasks).

As the full house sailplanes and computer radios have become more common, basic ways of enhancing each of these flight requirements have become more or less standard. They are enabled by mixing two or more control functions (for instance: flaps and elevator or aileron and rudder) together so that the flight characteristics of the plane are optimized for a particular flight requirement. The interesting part is that each airplane design will have its own reaction to the typical mixes and must be optimized individually for top performance.

A Few Definitions

Camber, reflex, crow and butterfly are terms tossed about by those baptized in the use of computer radios as if their meaning were obvious. From my experience they are only obvious if you already know them. (Or is that obvious?)



Anyway, a brief review won't hurt. Camber and reflex are kind of equal but opposite terms. They refer to the position of the wing's flaps and/or ailerons. Camber means that the flap or ailerons are deflected a little downward effectively adding under-camber to the normal wing airfoil. Adding under-camber means that the bottom surface of the wing becomes more concave. Reflex, on the other hand, is deflection of the flaps or ailerons upward. Moving the flap or ailerons up removes camber in the airfoil making the bottom more flat or even giving the wing a 'reflexed' trailing edge.

Butterfly and crow are different terms for the same thing. A sailplane in the crow or butterfly configuration has its flaps lowered and both ailerons reflexed (raised). The ailerons stick up and the flaps hang down making the plane look reminiscent of a crow or butterfly as they approach a landing.

The flaps, ailerons or the full trailing edge (both flaps and ailerons) can be referred to as cambered or reflexed. Camber and reflex are used in a variety of circumstances. Crow (or butterfly) is only used for landing or perhaps for diving out of a thermal.

Launch Mixing
A sailplane will launch from a winch or high start perfectly well without any trim adjustments — assuming that the tow hook is well positioned. However the launch may be enhanced by several adjustments. The first is to camber flaps a bit to generate more lift during the launch. A little up or down elevator compensation is frequently of benefit when flaps are used during launch. Flaps only cover perhaps 1/2 of the length of the trailing edge of the wing. Some fliers find that additional lift can be generated and a steeper launch attained if the ailerons are also cambered to match the flaps, or a little less, when launching. As a beginning point of reference, we are talking about a cambering of flaps and ailerons of perhaps 1/4".

At the end of the launch some additional altitude can be gained by "zooming" off of the winch line. This zooming can be enhanced by reducing airfoil drag by reflexing the trailing edge. That is, reflexing both the flaps and ailerons slightly above their normal positions, Again, as a point of reference, we are talking about maybe a 1/16" reflex of flaps and ailerons.

All of these things can often be controlled using the 3 position flaps switch as the master channel for the flaps and slaving the other channels that require adjustment (elevator and ailerons) to them. This means that a lot of flexibility for mixing to flaps is necessary for the launching task. That makes it one of the key things to look for if you are choosing a radio for a full house sailplane.

Landing Mixing
For landing a sailplane the flaps are again important.They are useful for obtaining the slow speeds while retaining good control that make spot landings easier. Most airplanes exhibit a nose up pitching motion (or "ballooning) when flaps are deployed. So a mix of elevator to the flaps is employed to counteract the pitching. The elevator mix used in the launch may or may not work (or be available) for the landing flaps deployment. So a different elevator mix may be needed. Most pilots also prefer to have landing flaps fully proportional and controlled by the throttle stick on the transmitter so that they can vary the flaps depending on their landing approach.

Another enhancement to the landing function is the use of ailerons as spoilers. When both ailerons are reflexed and the flaps are lowered the plane is said to be in the "crow" or "butterfly" configuration. A little reflex of the ailerons just dumps (spoils) the lift of the wing and steepens the glide slope. A large degree of reflex adds drag as well. So this landing mix is a lot like the launch mix except that the ailerons have a different motion, the elevator to flaps mix is different and the flaps are proportionally controlled by the throttle stick rather than having preset positions via the 3 position switch. Only the more advanced programmable radios and/or those specialized for sailplanes will have the ability to provide both launching and landing mix setups.

Flight Task Mixes
Perhaps the most widely used flight task mix is rudder to ailerons. The purpose of this mix is to allow coordinated turns to be accomplished using only the right stick on the transmitter. This mix also eases the transition from a two channel (rudder—elevator) sailplane to an aileron equipped model. (Just don't forget that the ratchet trim for the rudder is now under the left stick!)

There are also a variety of other mixes for the flight task requirements for sailplanes. Pilots tend to vary in their preferences for these mixes. Part of the preference is personal and part is because different planes respond differently. Some pilots like to have the trailing edge of the wing camber, either just flaps or flaps and ailerons, with the application of up elevator. This gives an apparent increase in the effectiveness of the elevator. Conversely they sometimes want the trailing edge to reflex with the application of down elevator. This makes the plane accelerate more quickly. Pi!ots like to be able to switch this mix in and out depending on whether they're in a thermal or not. So they turn it on and off with a switch on the transmitter.

In addition to or in place of the above,some pilots like to be able to 'dial in' some camber on the wing while they are working a thermal. With more camber some airfoils can fly slower, develop more lift, and get more altitude out of a given thermal. Once a thermal expires or is lost, pilots want to 'flee the sink'. The ability to reflex the trailing edge can be very effective when you need to get away from a particular piece of sky quickly. These controls are often handled by a pot (potentiometer) on the transmitter or, as an alternate by the throttle stick so that they are proportionally variable. In slope racing it is very important to make good 'bank and yank' turns. I understand that some pilots like to use an inverse aileron differential mix in order to put some adverse yaw in the plane as they bank up for the turn just prior to the 'yank'.

The Mix is the Secret!

There are many other mixes and variations on mixes that different pilots use for different flight requirements. I think that some of them must be closely guarded secrets! Secret mixes that provide a competitive edge that pilots develop and hand down only with greatest ceremony to select co-conspirators! I think that's why I can't fly as well as Brian Agnew or Joe Wurts (or a lot of other pilots for that matter) — I don't have any secret mixes! (Aren't conspiracy theories wonderful excuses!)