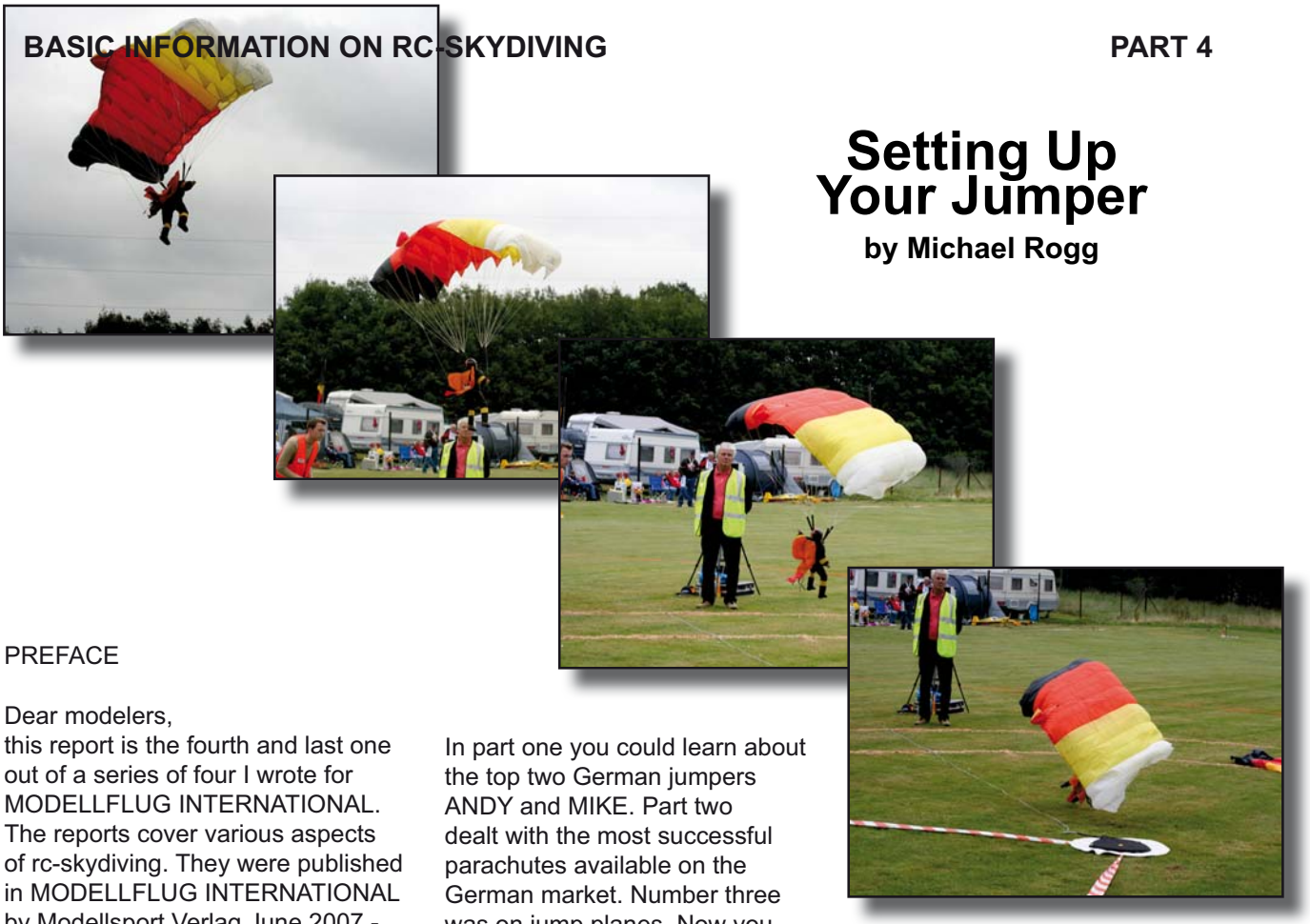


Setting Up Your Jumper

by Michael Rogg

PREFACE

Dear modelers,
this report is the fourth and last one out of a series of four I wrote for MODELLFLUG INTERNATIONAL. The reports cover various aspects of rc-skydiving. They were published in MODELLFLUG INTERNATIONAL by Modellsport Verlag June 2007 - September 2007.
By courtesy of Modellsport Verlag-Verlag Baden-Baden I translated the reports into English to provide the information involved to a wider range of readers. RC-parachuting is a fantastic sport and in my opinion information should readily available for anyone seeking for it - so it´s worth the effort.
YES, I translated my reports myself, yet, as you will easily notice, NO, English is not my mother tongue. So if you come across any miscellaneous points, just send an e-mail to: rgkestrel@t-online.de

Michael Rogg, June 2008

In part one you could learn about the top two German jumpers ANDY and MIKE. Part two dealt with the most successful parachutes available on the German market. Number three was on jump planes. Now you are going to read about how to set up your rc-set and test jump your rc-skydiver to get a really reliable and fully manouverable model that you can successfully compete with in accuracy events.

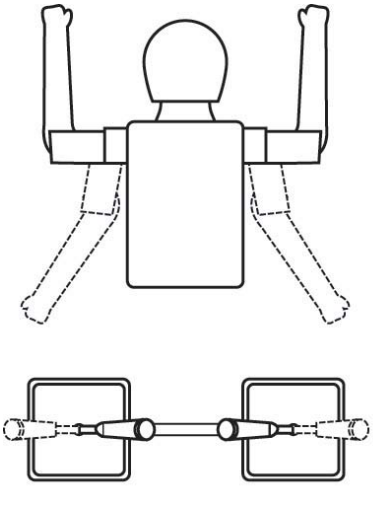
Transmitter
If you have a close look at the transmitters used for rc-skydiving you will surely notice, that there are almost as many set-ups around as there are rc-pilots. Some people prefer to control each hand with one of the main control sticks. Others like to steer by separating „speed“ (elevator) and „turns“ (aileron/ rudder). Then again there is a set-up employed that allows you control all the different functions with a single main stick.

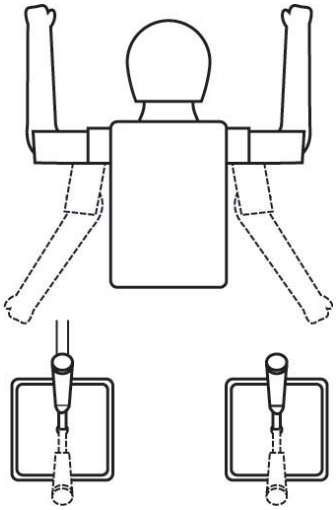
Level 1
If you own one of the cheaper standard transmitters you might not want to change much of the standard setting. So it´s a good idea to control one arm with „rudder“ on the one main stick and the second arm with „aileron“ via the remaining main control. (See drawing below.) If you connect the two sticks with a rubber band, your transmitter is set for „hands up“.

Some people prefer to use the functions „throttle“ and „elevator“ for the hands. Since the throttle stick normally is not self-centering, one rubber band is enough to keep, lets say the left hand in the „up“ position by pulling the stick to the most forward position, i. e. putting in „full down elevator“.

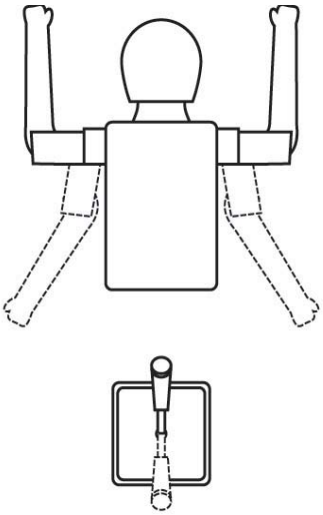
By employing one of those methods you can easily make use of the full servo throw, which you usually need to move the hands from the fully „up“ to the very „down“ position.

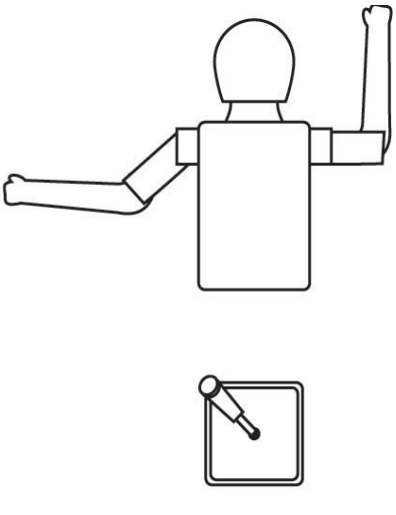
I personally don´t like either of those two techniques, because they don´t coincide with the way I normally steer my models. Oh, yes, I agree, as long as everything is smooth and working all right there is nothing to get concerned about because skydivers are rather easy to fly. But what if you turn back to flying aeroplanes and something unexpected happens? As we all know, in case of emergency, people act according to frequently repeated behavioural patterns. So, to



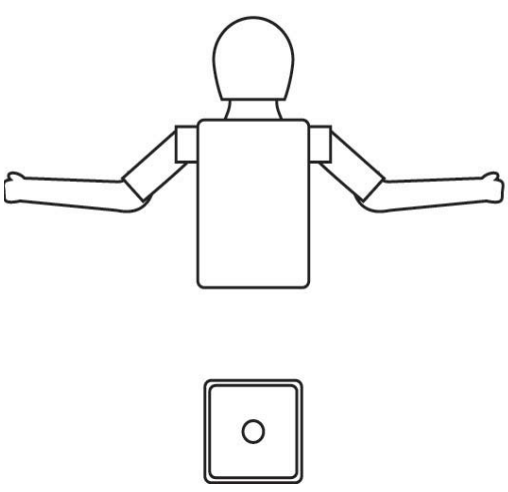


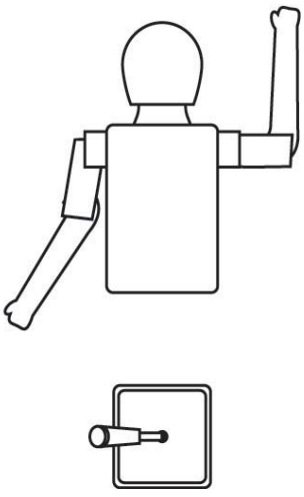
LEVEL 1
On the left a rubber band helps to pull both sticks into the desired position for „hands full up“. On the right only the self-centering stick is kept in the forward position by means of a rubber band.





LEVEL 2
If you use a „V-tail“ mixer, setting up the model is fairly easy. Yet there is a big disad-vantage for those seeking ultimate performance: As long as the stick is in the forward position, the hand travels only half way down when you move the stick to either side.





The tightest turns possible can only be achieved when the main control is in its centre position.

be on the safe side, I´d suggest you to resort to an array which enables you to fly your jumper exactly the way you fly your aeroplanes.

Level 2
V-tail mixers are very common with middle class computer transmitters these days. On model aeroplanes we use V-tail mixers to make two servos move the control surfaces up and down at the same time for „elevator“ and to opposite directions for „rudder“.
So V-tail mixers appear to be exactly what we are looking for. In case you have never used a mixer of that kind before, don´t worry. There are plenty of hints and examples given in the instruction manuals that come with the transmitter. If you jump in moderate conditions, such a mixer is an absolutely adequate choice.

Yet, those seeking ultimate performance will soon come across a very big disadvantage of V-tail mixers: If you want one hand to be in the „full-up“ and the other one in the „full-down“ position at the same time, you can only achieve this by moving the control stick to its center position first. When flying your jumper this means, that you have to slow down your model before you can steer the tightest turn possible. Especially when flying in strong winds and in competitions, this turns out a real handicap.
Induced drag is quite a bit of a problem with ram-air canopies. So if you fly down wind at full speed and finally decide to turn round briskly into the wind, you will notice, that your skydiver is very reluctant to do so. This simply happens because the drag of the canopy is so enormous. In other words, in a competition, you can´t steer your model precisely enough. Even if you loose just half a second, this can mean that the wind blows your model, let´s say, two or more metres the wrong way. In case you fly at displays, perfect steering may make the difference between a save or unsave maneouver. So after all, it obviously is worth looking for something better.

Level 3
Now let´s have a look at a set up which, in my opinion, offers maximum control. Since I own a Graupner/JR MC 24 I´m going to explain how it works on this transmitter.

As I have mentioned before, I fly aeroplanes and jumpers as well. And I want them to fly exactly the same way. The stick mode is 1. With motor planes, „aileron“ and „throttle“ are on the left stick and „rudder“ and „elevator“ on the other. To make it crystal clear: On the right hand main control the forward position means „full throttle/top speed“, the backward position makes the engine run at idle. When I fly a glider, the „throttle“ function is replaced by the „brake“ function. Of course the backward position means „brakes deployed“. And, surprise, surprise, stick to the right means a bank to the right and vice versa.

This is the complete set up of my MC 24:
Use the right main control stick (throttle/aileron).
servo assignment:
tail = normal, ailerons = 2
servo #1 = left arm (throttle) and
servo #5 = right arm (aileron)
free mixers:
linear MIX1: Ch1->CH5, mixer input and direction = +100%
linearMIX2: AIL->CH1, mixer input and direction = -100%
linearMIX3: AIL->CH5, mixer input and direction = -100%
linearMIX4: AIL->CH5, mixer input and direction = +100%

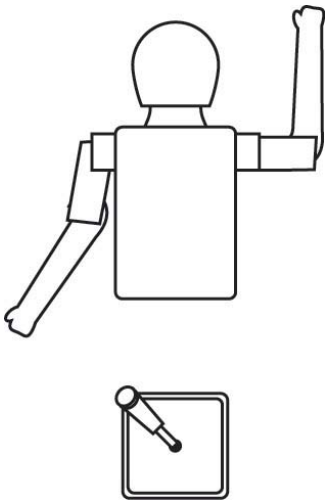
Miscellaneous points
The experienced rc-modeller usually adjusts the servos arms in a way that „full-up“ and „full-down“ are achieved by making use of the full servo throw. Then electronic means are employed to make minor final adjustments.

To give you an idea how it works, let´s assume the left arm is very close to the upper end position when the servo travels 100% of its throw. Now you add an extra 5 % or so to get the arm to exactly the position where you want it to be. Well done - and done for good, you might think. Yet there is a nasty problem that you haven´t taken into consideration yet: You are using mixers, and mixers add up on the servo throw. So, if you move your stick to the right in order to make the right arm go down, your left arm servo will want to travel beyond its 105% position. Since this is impossible mechanically, the servo will draw lots of electricity. Here is what I´ve seen from modellers who didn´t care: The very lucky ones just noticed an unusually warm servo. The still lucky ones lost their arm servos one after the other after some time. The unlucky modellers used up most of the battery energy when packing the canopy. Once up in the air there was not enough electricity left to deploy the canopy...
So what remedy is there to cure the problem?
The MC 24 and others offer a function called „servo limit“. You find it on the very right on the display under # 23 servo adjustment.

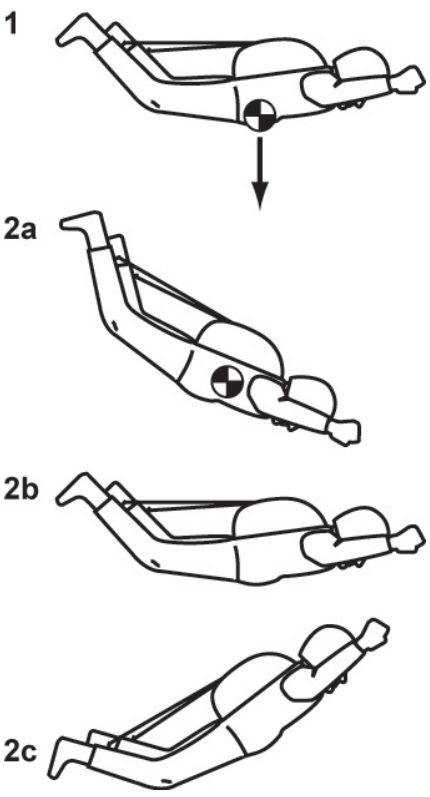
Helpful hints for beginners
Beginners are often afraid of deploying the canopy too late and therefore push the button as soon as the jumper has been dropped. In fact this is absolutely wrong. After being dropped the jumper needs some time to pick up velocity. This brings about a kind of air cushion below its body, which leads to a stable free fall. Therefore it is a lot better to calmly count to three, keeping a close eye at the falling jumper at the same time. If it appears to be in a steady and properly horizontal position, immediatley deploy the parachute.

Initial jumps
If you let your new jumper fall for quite a few seconds, I´m afraid you will almost certainly detect that it doesn´t behave the way it should. It will either „dive“ or „spin“ - often it will do both at the same time. This tumbling around the sky doesn´t do your jumper any harm, but it normally leads to canopy malfunction during deployment. So let´s look for an apt technique to fight these problems.

Towards longitudinal stability
Let´s deal with longitudinal stability first. If your jumper „dives“, either head or legs first, the center of gravity is not in the correct place. You must absolutely pay attention to your jumper during its free fall. If the movement is initiated by the head, the legs are too lightweight and vice versa. Just tape some lead to the legs and try again. Where should the lead go? If I don´t need much weight to balance the model I prefer to fix it near the knees because the lower

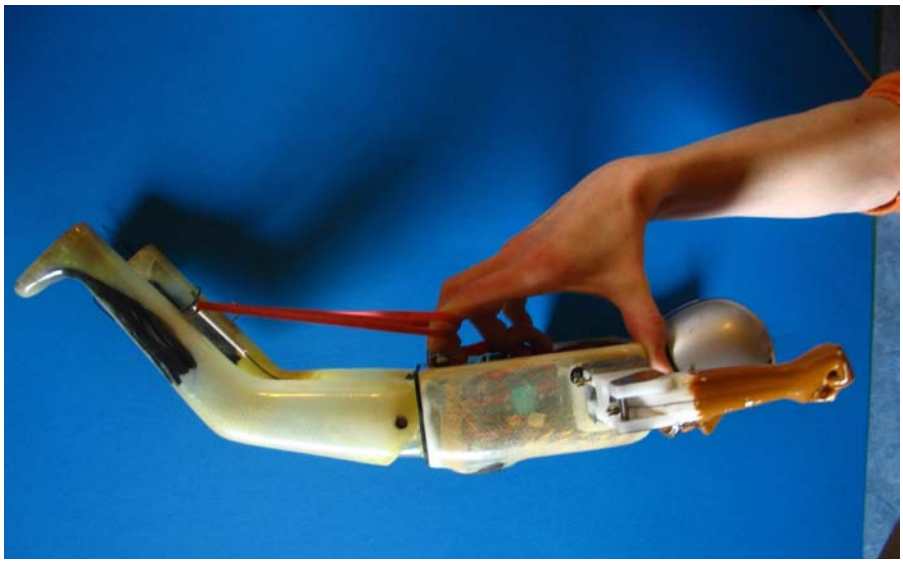


LEVEL 3
If you make use of four free mixers on a MC-24 you can make a hand travel down all the way with the control stick in its forward end position.



1: If the centre of gravity is in its correct position, the jumper stays in a stable horizontal position during free fall.

2a-2b: Here the centre of gravity is in a too forward position. The model starts to dive its head to a certain degree, then turns back into a horizontal position and beyond. Then the complete cycle starts over and over again.



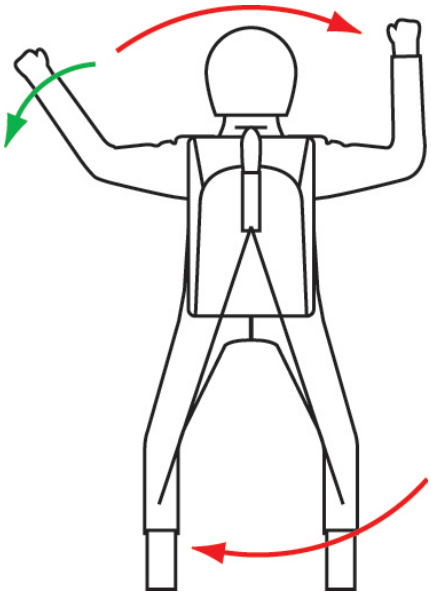
A well balanced model will descend in this position during free fall.

most of the weight is, the more stable the model will be during free flight. (For the same reason I also always try to get as much weight as possible into the „beer belly.)
I have also successfully decreased the angle between the thighs and the lower part of the body. That means, I allowed the legs to move a bit further rearward by sanding off material at the edge of the thighs.

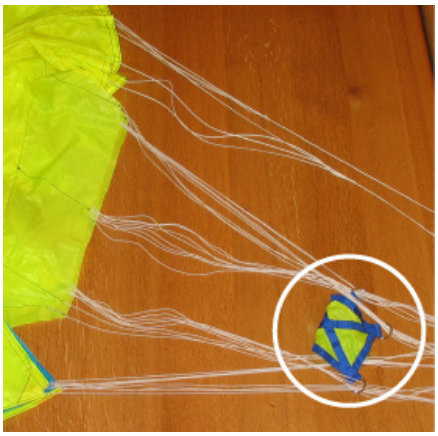
Spinning
When the jumper spins, it turns around its navel at a more or less high speed. This very much looks like a flat spin of an aircraft. If your jumper spins only occasionally, fairly slowly, and to either side alternatively- congratulations, you couldn´t do any better.
What if the jumper constantly rotates the same way and very fast? Then it´s time for a little doctor´s game. Open the body and apply some weight by means of silicone. In case the jumper spins to the right, the weight has to go on the left inner side, of course.

Stopping spins
Once your model is well balanced, you can use the arms to stop spinning during free fall.
Because we see our model from below rather than from above, let´s think carefully about the problem: When the jumper is falling towards us turning anti-clockwise, it is turning --- to the right! So you must turn your stick to the --- left -- to move the left arm. To say it in short: Move your stick the way the head turns.

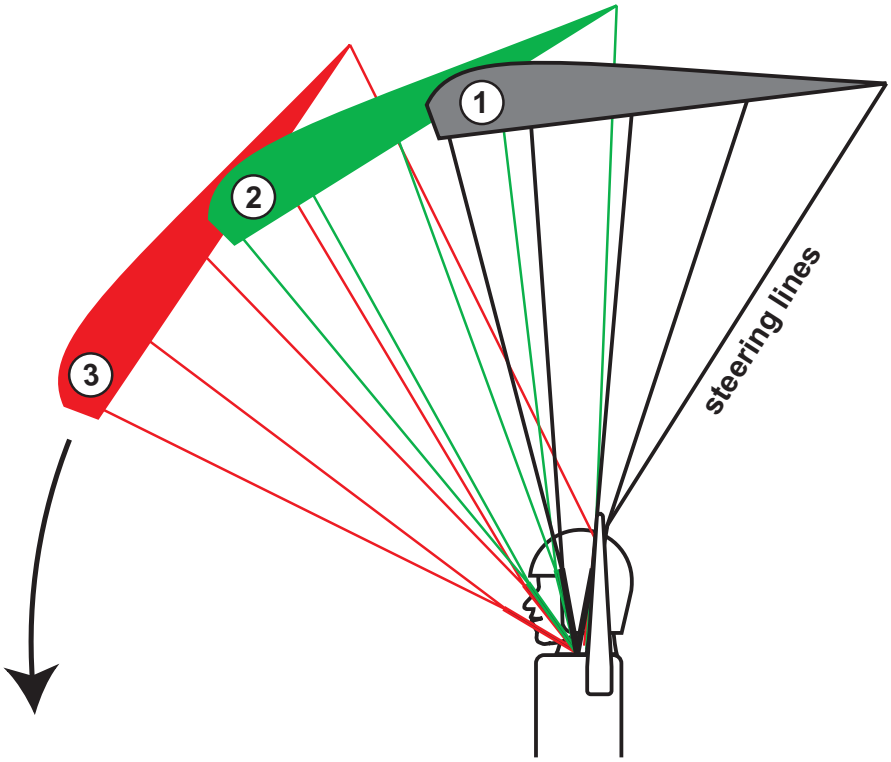
Please don´t forget to move the arm back into its „up“ position shortly before deploying the canopy. We don´t want he servo gear to get harmed during deployment, do we?



If your jumper keeps spinning clockwise (seen from above!), use the left arm to stop it.



Sliders can help to slow down the unfolding process of a canopy.



To be on the safe side, we normally must deploy our parachute with the brakes set to a certain extent. A non-braked parachute immediately starts to move forward and downward once its fully open.
#1: If your canopy stays in this position right after opening, you can make your steering lines a bit longer.
#2: Your canopy should not move beyond position 2 before it is pulled back into its top position by the jumper.
#3: If your canopy gets as far forward and down as seen here, the steering lines must be shortened for safety reasons.

Sliders - pros and cons
Meanwhile you have mastered the basics and thoroughly enjoy sky-diving. So you dare jump from higher altitudes, prolonging free fall step by step. As a result, your jumper keeps picking up more and more velocity before the canopy is deployed. One day the canopy unfolds so rapidly that the opening forces induce a terrible jolt on the jumper. As a result, you watch your little sky-diver jump towards the canopy like a mad cangaroo of the skies. This often results in a somersault of your little diver. After the ground impact of the from now on un-controllable system, you find your jumper wrapped up in the lines like big fish in a fishing net.

Let´s see what can be done about that. First of all try reducing deployment braking.

Also, a slider may be helpful. It is a rectangled piece of cloth with a D-shaped ring at each corner. The suspension lines run through these rings.

When rigging the canopy, you must pull the slider up to the tips of the flares. As the canopy unfolds, the slider slides towards the risers, thus extending the unfolding process. I have successfully used sliders on the parachutes of my fiber glass MIKES for many years now. My ANDIES are made from wood. They weigh exactly as much, but they are considerably bigger. That is why they apparently don´t pick up as much velocity. So I haven´t felt the need for sliders there.

Towards improving performance
Do your model jumper, its arm throws and the canopy match well? Are the servos strong enough? (Of course you should have kept an eye on these things when purchasing your equipment - for further details please see part one). Then let´s try to get the most ouf your model.

As I have already mentioned above, we must adjust the arms in a way that they are stopped mechanically during canopy deployment. This is the only way of protecting the servo gears from the opening force.

Only very experienced modellers should change the basic set up of a parachute. You normally can rely on the designer and therefore should neither change the centre of gravity nor the trim angle (incidence) of the parachute. On the other hand there is plenty to do when you want to find out the ideal length of the steering lines.

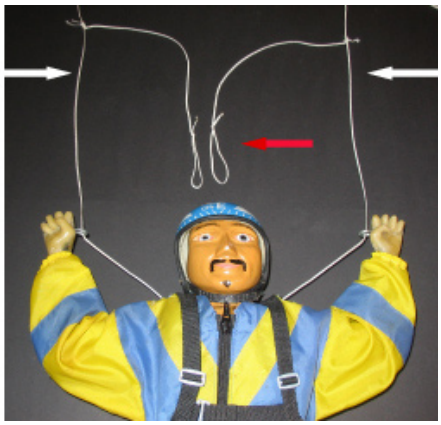
Maximum velocity - an endless story
To achieve maximum horizontal velocity the best thing to do is not to deploy the brakes at all, of course. So why not make the steering lines long enough to ensure that the trailing edge isn´t pulled down? To those longing for more speed, this seems to be a brilliant idea, but only at first sight. If you want to know why, just read on...

In order to understand why it can be hazardous to deploy a non-braked canopy we must have a close look at the unfolding process. When the canopy is released, the pilot chute is ejected first. Due to its drag, it pulls the main canopy out of the container just a moment later. Then the canopy

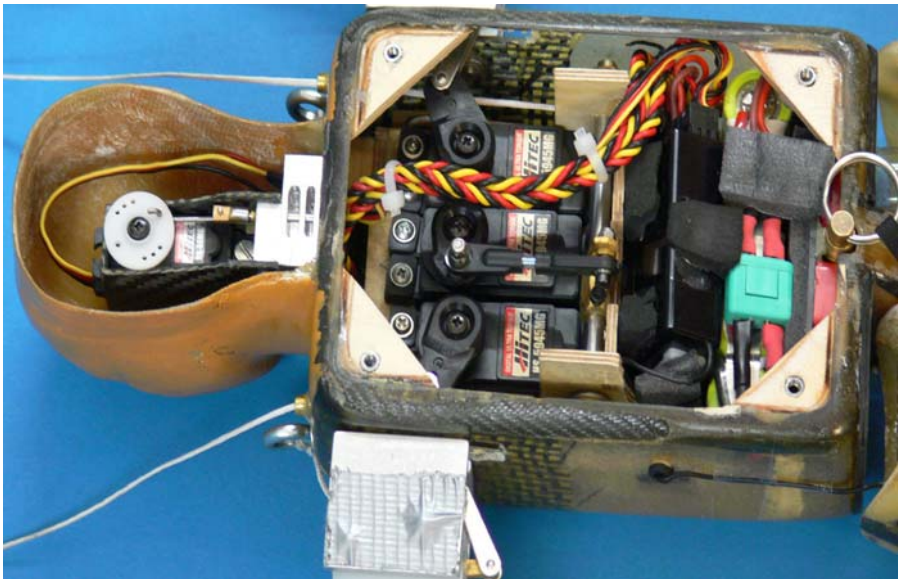
unfolds. The very moment it has reached its full span, the unbraked canopy picks up horizontal velocity, because, just like the wing of an aircraft, it wants to move forward. Yet, since it is attached to the jumper, the canopy moves forward and downward at the same time. This happens extremely quickly. While this is going on, the jumper keeps descending exactly vertically for another fraction of a second or so. Then, as the canopy surges forward, it induces horizontal velocity on the jumper. In the final stage, the canopy and the jumper move towards each other and sooner or later the jumper gets entangled in the canopy or its lines...

So, to prevent such incidents, we must set the brakes to a certain extent beforehand. (By the way, this is exactly what the full-size jumpers do as well.)
Naturally, it will take several test jumps to find out the best set up. But now, as we understand what is going on, we can reduce deployment braking step by step.

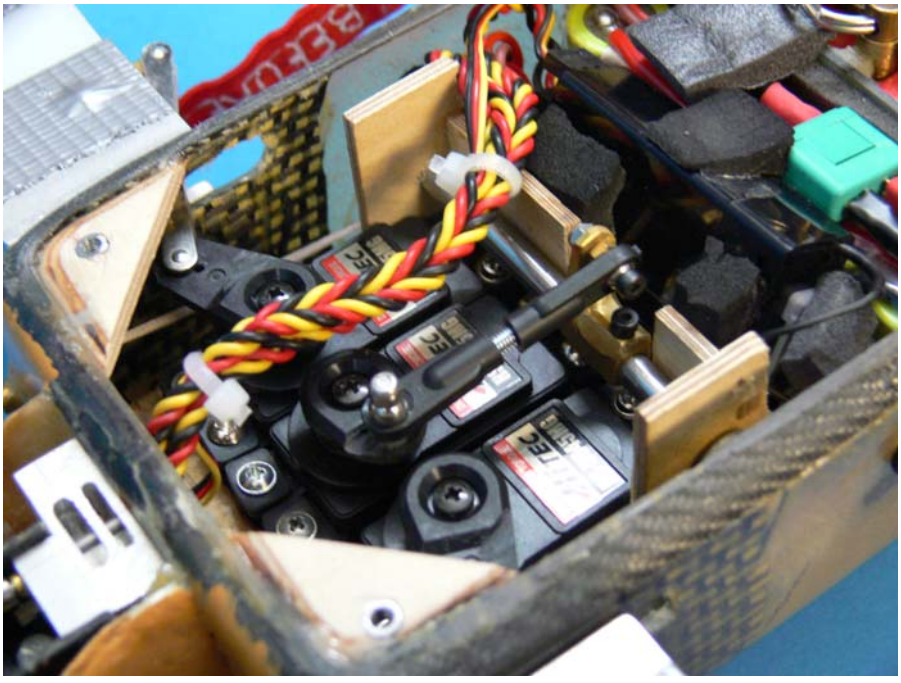
Who´s got the edge...?
...is the big question when jumping in competitions or in strong winds. So let´s look for further means in order to achieve maximum performance.
As we can learn from full size



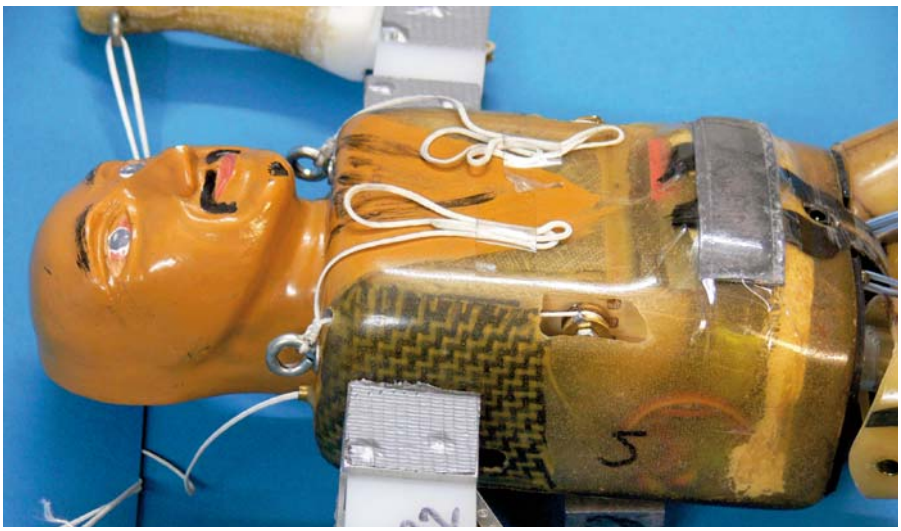
The white arrows highlight the main steering lines. The red arrow points out the interlaced lines used for deployment braking.



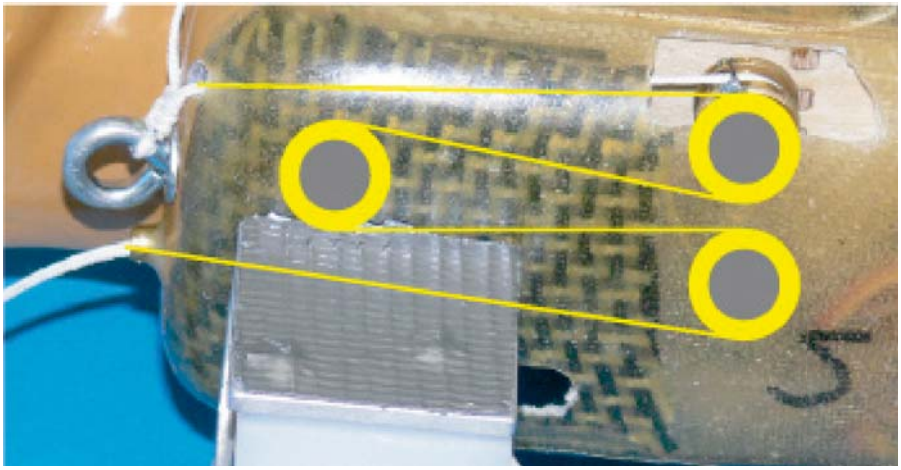
**This MIKE is crammed with equipment.
The release servo had to give way to the „block and pulley“ servo, which is the Hitec 5945 in the middle. In the middle you can also see the pushrod that moves the 5 mm silver steel shaft. The flanges are on the sides of the servo bay, which is made from 2 mm plywood.**



In this close-up you can clearly see the brass lever that operates the shaft.



Because I wanted the flanges to be as long as possible, I had to cut slots into the body.



This picture gives you an idea on how the steering line is run through the mechanism.

gliders, the angle of descent can be influenced by changing the wing loading. So let´s add some extra ballast and tape or glue it in the centre of gravity. And now for the next test jumps: Yes, a higher overall weight of the system, influences deployment. So you may have to adapt the length of your steering lines and - the game starts all over again...

All right, the flying season is not over yet. You are quite satisfied with your jumper. It penetrates into fairly strong winds. But what about turns? Are they tight enough? Can you still reduce horizontal velocity to nill when there is no wind? Can you stall your parachute, although your control stick is not in its back end position yet? Can you get some more throw out of your servos and/or arms? If the anser is „NO“, then you should indeed shorten the steering lines and do without maximum horizontal velocity. Yet, if your answer to all those questions is „YES“, it´s time for further adjustments and maybe for another trick: a set of lines which temporarily brake your canopy during its opening. Just interlace them with the lower part of the main steering lines. Consequently, your container lock needs two slots. In the air, you open your container first. As soon as the unfolding process is over, the deployment brakes are released. Hurray, yet another step towards better performance, but that is not the end of the story yet...

Full-size jumpers pull on their front risers to increase the rate of descent. So modellers have devised a simple technical means to increase sinking as well. They use two „rockers“, made from aluminium sheet, and two pieces of trace. The trace is tied to the rockers at the one end and to the front risers at the other. In the middle of the rockers there is a swivel. The swivels are mounted on the sides of the servo bay. The rockers are linked to the release servo via a pushrod. Now the release servo can pull down the front risers via the rockers and the trace by about half an inch/1.3 centimeters or so. Thus, two things are achieved at the same time: The bent canopy creates less lift and the trim angle is increased. Both result in a higher rate of descent.

After experimenting with the length of the steering lines etc. for a while, I concluded that the arm throw of my MIKE was not sufficient to get all the possible performance out of my PARAFOIL 96. So I devised a mechanism on a „block and pulley“ basis. The idea was to adjust the length of the steering lines according to the flying tasks. To penetrate strong winds, I wanted my model to fly with no brakes at all. On the final approach to the target, I wanted my jumper to be able to turn round like a balley dancer...

Because I needed a very strong servo for the pulley, the release servo had to go in the head of the jumper. A very powerful Hitec 5945 took its

place in the body.
In order to get enough space for the block and pulley, the rather big pieces of wood that normally take the drive-in nuts for the arms had to be removed. The body was reinforced with a layer of carbon-kevlar fiber. Then new, quite platy nuts were made from silver steel and epoxied in place.

I also milled 2 mm wide slots into a 5 mm silver-steel shaft and mounted it as closely as possible to the servos from above. To get a very durable low-friction mount, I made sleeves from M 58 brass.
Then I made four side pieces from 1,5 mm brass sheet. Two of them form a kind of flange. The flanges take two brass pulleys each. Each pulley is about 10 mm in diameter. To reduce friction, I built in tiny ball-bearings, with 3 mm inner and 6 mm outer diameter.
In the area where you normally find the collarbone, there is a second shaft. It is made from 3 mm piano wire. Each end of it holds a block.

Was all this worthwhile? Well, now I can produce an extra 3 inches/appr. eight centimeteres of steering line. As a result, I can fly my PARAFOIL 96 with absoluetely no braking at all. Although the canopy is purpose-designed for accuracy jumping, it outruns most other parachutes. When I push the button, the eight centimeters of line are pulled in and the model becomes extremely responsive on the controls.

Heel!
That´s what you shout when you want your beloved pet to come to a rest next to your feet. If you want your little jumper behave exactly like your compliant dog, you must undergo intensive training.
Let me finish off this report with just a few basic hints on accuracy jumping in strong winds.

You had better drop your jumper a bit „too far away“. As you gather more and more experience you will repeatedly notice that your jumper hardly ever touches down too far away in front of you.
In case your suspension lines are twisted you will be very relieved to see your model go down somewhere behind you nearby. In case you expect your model not to reach the target, don´t set the model at maximum velocity. Set your jumper at the lowest rate of descent possible instead and let the wind drive him towards you.

Happy landings!

As you know, these four reports are translations of articles I wrote for Modellflug International in 2007.
I also handed in articles on how to practise accuracy landings and rigg model parachutes then. They could be downloaded from the Modell-sport Verlag website for a while. I hope to find the time to translate these reports into English soon.

Meanhwile many developments have been initiated in rc-skydiving. Alfred Rachner, several times European champion, has developed and successfully test flown an entirely new jumper, which is expected to be put on the market in the near future. His new jumper is considerably smaller, more lightweight and a lot cheaper than MIKE and ANDY. Nevertheless, Alfred managed to come in first with it in a big competition earlier this year.

The new ANDY features ample arm throw for big parachutes. I have designed and tested a new accuracy canopy of the parafoil type which I hope will be a perfect match for the new ANDY. The project is well under way, but not completed yet - after all rc-skydiving is just my favourite pastime.

Michael Rogg, June 2009

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