Flying like on rails

FUZZY SMM, hints for flying with airplane gyros.

Application
FUZZY SMM is the perfect extension for all gliders or other airplanes. At starting or landing, flying straight or in thermos, FUZZY SMM keeps the model stable, no wind gust can disrupt the landing approach, no matter how stubborn the thermo, the model is stable. The FUZZY SMM can also be used for the elevator or rudder axis in aerobatic models with two (or one) elevator (rudder) servo, but in general for all model axes, which are controlled by a servo. Each model will be flying straight on its path.

For to search thermos with a glider model, the SMM FUZZY must be switched OFF. As soon as the "thermo" is found" the FUZZY SMM will be activated and the model will climb up in the centre of the thermo when used the FUZZY correctly.

When tugging model airplanes, not only in the glider, also in the airplane, FUZZY SMM stabilizes both absolutely straight and no sudden movements on the longitudinal axis can have influence.

Mode I
This Mode works as a very sensitive dampener acting against rotation movements of the model caused from outside conditions like wind gusts. The gyro doesn't move the model back to its original position, it is also not capable to know the horizontal position. The countermeasures are lasting as long as the rotation movements are active. The FUZZY SMM recognizes these movements significantly earlier than the pilot could recognize these movements visually. Used in a glider model it will increase the performance, because the models total air resistance, caused by control deflections of the controls by the pilot, is much lower in total.

Over steering
FUZZY SMM with its inbuilt over steering stick function supplies the normal stick control feeling to the pilot.

The use for the ailerons in a jet is ideal because these models are very long and at the same time they have very low wingspans. The gyro eliminates the annoying "rocking" of the model on the longitudinal axis. Since a jet flies with large speed differences, the adjustment of the SMM FUZZY Jet (special version) is specialised for jets and very sensitive. It is optimized for high speeds and has a streamlined rule for jets characteristics, compared with the normal FUZZY SMM.

With the gain channel the FUZZY SMM can be operating ON and OFF or continuously adjusted in sensitivity (gain) between 0% and 100% during use. Thus, the FUZZY SMM can e.g. be turned OFF to find the thermos, as with activated FUZZY SMM the thermo nearly can`t be detected. In addition, it can be chosen between two modes, Mode I and Mode II (see below).

Installing the sensor and electronics in the model
Before the first flights of course the sensor should be fixed as necessary for the desired axis. But as the testing and adjustments of the functions must be done before the first flights, we recommend **not fixing the sensor** before the tests (see below) are done.

Checking the gyros functions
The example describes aileron stabilisation and using Mode 1.

All settings and the installation of the FUZZY SMM should be done after the model has been flown already and the pilot knows its characteristics without the gyro. All servo throw settings should already be done and optimised. If this preparation is done, the gyro can be connected between the servos and the receiver according to instructions.

Servo direction and stick movements
Switch ON receiver, then switch OFF the FUZZY SMM gyro functions with the sensitivity channel (0%). = FUZZY SMM without stabilisation function.

During the activation time of the gyro (2-4 seconds) do not move the model. During this time, the microprocessor performs a self-calibration. After a short servo movement it is completed (LED blinking). Move the corresponding control stick (aileron) of the desired stabilising axis, here it is aileron. Check the servos directions. Do they work in the right direction?

If existing, check the mixing functions (Butterfly, Flaperon aso.). If a servo moves with wrong direction, it must be reversed at the transmitter with the servo reverse function.

These tests must be finished successfully before the next test point.

Checking the gyro function
Set the sensitivity to 100% (only for testing) with the gain control of the transmitter. Then turn the model around the axis to be stabilised. At the same time observe the deflections of the aileron controls. These must counteract against the direction of rotation of the model. Means the model is turned around the longitudinal axis to the left, the aileron deflection must work with deflections to the right. If this is not the case (e.g., the ailerons are moving to the wrong direction), turn receiver OFF, switch DIP switch of the wrong moving servo. Switch ON receiver again, start the test again. Make sure that all servo directions and functions are working correctly.

As the counter measures of the gyro are lasting only as long as the rotation movement lasts, it is recommended for testing the aileron deflections to set the model with its nose to the ground, the pilot keeps the fuselage in hand and turns the model around its longitudinal axis together with the pilot. In that case the pilot can observe the deflections much longer and better.

If the model is only turned by moving the wing tips up and down short times, the control deflection can`t be observed as they are to short and the movements are very small.

Note:
There are two reasons for the directions and throws of the servos:
Control deflections from the stick -> this must be set on the transmitter (direction/throw).
Control deflections from the gyro, as long as it is moved -> this must be adjusted at the gyro (direction/deflection throw).

If the servo throw is adjusted or reduced in the transmitter, it doesn’t have any effect to the servo throw effected from the gyro.

Adjustment of servo end positions (DIP 3)
For maximal results of the gyros functions the stabilised controls of the model should be set mechanically in a way, that the servo throw in the transmitter is set to maximum. If the servo throw is reduced by more than 15-20%, the effect of the gyro will be reduced to.

If the test flying results are showing that the control movements are too big and must be reduced, again: No reduction of the servo throw with the transmitter servo throw adjustment, but mechanical reduction by changing the linkage between control horn and servo horn.

If the servo movement coming from the gyro during rotation (not from the stick), despite optimal mechanical adjustment of the controls, are to big, the gyros servo throw can be reduced within limits. It should however be made with only small reductions (up to -15%), otherwise the quality of the gyro reaction (resolution) is reduced; the gyro can not work perfect.
Adjusting the gyros servo throw (teach in)
To reduce the servo throw **of the gyro,** first the DIP3 must be set to ON position. Switch OFF receiver and switch it ON again. The servo throw adjustment teach in process starts, the LED blinks continuously. Now, move the control servo with the aileron control stick to the desired maximum position on both directions. Make sure that there is no mechanical limit from the linkage.

When the servo throws are teached in, set the DIP3 switch to OFF position, this stores all data. After the DIP switch is set into OFF position, the aileron servos will move to the teached in positions: right - centre - left. The servo throw now corresponds with full gyro deflection to each side.

We repeat at this point: The setting for the servo-throw in the transmitter has no influence to the response throws of the gyro

Switch OFF and ON receiver again, the gyro is back in normal use.

Stick fade out function
The stick fade out is used to ensure that the desired rotation of the model is not delayed from the gyro. Without this function, the gyro would counteract against any rotational movements, even caused from the stick. At ailerons, the model would rotate very slowly; the whole feeling of model control would change completely. The setting of the stick fade out will be adjusted with the pot from 20% and 100% from stick centre position to the limit of each side.

Pot to the left = stick fade out at 20% stick travel
Pot to the right = stick fade out at 100% stick travel

To test the stick fade out, set pot to 20%, push stick, while rotating the gyros sensor (best if it is not fixed in the model). The gyro should stop working at about half throw to one side of the stick.

The stick fade out should be optimized for the flight; the centre position of the pot is a good value for the first flights. Later it can be adjusted to the pilots “personal feeling”.

Intelligent mixer recognition
The gyro stabilises only one (rotational) axis of the model. If multiple axes of rotation are mixed into controls, like aileron are also flaps, the gyro must know which is the desired rotation it shall counteract.

Example:
Ailerons are used at the same time as flaps. The gyro only should work against rotation on the longitudinal axis (ailerons). Flaps would work on the lateral axis. The sensor must be installed for the longitudinal axis

Test:
Rotate gyro left-right, (best if it is not fixed in the model). Aileron must counteract these rotations. Move the aileron stick to one side. The stick fade out function must stop the counteraction. If not, then move the flaps to full limits. If now the stick fade out has stopped the counteraction of the gyro, the gyros servo connectors at the receiver must be changed vice versa.

Then all tests must be repeated, especially servo directions and mixer functions.

Manual sensitivity adjustment
If there are not enough servo outputs or transmitter controls and the gain lead is not connected, the gain can be adjusted manually with the gain pot (pot 1). Then this pot can not be used for dynamic adjustment.

Installing the sensor in the model
In order to stabilise the desired model axis (for aileron = longitudinal axis), the sensor of the FUZZY SMM must be installed with its longitudinal axis (see drawing in the manual) according to the desired axis in the model. For aileron, the sensors body must be turned 90degree. The sensor must not be installed in the pivot point of the model; it can be installed parallel to the desired axis and at any other point in the model.

The fixing should not be too hard, so that engine vibrations (if any) directly to the FUZZY SMM sensor will not occur. If the fixing is too soft, the case can start swinging which is not good for the function of the FUZZY SMM.

For the best results of the FUZZY SMM in flight, note these points:

- The higher the mass of the model, the higher the necessary sensitivity.
- The faster the model, the lower the necessary sensitivity
- The faster the servos, the more precise the stabilisation
- The more smoothly the linkage, the more precise the stabilisation
- The larger the controls, the lower the necessary sensitivity

Recommended Settings for the first use
- Both pots in mid position
- DIP switch into Mode 1

General issue:
- The goal of using gyros is flying with the maximum possible sensitivity, only this gives the best results and increases the models (and the pilots) performance.
- The gyro itself doesn't do anything, only the controls are responsible for any effect the gyro can do.

Flying with the FUZZY SMM
If everything in the model is set, the model adjusted without gyro, and the pilot knows the characteristics of the model, now the gyro can be activated in flight.

When the model is flying with a give speed, increase the sensitivity (gain) of the gyro at the transmitter, starting with slow increases of gain. The point at which the model starts wagging, the gain should be reduced a little bit until wagging stops. Then the right point for this certain model speed is found.

The point when the model starts to wag depends very much on flight speed. Therefore it is recommended that for every flight situation the gain should be adjusted individually.

Attention!
If the sensitivity is set too high at high speed it can happen that the model wags so strong that it "explodes in the air". Therefore it is important to increase the gain slowly and to handle the gain control on the transmitter in a way that the sensitivity setting can be switched OFF quickly if necessary (sensitivity 0%). At many situations, the channel sensitivity can be overriden with a function switch, so that to switch OFF can be done with "one click".

For gliders this is perhaps less important, but it is vital for Jets and all other fast models.

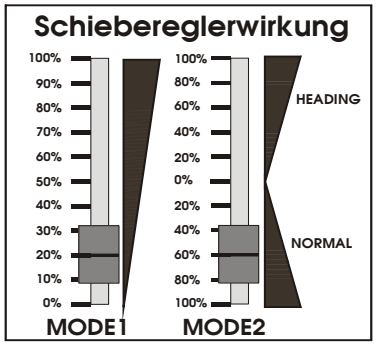
When everything is set optimally and the best sensitivity setting is found, we recommend now to activate the sensitivity of the gyro with a control switch by changing the control from a slider to a channel switch at the transmitter for to switch between the found gain points. The desired gain percentage can be adjusted with the endpoint adjustment of the gain switch.

Dynamic adjustment setting:
The dynamics control can be further optimise the sensitivity settings. The dynamic control allows the gyro to be adjusted related to the mechanical conditions of the model, which are servo speed, linkage, and mass of the model aso. If the dynamic pot will be turned out of the centre to the "wrong" side, the model normally wags earlier. But it also can happen, that the opposite situation happens. Then the gain pot should be turned to the opposite side. Goal is to be able to set the gain to higher values. This improves the performance of the model again. Turn to the left = soft, turn to the right = harder.

But best is to start testing with the pot position in centre

Note again:
If the gain-channel of the FUZZY SMM is NOT connected to the receiver, the pot works as manually gain pot, the gain can be manually adjusted.

Using Mode II, Heading (AWCS), Dip switch 2



This mode we only recommend to use when the gyro already works perfect with Mode I and the pilot already has a "top-experience" flying with gyros. With Mode 2, the control feeling of the model can be completely unfamiliar.

The reason is -> the stick doesn't control the deflection of the models controls, the stick controls the gyro and the rotation speed of the model. The gyro controls the ailerons, ruder, elevators aso.

In this mode, the gyro signal is evaluated in a way that the return servo rate lasts until the original position is reached again.

With no stick deflection from the pilot, no rotation of the model will be given from the gyro.

No rotation out of the last position is possible. As initial position the position at switching from NORMAL to HEADING mode will be set, or the position of the model, which was taken after releasing the control stick.

With DIP switch 2 in the ON position, both, the NORMAL mode (Mode I) and the HEADING mode (Mode II), are available. In MODE II the AUX channel changes as shown. Minimum sensitivity is in centre position, maximum sensitivity in normal Mode (Mode 1) is at one max. position of the sensitivity channel, max. sensitivity of HEADING-Mode (Mode II) is at the other end of the sensitivity channel. In that way it can be switched between Mode I and Mode II. HEADING will be indicated with the LED twinkling 3 times. The position of the DIP switch is read in only at start up of the gyro.

In HEADING it also should be started carefully with the sensitivity. Once in the air, increase the gain slowly until the model starts to wag out, then reduce the gain until it stops. If you are experienced with that function, you can adjust the dynamic pot and try to increase the gain.

During HEADING, there is no stick trim available, because a given trim amount will lead to a given rotation of the model. Therefore trim the model during use in Mode I, and then switch to HEADING. The trim position of Mode I will be overtaken as zero position of the function during HEADING. Any further trim movement during HEADING will start to rotate the model with aileron deflection.

In HEADING-Mode, the gyro controls the angle speed in conjunction to the stick position; therefore any servo signal out of the centre position will result in rotation of the model.

Note: A slow drifting of the servo's neutral position at high gain during HEADING is normal. During use it will be compensated.

Again, for the practice:

Increase the sensitivity slowly and handle the gain control on the transmitter in a way that the sensitivity setting can be switched OFF quickly if necessary (sensitivity 0%). At many situations, the channel sensitivity can be overridden with a function switch, so to switch OFF (centre position of the gain channel) can be done with "one click".

Now, when everything is set optimally for Mode II and the best sensitivity setting is found, we recommend now to activate the sensitivity of the gyro for Mode I and Mode II with a control switch by changing the control from a slider to a channel switch at the transmitter for to switch between the found gain points. The desired gain percentage can be adjusted with the endpoint adjustment of the gain switch. Centre position = Gyro OFF. Heading gain maximum = full deflection one side, Normal Mode gain maximum = full deflection other side.

Important for using Heading Mode

- Not any mixing function must be programmed for the axis to be stabilised (Flaps, elevator compensation aso)
- Trim adjustment are also working like stick deflection, the model will rotate. The stick trim is NOT available.

More hints for HEADING operation:
If the control of the model in HEADING mode appears too directly, an expo-curve can be programmed in the transmitter. If a trim reduction function is available in the transmitter, it should also be set to minimal trim travel.

Flight Mode set ups
Now it is getting a bit more "complex" .....
As already described, the effect of the gyro depends on the flight speed. Flight mode programming is ultimately necessary if the best performance should be reached.

If a gain setting is found for "high speed", then it is not enough gain for slow speed. The bigger the speed differences of the model, the bigger the gain differences.

Therefore the best gain must be found for each flight condition and then stored in the transmitter to the gain control (switch). Optimally adjusted and programmed, the mode switch automatically changes the gain settings to the certain flight condition.

Maybe this is some effort, but who has set a model once perfect and flown, will not fly without a gyro anymore.

Applications in practice
Although the FUZZY SMM was initially intended for ailerons, all other axes of a model can also be stabilised. In generally the FUZZY SMM produces a special kind of “artificial stability”. That means it leads for example for the landing approach to the point, that the stall can be delayed to a further point. But of course it requires, that the pilot must know the model very well.

Flying gliders in calm air
Here a gyro is not needed. But in a thermo, it can increase the performance tremendously. In gusty weather conditions, the FUZZY SMM is perfect. Gusty weathers you only notice with FUZZY SMM, if you switch OFF the FUZZY SMM.

Nevertheless, if you want to set up the gyro in calm weather, a simple test can lead to the right set up. Effect a fast roll and end this abruptly, the model must actually "click in". If a wagging takes place, the gain is too high. Set back the gain slightly and roll again until the model clicks in exactly as you release the stick.

If the model is not able to fly a role, the SMM FUZZY generates little stabilizing effect. Only if the ailerons or the controls are aerodynamically large enough and the servo movements are fast enough, the SMM FUZZY build its stabilizing effect.

If the gyroscope has to stabilize the rudder of an airplane with combustion engine, it is very good for the launch, when the rudder is blown strongly. For the landing it may look quite different, because since the engine idling the rudder has little rudder action. For that the gyro can`t effect miracles .....

Aileron (longitudinal axis)
The gyro creates a clear reassurance for this axis. In landing this can save a model, and thus can be pay back the price for the gyro very quickly. A crashed landing is more expensive.

Switched ON for circling in thermos, the FUZZY SMM stabilises the circling immediately, this results in less air resistance and better performance. For searching thermos, the FUZZY SMM should be switched OFF, at least you will not find thermos anymore.

For towing, both with gyros, the tug and the glider, the “wagging” of the team disappears, it gets more sure.

Aerobatic manoeuvres are getting simplified and much more precise.

All jets are having fast roll rates, which makes precise flying often difficult. For that, the FUZZY SMM is almost essential because the gyro will stabilise the model all the time, even it deflects the gyros effect when the pilot moves the stick.

Rudder (vertical axis)
Here the FUZZY SMM is recommended for all models that have a tendency at the start not to keep the direction, for example towing models with a strong engine, a large pro-propeller and high torque. Even jets can have this tendency.

For aerobatics flying like knife edges or torque-rolls, pilots will be thrilled from the effects the FUZZY SMM supplies.

If the gyro is installed for rudder or steering wheel and the airplane rolls to the start, Mode I should be used. Then short before full power is effected from the pilot, it should be switched from Normal to Heading Mode. The model will not “break out”.

The use of FUZZY SMM is also possible in V-tailed tails by the intelligent detection of mixing functions. It must be decided, however, whether the mixing deflection will be applied to elevator deflection or rudder deflection.

Elevator (pitching)
Again, we have unprecedented results, models in the landing like to tend to "jump", with the gyro this will be stopped. The airplane really sticks to the ground at landing.

At aerobatics it gives an incredible help to calm and control torque-rolls.

Also perfect when towing gliders with combustion models. If the correct climb angle for the respective glider is found, with Mode II this angle will be kept automatically. The pilot only must control the ailerons and the rudder, the climbing angle is controlled by the gyro. Particularly advantage when the tow team is very high and far away.

Even ideal for landing.

Servos and FUZZY SMM
For best results, it is obvious, that fast servos are recommended. The faster the servos the better the result. We recommend digital servos, they are more precise around neutral position and they can handle the fast signal outputs of the gyro.

Servo jittering
Since long piezo gyros from Futaba or ACT are working fine with the "fast servo signal output" of the gyro. In any case all Futaba servos and all digital servos. Some JR/Graupner analog servos, or some simple analog servos or old analog great are not working properly, these don`t find the neutral, or they buzz and vibrate slightly in the center position. One of the reasons is the "faster" servo signal output of the gyro of about 14ms. And of course, a low signal resolution of the servos.

The fast signal output is needed to achieve an optimal result of the servos, they have to start from neutral with strong power and starting quick, digital servos do that quite well.

The reason of the jittering or vibration is usually not alone the fast servo signal output of the gyroscope. All channels of the transmitter are "jittering". And just because not all transmitters are totally similar, even within the same brand or series or type. There are transmitters with higher jitter, and transmitters with lower jitter. A strong jitter moves the servo much more than a low jitter. It depends very much on the resolution of the servo.

Even the receiver/servo power supply has some influence, it depends on internal resistance of the of the RX battery or BEC.

Generally spoken, all digital servos and Futaba servos, if analog or digital, never have problems, and also all Hitec, JR and lots of cheap digital servos.

There is a rough test for this “effect”. Take the stick to full throw and let it go…., it will shortly commute back and forth and then be centered. If then the servo doesn`t find its neutral position, it is a servo which can cause problems during flight. Of course it should be tested with other transmitter or battery.