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R/C Soaring Digest (RCSD) is a reader-written monthly publication for the R/C sailplane enthusiast and has been published since January, 1984. It is dedicated to sharing technical and educational information. All material contributed must be exclusive and original and not infringe upon the copyrights of others. It is the policy of *RCSD* to provide accurate information. Please let us know of any error that significantly affects the meaning of a story. Because we encourage new ideas, the content of all articles, model designs, press & news releases, etc., are the opinion of the author and may not necessarily reflect those of *RCSD*. We encourage anyone who wishes to obtain additional information to contact the author. *RCSD* was founded by Jim Gray, lecturer and technical consultant.

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TABLE OF CONTENTS

Don't forget to check out the *RCSD* web pages each month. Cover photographs are always available for viewing, and usually available for downloading, as well. Special article .pdf files are frequently available for a limited time, and of course our web masters update the highlights and status information of each issue as it becomes available.

Advertiser Index

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Monthly Feature Photography & Web Version of the Printed Article (where appropriate)
Highlights & Mailing Status of the Current Issue
About RCSD
.... **Subscription Information**
.... **Advertising Rate Card** (Adobe Acrobat PDF format)
.... **RCSD Feature Columnists, Reporters, and Editors**
.... (E-mail/web addresses, plus general information about their areas of interest)
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Links to Organizations, Special Interest Groups & Clubs
On-Line Articles - Great articles originally written for the printed version of *RCSD*.
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.... "Flys Faster" by Dr. Michael Selig
.... "The Square-Cube Law and Scaling for RC Sailplanes" by Dr. Michael Selig
.... "Modifying & Building the MB Raven (Parts 1-4)" by Bill & Bunny Kuhlman
.... "Butterfly and Moth Airbrushing Tutorial" by Joedy Drulia
Bookshelf Listings - A listing of recently published books of interest to aeromodelers.
Complete RCSD Index, 1984-2002

The Soaring Site

LSF Board of Directors Election

We received an e-mail from Mike Glass with the Soaring League of North Texas. Mike had received what follows from Henry Bostick who asked that he send it to their e-mail group. Many of you are likely interested in this subject, as well.

Henry said, "Mike, I have known these fellow flyers for a number of years and believe they would be an excellent slate for any flying organization. Would you be so kind and forward this to our club e-mail list. The LSF is a major SIG working with the AMA, giving direction and guidance to R/C Soaring, and most especially the National Championship in Muncie."

— Forwarded by Tom Kallevang/IT/SEARS on 08/22/2003 09:00 AM —

"Hello, all. I'm sending this note to you because I and several others are interested in running for the LSF Board of Directors during this election cycle and we are soliciting nominations for our slate.

"I am running for the office of President, Martin Doney of Baldwin, Michigan is running for Vice President and Larry Jolly is running for Treasurer. We are not running a Secretary nominee as Jim Deck is the incumbent and will be finishing off his term that was interrupted by his illness. Jim's experience brings continuity to the new Board.

"The information you need to provide in a nomination is the following:

President:	Tom Kallevang	LSF #303
Vice Pres:	Martin Doney	LSF #7429
Treasurer:	Larry Jolly	LSF #3579

"Right now, only mail-in nominations are being accepted, although the online page at the LSF web site should be active soon.

"Here is the URL for the nomination web page: http://www.silentflight.org/vote/vote.shtml

"There is confusion about whether you must contact the LSF once every two years to be considered an "active" member. In previous elections, the entire LSF membership excepting aspirants were allowed to vote. Because of some outdated verbiage in the By-Laws that was designed to help keep the mailing costs of LSF newsletters contained, some people feel that only those contacting LSF within the last two years (this includes upgrades in levels) are "active" members.

"A Level 4 or 5 is considered active regardless if there has been communication or not. *RCSE* posts by others indicate that you must contact Jim Deck with your current information (name, address, LSF #) so he may update the database. That's a good idea in any case, since the LSF should know where its members are located.

"You can send Jim an e-mail at this address: <james.deck@comcast.net>. Please include your name, address and LSF #.

"Larry, Marty and I hope we can count on your support to win our way into the election via your nominations. If you feel we are the right people to advance the sport and your interests, then please exercise your LSF membership rights and nominate us for the next Board of Directors.

"Please feel free to share this information with other LSF friends that I may not have had an e-mail address for.

"We should have a web site that gives basic bio and position statements available soon. Keep watching RCSE for more developments.

"Thanks in advance for your support. With your help, we can continue the evolution of our sport and our organization."

(signed) Tom Kallevang
Member of SOAR (Chicago, IL)
AMA 8293 (Contest Director of the annual SOAR FRED contest)
LSF #303, Level V #103

Happy Flying!
Judy Slates

Elmira 1999

Elmira Aero Tow event.

Photography by Dave Garwood, New York.

Back Cover

ELMIRA 1997

Elmira Aero Tow event.

Photography by Dave Garwood, New York.

Model Sailplane Competition: From Awarding Points to Measuring Performance Skills

By Rense Lange

Let's face it, the rules for Thermal Duration (TD) contests are easy to explain. Staying up longer is better – i.e., until you go over the time limit set by the [C]ontest [D]irector – and so is landing closer to the target. Therefore, it seems obvious to most that we simply quantify flying times in seconds and landing performance in some distance metric (often the marks on a tape or a stick) and then add them to get "points." Next, perhaps after normalizing flying times relative to that of the rounds' best performer, and/or throwing out peoples' lowest flight times, we sum the points across rounds, and we declare the pilot with the highest sum to be the winner.

Note that I am not claiming that common scoring practices are problematic. *If anything, this paper will demonstrate that the standard contest rules serve their basic functions just fine.* Also, the rules for model sailplane competition have the virtue of being simple and easy to enforce, and in most people's minds, the whole scheme seems fair: after all, this is pretty much how your teachers computed your grades in school. Thus, we are all set, as social acceptance of the rules is guaranteed, especially when they are applied as was announced by the CD during the pilots' meeting prior to the first round, the occasional troublemakers, complainers, or sandbaggers not withstanding.

So, what is the issue with points and performance as announced in the title to this piece? Well, consider four hypothetical pilots, Joe, Sue, Bob, and Bill and let's further assume that these pilots somehow end up with 400, 800, 900, and 1000 points, respectively. The question here is: What does any arithmetic we might want to do on such points tell us about how good or bad Joe, Sue, Bob, and Bill really are at TD flying relative to each other. For instance:

- Is it true that Sue (with 800 points) is twice as good as Joe (with 400 points)? That is, can we multiply points (by two in this case) and obtain something useful for comparing pilots' performance?

- Is Bob better than Sue by the same amount as Bill is better than Bob? That is, does a difference of 100 points represent the same performance differential regardless of where it occurs?

- Joe (with 400 points) finished 12-th in this contest, and his brother Jack finished third in another contest (held a week later) with 300 points. Does this mean that Jack is a better pilot than Joe is?

In the above, I tried to stress the distinction between the points pilot receive and their actual skills. The points are what a pilot deserves according to the rules of the game, whereas performance skills refer to how good are pilots at whatever it takes to fly TD contests. The skills needed for high performance include reading the air, knowing one's plane, making correct judgments concerning wind and temperature, appropriate tow hook and flap settings, correctly judging the height of the trees near the landing site, and knowing when to hold or when to fold when in light lift. In short, I hope that you agree that "points" and performance are not the same things at all.

To complicate matters, everyone knows from experience that performance in our sport has a chance factor because even Mr. Wurts does not always finish first (although, … I just saw the 2003 NATS results), and sometimes a rank beginner blunders into a boomer thermal while experienced pilots' planes fall out of the sky like airsick turkeys. Thus, if we really want to discuss this properly then we will have to make provisions for chance fluctuations as well.

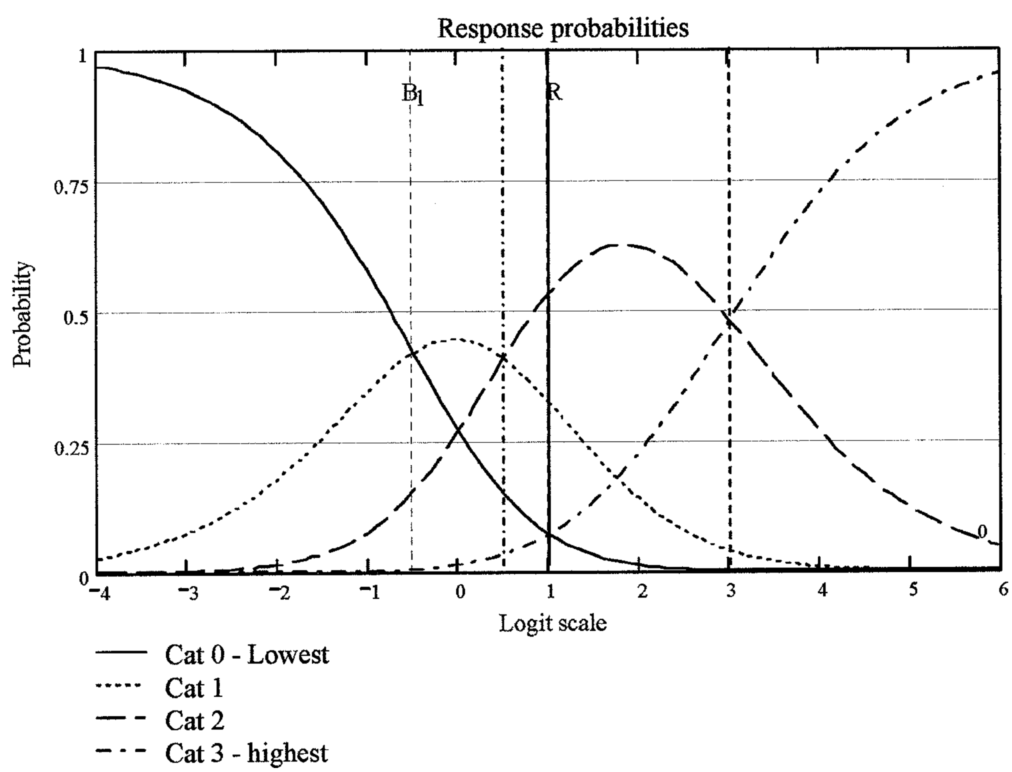
Before doing this, it may be instructive to compare TD performance with physical measurement. The difference between TD points and, say, measuring length is striking. Sure, both situations involve numbers, but the points in TD contests and the inches used in measuring have very different properties, the most important being that in measuring length there is a direct relation between the numbers being used and physical properties the object.

In particular, if you already have pieces of wood of one inch each then measuring five inches is easy enough as all you have to do is to place five pieces of wood next to each other. Not so in TD flying: even if we forget about the sex change operations this would require, two Joes don't make one Sue, and neither do their skills add up! In other words, even though points are numbers and better pilots probably get more of them, there is no one-to-one correspondence between points and TD skills.

However, don't we in fact treat TD scores that way? We DO add up pilots' scores, and we do assume that, say, if Bob is 50 points short in one round, then he can make up for this by getting 50 points more in the next one (provided that he would have scored at least 50 points below the next round's maximum). But, we already agreed (I hope) that "points" and TD performance is not the same thing, and so there is no real guarantee that the pilot with the most points is indeed the best!

A solution to this problem is outlined in the following section. Although written with TD competition in mind, the method applies equally to other types of contests, including full scale ones or non-airplane contests. The Method section discusses technical issues, but the application described next (the 2002 AMA NATS) should be understandable also by those who skipped the Method section.

Figure 1



Method

To address the issues raised above, so-called Rasch scaling is used (see references). That is, the log-odds transformed TD scores (see below) are decomposed into two major components: the difficulty of the round (R_r) – which will be ignored throughout the remainder – and the skill level produced by a particular pilot / plane combination (S_s). That is, for simplicity, pilots and any planes they prefer to fly are treated as a single unit *s*. Next, the seemingly numerical properties of the TD points are addressed by treating them as a succession of ordered categories ($C_0 < C_1 < ... < C_n$) which cover the entire range of "points." These categories are separated by (internal) boundaries ($B_1, B_2, ..., B_b, ..., B_n$) which are included in an additive fashion as well. (Note: The B_b sum to *0*).

To accommodate the probabilistic nature of TD performance, we are interested in the quantities P_{nmb} which represent the probability that person *n* in round *r* achieves a score in category *b*. That is, we recognize from the outset that all performance is subject to random fluctuation. Finally – and this is the central "take my word for it" part (but see references) – *if we insist that summing points should make sense*, it is required that:

$$\ln\left(\frac{P_{srb}}{P_{sr(b-1)}}\right) = S_s - R_r - B_b$$

In other words, the log-odds of the probability of reaching performance category *b* rather than performance category *b-1* increases with the pilots' skills (S_s) and it decreases with the difficulty of round (R_r) and distance between category boundaries *b* and *b-1*. If this holds, then the central quantity of interest, i.e., the pilots' skill levels S_s, can be estimated in a nonlinear fashion from the sum of the points they received. (Technically speaking, such sums are sufficient statistics; consequently, there is nothing to be gained by considering any other information). Figure 1 shows the probabilities P_{nmb} for a hypothetical round with $R = 1$, and $B_1 = -1.5$, $B_2 = -0.5$ and $B_3 = 2$.

Note that all quantities are expressed in the same metric. Given the left-hand side of the equation, this metric's units are called *Logits*. The metric has no true zero, and we may add (subtract) any constant to the parameters, as long as we are consistent in doing so. The software used to fit the equation also provides indices of fit, together with estimates of the error of measurement of all parameters. Accordingly, it is possible to determine whether the difference in performance of two pilots is due to chance.

Example: 2002 Unlimited Nats

To illustrate the procedure I reanalyzed the results of the AMA Nats of 2002. This contest had 11 rounds (with points ranging from 0 to about 1100), and the data for 91 pilots were available from the web. The pilots' names and their rank as determined via the contest rules are shown in the first two columns of Table 1.

It soon became clear that the precision suggested by the wide range of 1100 points is quite illusory since more reliable findings could be obtained by dividing the pilots' points into just 25 point categories.[1] The resulting estimates of pilots' skills *Logits* are as is shown in Column 4 of Table 1. Note that the recoding introduces slight shifts, as pilots' ranking according to the contest rules (Column 1) and that in *Logits* (Column 3) are not identical. Differences are further introduced because I did not exclude the lowest round (which the contest rules did); moreover, the estimation procedure does not require complete data and missing rounds do not necessarily lead to lower *Logit* values. However, the net effect of these shifts is relatively minor (the correlation between the ranks in Columns 1 and 4 is *0.91*).

The table also lists the standard error made

[1] For each round the points were recoded as (0 = 0) (1 thru 100 = 1) (101 thru 200 = 2) (201 thru 300 = 3) (301 thru 400 = 4) (401 thru 500 = 5) (501 thru 600 = 6) (601 thru 700 = 7) (701 thru 800 = 8) (801 thru 850 = 9) (851 thru 900 = 10) (901 thru 925 = 11) (926 thru 950 = 12) (951 thru 975 = 13) (975 thru 990 = 14) (991 thru 1000 = 15) (1001 thru 1010 = 16) (1011 thru 1020 = 17) (1021 thru 1030 = 18) (1031 thru 1040 = 19) (1041 thru 1050 = 20) (1051 thru 1060 = 21) (1061 thru 1070 = 22) (1071 thru 1080 = 23) (1081 thru highest = 24).

in estimating the pilots' performance (SE). For instance, the error in estimating the winner's (Kiesling) performance is 0.*29 Logits* and that in the runner-up's (Burnoski) performance is 0.*10 Logits*. Statistically this means that – at least in this contest – the difference between these pilots' performances (*1.01 vs. 0.38 Logits*) is unlikely to have occurred by chance alone (the probability of this occurring is less than *5%*).

Table 1

Placement	Name	Logit order	S_s Logits	SE	Model Fit	Fit z	Comment
1	Kiesling	1	1.01	0.29	1.1	0	
2	Burnoski	2	0.38	0.10	1.1	0	
3	Bacus	3	0.33	0.09	1.3	0	
8	Valdes	4	0.31	0.08	**3.3**	**2**	*Too inconsistent*
5	Miller	5	0.30	0.08	1.8	1	
6	Barnes	6	0.30	0.08	1.7	0	
4	Bothel	7	0.28	0.08	1.0	0	
9	Lachowski	8	0.24	0.07	0.9	0	
20	Siebenaler	9	0.22	0.07	**0.2**	**-2**	*Moved due to "missing data"*
19	Steifel	10	0.22	0.07	0.7	0	
7	Robertson	11	0.21	0.07	1.3	0	
15	Lawicki	12	0.20	0.07	2.0	1	
11	Wiederkehr	13	0.19	0.07	1.1	0	
13	Kallevang	14	0.18	0.07	1.6	1	
12	Stump	15	0.15	0.06	0.8	0	
10	Scully	16	0.14	0.06	1.0	0	
17	Schlitzkus	17	0.14	0.06	1.4	0	
49	Pike	18	0.14	0.07	0.7	0	
35	Strother	19	0.14	0.07	0.9	0	
16	Wingstedt	20	0.12	0.06	1.1	0	
14	Brittin	21	0.09	0.06	0.7	0	
59	Wiese	22	0.09	0.07	1.0	0	
42	Storie	23	0.09	0.06	1.7	1	
21	Tock	24	0.09	0.06	1.8	1	
22	Berlin	25	0.09	0.06	1.7	1	
40	Richmond	26	0.08	0.06	1.0	0	
36	Barry	27	0.07	0.06	1.0	0	
23	Goldsmith	28	0.07	0.06	1.7	1	
28	Schlitzkus	29	0.07	0.06	1.1	0	
43	Stone	30	0.07	0.06	**2.9**	**3**	*Too inconsistent*
31	Riebesehl	31	0.07	0.06	1.4	1	
39	Marcicki	32	0.05	0.06	0.8	0	
18	Vetter	33	0.05	0.06	0.9	0	
34	Walter	34	0.05	0.06	0.9	0	
26	Posthuma	35	0.04	0.06	0.5	-1	
27	Woelfel	36	0.04	0.06	**0.4**	**-2**	*Too consistent*
37	Meyer	37	0.04	0.06	1.4	1	
24	Jeffery	38	0.04	0.06	1.0	0	
30	DeVries	39	0.03	0.06	0.8	0	
33	Shape	40	0.03	0.06	0.6	-1	
86	Campbell	41	0.03	0.07	1.9	1	
41	McGowan	42	0.03	0.06	1.2	0	
32	Kukral	43	0.02	0.06	0.8	0	
51	Brock	44	0.02	0.06	1.0	0	
25	Mong	45	0.02	0.06	0.5	-1	
29	Densford	46	0.02	0.06	0.8	0	
52	Smith	47	-0.01	0.06	**0.3**	**-2**	*Too consistent*

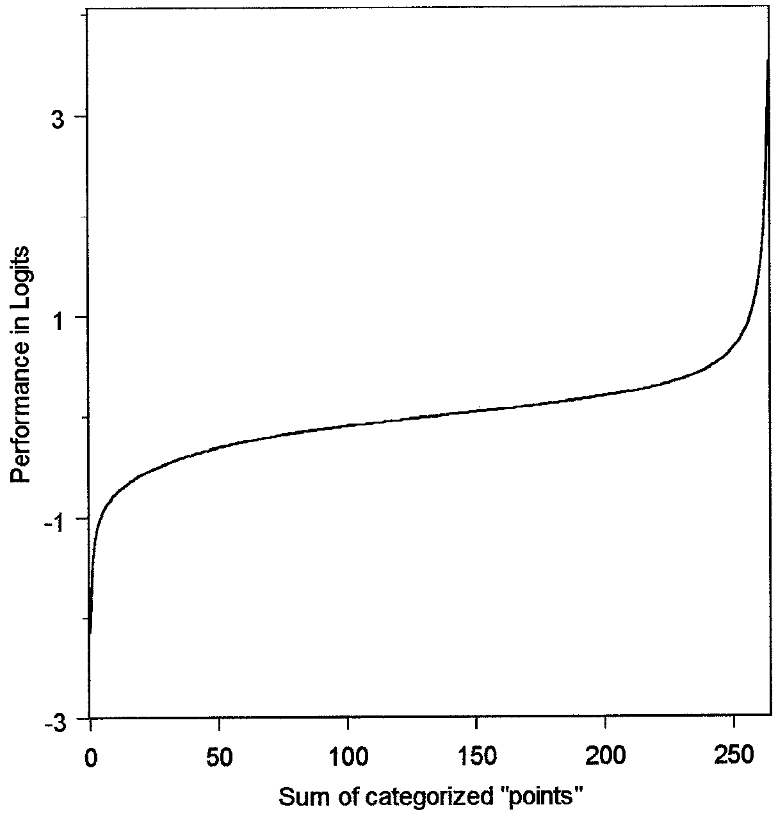
38	Maize	48	-0.02	0.06	0.6	-1	
46	Wilson	49	-0.03	0.06	1.5	1	
61	Glover	50	-0.03	0.06	1.8	1	
48	Squire	51	-0.03	0.06	0.5	-1	
56	Bryan	52	-0.03	0.06	0.9	0	
67	Doney	53	-0.04	0.06	1.2	0	
45	Roberto	54	-0.04	0.06	0.5	-1	
47	Wade	55	-0.05	0.06	1.3	0	
84	Corven	56	-0.06	0.07	0.7	0	
55	Schmitz	57	-0.06	0.06	**0.4**	**-2**	*Too consistent*
64	Siler	58	-0.07	0.06	1.1	0	
53	Meek	59	-0.07	0.06	**0.2**	**-3**	*Too consistent*
44	Johnson	60	-0.07	0.06	0.7	0	
50	Diniz	61	-0.07	0.06	0.4	-1	
58	Schmoll	62	-0.07	0.06	0.4	-1	
75	Cole	63	-0.08	0.06	1.5	1	
54	Pierce	64	-0.08	0.06	0.6	-1	
60	Swanson	65	-0.08	0.06	0.9	0	
89	Coleman	66	-0.08	0.10	2.9	1	
66	Winstanley	67	-0.09	0.06	1.0	0	
74	Mohs	68	-0.11	0.06	0.7	0	
85	Allen	69	-0.11	0.08	1.4	0	
57	Beatley	70	-0.12	0.06	0.4	-1	
73	Iafret	71	-0.14	0.07	0.8	0	
76	Prater	72	-0.14	0.07	1.1	0	
69	Smith	73	-0.14	0.07	**0.3**	**-2**	*Too consistent*
78	Foster	74	-0.15	0.06	1.5	1	
65	Bhattacharyya	75	-0.15	0.06	0.5	-1	
62	Murray	76	-0.15	0.06	0.6	-1	
77	Dubich	77	-0.16	0.07	0.5	-1	
63	Sewell	78	-0.16	0.06	0.8	0	
68	Redden	79	-0.17	0.07	0.7	0	
82	Dubich	80	-0.17	0.07	1.0	0	
70	Johns	81	-0.18	0.07	0.9	0	
71	Quesada	82	-0.18	0.07	0.9	0	
79	Hoover	83	-0.18	0.07	0.9	0	
72	Schwerin	84	-0.19	0.07	0.6	0	
80	DeBoer	85	-0.20	0.07	0.4	-1	
81	Anderson	86	-0.24	0.08	0.8	0	
91	Remus	87	-0.26	0.18	0.2	-1	
83	Thurman	88	-0.31	0.09	0.9	0	
87	Hutchings	89	-0.39	0.13	0.5	0	
90	Douglas	90	-0.66	0.20	1.1	0	
88	Mandel	91	-0.78	0.17	**2.8**	**2**	*Too Inconsistent*

Reliability 0.86. Fixed (all same) chi-square: 399.8 d.f.: 90 significance: .00

Thus, Kiesling was clearly the winner. The differences between the pilots in the middle positions is far smaller, and most of their *Logit* differences (and hence their different rankings) are really just chance fluctuations!

Of course, we can always improve the reliability of the rankings by having pilots fly more rounds or by flying more contests. Such data may well be available. However, to protect the self-esteem of the lower-ranked pilots, no further data are analyzed here. Thus, they can continue to claim that Burnoski and Bacus really are not better pilots – it just happens to be the case that these guys have more luck in contest after contest.

Figure 2



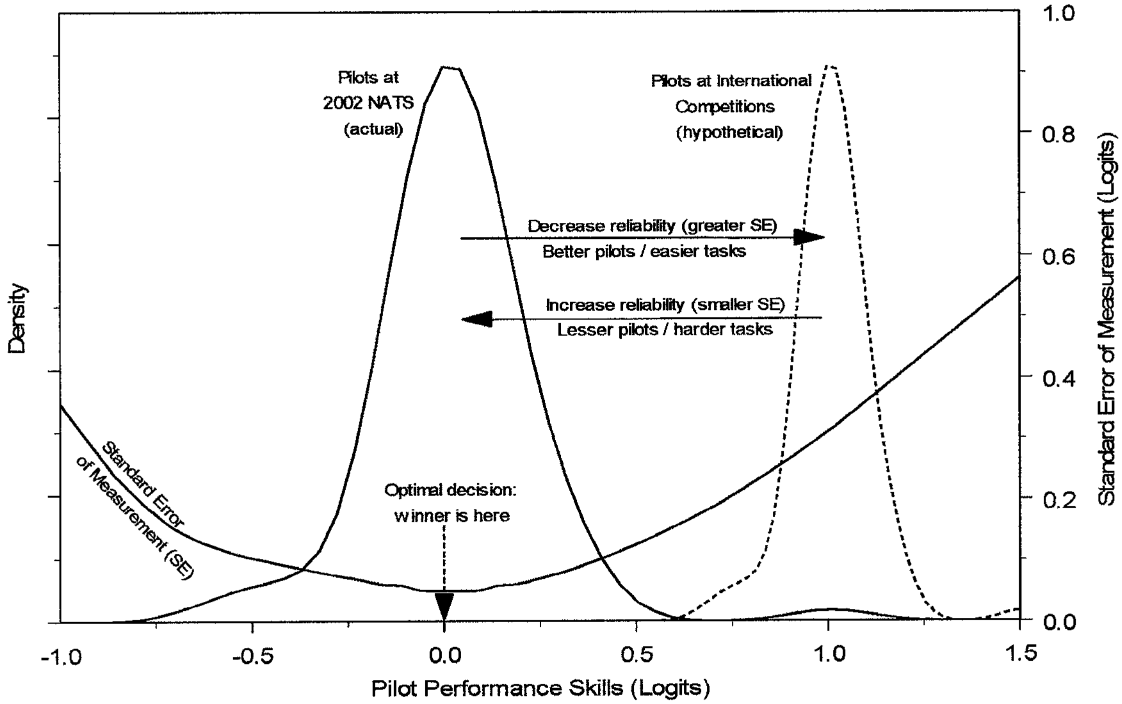
The main finding is *not* that Kiesling really won the 2002 NATS and Mandel did not – such issues are settled by the contest rules. Rather, the most important conclusion is that the data fit the equation shown earlier rather well. (Only 3 of the 91 pilots deviated noticeably from the equation [$z > 2$], and this number of deviations will occur by chance alone anyway with probability greater than *19%*). From this it follows that adding points as was done in this contest truly estimates of pilots' TD flying skills – albeit in a non-linear fashion (see below). In all likelihood, this conclusion applies to other contests as well. If I sound rather sure, this is because I successfully analyzed the data of several other contests in a similar fashion.

While the above implies that most standard contest scoring schemes are probably just fine (i.e., they rank pilots appropriately), it implies that standard arithmetic over the differences between pilots' points is misleading. For instance, the graph in Figure 2 shows how the sum of the (categorized) points translates into *Logit* values. Note that the relation is not linear as increases near the top and bottom yield of the X-axis yield greater *Logit* changes (Y-axis) than do point differences near the middle. Of course, the point categorization described earlier does not help either. This, together with the fact that "points" have no true zero, implies that any operations on points of different pilots involving addition, subtraction, multiplication and division are by definition meaningless. It is only when performance is expressed in *Logits* that addition and subtraction (but not multiplication and division) start to make sense.

Finally, a quick glance at the top and bottom entries of Table 1 suggests that the error in estimating pilots' skills is greatest near the extremes. That is, the S_s can be estimated less reliably for extreme skill levels than for intermediate levels. Unfortunately, *from a measurement perspective*, in contests like the World Championships F3J the pilots are very, very good as pilots qualify for participation only after winning rigorous national championships.

lots' skills are far higher. Figure 3 also suggests a solution, because *increasing the difficulty of the task* would push the hypothetical (high) distribution down to where pilots' skills can be measured more reliably. While I leave it to others to decide how the difficulty of TD contests might be increased in a meaningful

Figure 3



Hence, arguably the most "important" TD decisions are often made in the presence of the greatest error. Already, this issue plays in the 2002 NATS data. Figure 3 shows the smoothed distribution (density) of the pilots' skills, together with the errors made in estimating their skills (the U-shaped curve). We can see that the error for the top pilots accelerates at an alarming rate.

Matters are worse in international competitions. It is reasonable to assume that the best pilots from other countries have roughly the same skills as the top pilots in the 2002 NATS. Hence, as is indicated by the dotted curve, the skill distribution shifts to the right and it has a smaller spread. Accordingly, the distribution ends up where the errors in estimating all pi-

fashion, the method outlined here might assist in evaluating the properties of various proposals.

Conclusion

The measurement exercise reported here indicates that if we add pilots' "points", then these sums indeed order pilots according to their skill levels – *albeit that their skill differences are not proportional to the variations in their contest points.* Thus, except for chance fluctuations, we will identify the correct winner, runner-up, etc. The fact that most readers already thought so detracts little from this conclusion as few had any reason for believing that adding points should really work, other than convention or faith.

More importantly, the present findings pave the way for more advanced applications. For instance, it was already noted that randomly missing data pose no particular problem (other than a loss of precision). Hence, we can express the results of two different contests (flown under different conditions and with different participants) in a common metric, if there are pilots who participated in both contests. This also provides information concerning the performance of pilots who participated in just one contest. It is thus possible to determine whether Bob's 17-th place in contest A, with many great pilots and 112 participants, represents better or poorer performance than Joe's 9-th place in contest B with only newbies participating. Similarly, this would allow us to compute meaningful indices of the "difficulty" of a particular contest (e.g., due to weather, the quality of the other participants, or the format selected by the CD) relative to another.

While this was not addressed in the introduction, the present approach can be extended to include the effects of other factors such as type of plane (e.g., V-tail vs. X-tail, weak vs. strong wind conditions, 2M vs. Unlimited planes, or contest rule variations) – again provided that some pilots fly both. An interesting application, although not for TD competition (but perhaps for F3B?), is the inclusion of judge effects – as would be appropriate for instance in scale competitions or aerobatic contests. Specifically, in cases where results depend heavily on human judgment it is possible to correct for the effects of lenient vs. hard judgment styles, even when performance is rated by different (but overlapping) sets of judges.

It might take some effort to set things up properly for quick analysis (well-maintained linked data bases come to mind), but the use of the *Logit* metric described here holds the promise of producing true indicators of TD skills. When asking how good a pilot someone is, we no longer have to be content with statements like "*he beat Bob once, lost to Sue twice, and placed 14-th among 54 experts and 17 beginners*" – which leaves us to do the math, so to speak. Instead, we can now know where everyone stands in relation to each other, how much each improved over time, and whether one contest was more challenging than another was. Of course, some of us might well feel better not knowing about such things ...

About the Author

Although the St. Louis flying field is some 125 miles away from my home, I try to be a member of the Mississippi Valley Soaring Association. I am also involved in the Institute of Objective Measurement, which studies and promotes the Rasch measurement methods used here. When not flying my Sharon Pro 3.7, Sierra 2.5, XP-3, or writing papers like this, I hold jobs at the Illinois State Board of Education and the Dept. of Psychiatry of Southern Illinois University, both in Springfield, IL. (That is, apart from living in general). There, I apply Rasch measurement to the yearly test scores of Illinois' elementary and high school students, as well as to olfactory stimuli that can be used to diagnose the precursors of Alzheimer's and related diseases, and, lately, to scaling the performance of advanced artificial intelligence systems. You can reach me via email at: renselange@earthlink.net.

References

Those interested in learning more about the scaling methods used here should start by reading about Rasch measurement. While the following book focuses on educational issues, its clarity of exposition makes this an excellent overall introduction.

Wright, B. D., & Masters, G. N. (1982). Rating Scale Analysis. Chicago, IL: MESA Press.

The reader can additionally obtain a wealth of information by following the links at website: http://www.rasch.org/.

Those who want to try scaling themselves can download fully functional (and free) software from the website: http://www.winsteps.com/ (*Bigsteps, Facets*). From there you can also reach sites showing how Rasch scaling was successfully used to predict the winners in College Football and Basketball.

TECH TOPICS

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POLECAT AERO'S XP3 DLG

A little while ago one of Denny Maize's XP3 kits showed up at the house. Upon opening the box, a really serious round of cussing and carrying on ensued. Cats dove under couches. Paint peeled off the walls. Water boiled in the pipes.

After regaining some composure I had to admit there was just no way I could ever come close to the quality of this kit. You try and take pride in your own workmanship but when you're outdone this badly it really hurts. It's simply the highest quality kit I've ever had the opportunity to own.

With the fires somewhat ebbed, let's look at the details of this very well done DLG. As readers of "Tech Topics" recall, we've had a good time analyzing HLG's and DLG's recently. Mark Drela's X-Foil has been used to analyze airfoils. A Visual Basic program was written to estimate launch conditions. Other analyses were done to estimate performance, wing loading and optimized planforms.

The bottom line is that if I wanted to design something to meet all the criteria evaluated, it came out looking an awful lot like an XP3. After a couple of e-mails to Denny, a flaperon XP3 was on the way.

Sorting through the box you'll find a Kevlar fuselage with a carbon boom, two of the most gorgeous DLG wing halves you're ever going to see, and horizontal and vertical balsa stabs that are faced with light glass fabric. The appropriate hardware is supplied for mounting the wings and horizontal stab. Several control linkage options are also included.

You'll find the instructions on the Polecat Aero web site along with several articles on set up, flying and trim all in PDF format. This is a great way to do it since the latest updates are always available to everyone.

You supply the wing wiring harness but you will probably choose specialized servos for the wing so your wiring will be particular to your installation. The channel for the harness is nicely drilled out and the servo wells were perfect. Instructions for drilling the peg position and angle are covered on Denny's web site. There are streamlined pegs now available so the choice of launching peg is up to you.

Although the parts count is low, some care and preparation should be taken before getting into this project. The first thing is downloading and printing the assembly instructions. Then read them over several times and visualize all the assembly details.

For instance, notice that the mounting bracket for the horizontal stab fits properly in only one direction. The taper is subtle but important. If the stab doesn't clear the vertical fin, you've got it on backwards! Do this assembly dry and then mark the proper end of the fixture for later use (guess who almost got this wrong?).

Next thing to consider is your choice of equipment. Micro servos of the S90, HS50/55 JR241 and similar variety are appropriate for the rudder and elevator. Probably something on the 15 to 24 in-oz torque range would be appropriate (high end for the rudder). If you've got the poly version, that covers it. If not, read on.

The wing uses Drela airfoils and is quite thin in the servo area. If your servo is over ~9mm thick it will protrude a bit. There are only a very few models that fit completely in the wing. The JR241 appears to be the preferred wing servo and at a bit over 10mm it will protrude slightly.

I ordered PS30s from FMA for this project. They are 9mm thick and have 12 in-oz of torque at 4.8V. They fit perfectly in the existing servo wells and were exactly flush with the wing lower surface. The other servo that fits completely in the well is the Dymond 60. Randy McCleave speaks highly of these and I have a set of them on order.

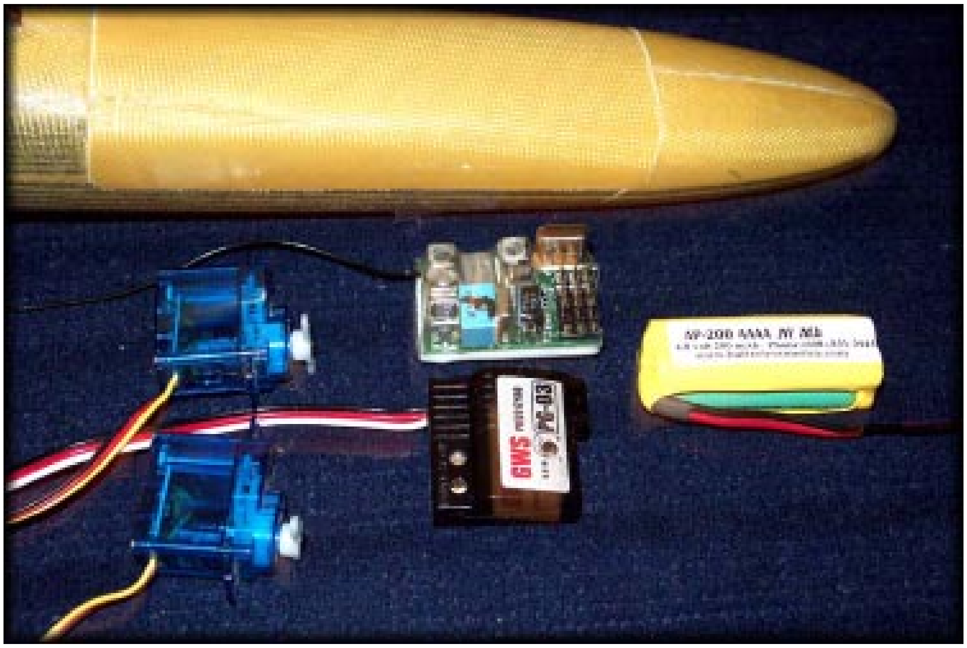
The completed XP3 DLG model out on the front lawn. It's 100+ these days so not too much fun to go out and get flight shots.

Also check out your battery, Rx and gyro needs before you get started. I wound up with a 110maH NiCd pack in the nose followed by the gyro and servos under the canopy and a FMA M5 receiver under the wing but jammed up against the rear of the servos. You may want to use adhesive tape for anything not nailed down. The launch forces can get to be many 10's of G's so things will move if given a chance.

A NiMh pack (AP 200 square pack style AAAA battery sizes) from Batteries America will also work (200maH). Denny makes his own pack from 280maH NiMhs.

Most everything you need to know for assembly is covered by the instructions. I'll just highlight one or two things.

I would recommend setting up the wing peg hole prior to joining the wings. Setting the angle is a lot harder with 60 inches of wing hanging off your drill press. To set the angle, I took half the total dihedral angle, set that on the drill press base and worked my way up on drill sizes. Glass, Kevlar



All That's Going in Here? HS55 servos,
Gyro, FMA M5 Rx and 200mah NiMh pack.

Yup, it All Fits! NiMh Pack SLides
Completely Into the Nose.

Stabilizer Detail - Z-Bends and Balsa
Support for Rudder Linkage.

and foam don't drill real clean so don't hit it with the final size first. I prefer to take it in two steps with the final hole a few thou under the final dimensions so assembly is very tight prior to gluing in the peg.

Joining the wing halves worked fine. Choose the dihedral angle that works best for you and then epoxy as directed. I had some misgivings about the filled epoxy for the wing bolts. They seem to be OK now but they had a little give after 24 hour cure. I added a 1/64" ply cap over each bolt hole.

After tapping the holes in the ply wing saddle for the wing bolts, hit them with thin CA. Let that set and then tap again. Repeat a couple of times until you've got very hard but accurate threads in the wood base.

Splooging the wing saddle is a highly technical term Denny uses for globbing up the gaps in the wing saddle with filled epoxy. Sand and clean the wing saddle first to remove any release agent. Then cover the bottom of the wing with Saran. Use tape at strategic points to stretch it out smooth in the contact area. Apply some wax or Vaseline to the nylon bolts. Mask the fuselage sides around the saddle with tape so the overrun peels off easily. Then mix up a ketchup like consistency of micro balloons in 30 minute epoxy, slather it on the saddle, bolt on the wing and go have a couple of beers.

With the wing mounted, you can now accurately glue on the horizontal stab fixture. Mount the stab (get the right end forward!) and eyeball the stab to be properly aligned with the wing. Be sure you sand the boom under this fixture so the glue will grab well. Once you've got the alignment right, hit the fixture with CA and then LEAVE IT ALONE FOR ABOUT 15 MINUTES. CA sometimes does not fire off immediately on some carbon surfaces. Add the adhesive carefully and then back away from the airplane. Perhaps another beer is called for here.

After the horizontal stab is set, notch the vertical stab for the boom taper. If you've done this right, the vertical stab has a slight friction fit to the boom so you can set it properly and not have to support it with an external fixture while the CA grabs it. Use a right angle to be sure you've got the vertical AND horizontal alignment just where you want it. Then hit the contact area with thin CA and again leave this alone for about 15 minutes.

As per the instructions, you're going to CA glass fabric reinforcement on the vertical stab so the initial glue joint does not have to be massive. Oh yeah, you did round off the leading edge of the stabs before getting to this point didn't you?

Linkage is up to the builder. There are instructions for running a pull-pull system. There's also Teflon tubing and wire for running a stainless steel pushrod system as used by Mark Drela (~ 0.014" wire). There's some larger diameter tubing for running a 0.020" carbon pushrod system as well (supplied in the kit).

My choice for linkage is 0.055" z-bend music wire for flaperons (supplied) and 0.020" music wire for the stabilizers (not supplied in lieu of the carbon rods). The stab linkage uses the larger diameter tubing (yellow supplied with kit). Although I love to fly DLG, at my age I'll never be competitive so I opt for something a bit more robust and reliable.

I used the supplied 3/32" ply horns for the flaperons but made my own 1/16" ply horns for the stabs. The longer stab horns still provide plenty of travel but minimize the effect of play in the linkage or servo gears.

The linkage tubing for the stabs is routed through a small opening at the base of the wing saddle and then tack glued with Goop along the carbon boom. A third tube is also used in this location for the Rx antenna to exit the fuselage.

The connections at the stabs are z-bends. This allows the horizontal stab to be easily removed. I use nylon mini-clevises at the servo end for all linkages (not supplied).

At this point, adjust your throws and trims as per the instructions. As with any high performance ship, there are many ways to set it up. The instructions on the Polecat Aero web site are an excellent basis for configuring an XP3. Mark Drela's article also provides very valuable suggestions for trimming and launch set up. For me, a gyro is a must. I prefer the near instantaneous response of the gyro during those first few fractions of a second after launch.

FLYING THE XP-3

We ran into a few equipment problems getting the XP3 in the air and this is probably the place to cover those.

The PS30 servos had some issues. They both had a very bad buzz near center. The right wing servo would freeze in the up aileron position (very bad!). Thermal drift was quite noticeable. Going from the basement to the field required about 50% change in sub trim. Both servos drifted the same requiring and the exact sub trim correction is definitely the temperature dependent. The HS55's in the fuselage did not exhibit any of these problems.

After shortening the servo arms, regluing the servos in the wells and changing from metal to nylon clevises, the buzz got down to manageable proportions and the right servo stopped jamming in the up position. However, the drift never went away.

First outing at the field showed that the CG setting was good (I use the most rearward setting I can handle) and the elevator throw could be cut down by ~ 25%. Flaperon differential was good with no rudder coupling. I've since found that I like just a hair of rudder coupling to keep the nose tracking a bit better in the turns. Other XP3 flyers prefer no coupling. Flap throw was a bit generous and needed to be cut back. That's what ~ 1/3 chord flaps will do for you!

What turned out to be the last toss of this outing had a fortuitous glue joint failure. The landing was in tall grass but with a slight crabbing motion and the vertical stab twisted completely free of the boom. If I had done the Full Monty on a discus launch it would have been all over.

Close inspection of the failure indicated good wetting of the carbon boom and the vertical stab with the CA. The glass was also well penetrated but the glue failed at the glass interface. Apparently the CA hadn't polymerized properly in this area and was very brittle. Foam-safe CA can be touchy on shelf life and this one must've had it. It was fresh from the store but who knows how long it had been on their shelf?

Repair was my trusty Goop and balsa fairing which has never failed me over many crashes with my own designs. Please note that neither the PS30 chatter/drift nor the stab joint failure were XP3 problems. But they are things to watch for because this ship is just too nice to mess up with stuff like that.

With various repairs complete, it was off to the field again. By now it's 8:45 PM and it's almost dark but what the heck. A few hand tosses and everything looks fine. Re-center the PS30's for the 85F temperature and we're ready to go.

First shot is a gentle spin and release and ÖÖ WOW! The XP3 took off like a scalded cat and I wasn't even trying. Gyro setting is perfect as the launch is straight and true right from the release. Turns are great. A little down trim to handle the rearward CG a bit better and we're all set.

The next few launches get a bit more velocity into it. Absolutely everything works superbly on this airplane. Launches are incredible. At my age I'm in that geezer category where I can't get supersonic launch speed but this ship is sure making me look awfully good!

Last flight is nearly full force. Well, as full as a fat old guy with a bum shoulder can get. The plane just keeps going and going and Ö. ooops, it's so dark now I can't see it at the top any more. A little strategic positioning and the plane can be silhouetted between a street lamp and the full moon for a very nice little flight. There are lots of bumps and wiggles from the after dark low level turbulence.

After about a minute it's full flaps and down stick to bring it home. Below about 10 feet I can't see it at all but hear the sssshhhh into the grass a few feet away. Then just follow the buzzing servos until I'm close enough to find it and we're done for the night.

Since then we've had several very enjoyable outings with the XP3. There's a reason this is probably the premier DLG kit on the market right now. The construction is excellent. Phil Barnes wings are as close to perfection as you can get. The Drela airfoils work superbly. The control set up is pretty much right on the money. The launch height is outrageous. What more can I say?

As a post-script for this project, last night the flying was great and launch technique was being refined. After a particularly towering zoom, it was time to work on the flap and elevator trim for rapid decent. After a couple of turns for setup, the flaps were deployed and the left wing servo locked in the down position! About all you can do at this point is watch it spiral down and play with rudder and elevator to try and keep the impact moderate. When it hit on the nose and right wing tip it just bounced!

Inspection of the damage showed a small tear near the hatch and a wrinkle in the flaperons about 2/3 of the way out on the wing. This is a certifiably tough airplane. My home built planes would not have survived that dive and impact!

Note that this servo was the OTHER one that had not been locking up. At this point the gears are stripped on both flaperon servos, probably from the impact, so one unfortunate lesson for me is don't use PS30's in this, or any other aileron DLG. They may be fine for indoor electric but the centering, buzz and lock-up are not worth putting a plane like this at risk. We'll be back in the air as soon as those Dymond 60's get here!

Be judicious in choosing the equipment to install in this ship. It deserves the best and will give you all of that back in performance when you get it right. I may never win a contest in DLG but I'm still having the time of my life with this airplane. It's really put the fun back in flying for me.

Thanks Denny!

■

Please send in your scheduled 2003 events as they become available!

Golden State X.C. Race

September 19, 20, & 21, 2003
California Valley,California

Special Announcement

With the cooperation of C.V. Lodge owner Ken Tabb, we have moved the start finish line and launch area next to the C.V. Lodge. This will allow pilots to set up and launch within walking distance to the Lodge and restaurant. In addition, the course has been expanded to a 50K or 31 mile course; most of the course is on pavement, and still offers an unobstructed flight path as far as trees and other vehicle traffic. The new course has all the features which can develop the world famous lift that C.V. is know for.

We are excited to announce that the South Bay Soaring Society is sponsoring the Golden State X.C. Race, September 19, 20 & 21, 2003. This Race is the ultimate challenge in cross country soaring. It is 3 days of fun and competition for all levels of X.C. soaring. September 19th, Friday, will be a course practice day. We will also offer LSF levels 3, 4, & 5 task goal and return markers set on course. Level 2 witnesses will be available to sign off your completed tasks.

California Valley is located at the northern tip of the Carrizo Plain Natural Area Preserve. the reserve is predominately shrub and grassland which provides an arid basin allowing wide open spaces for the best thermal activity. It is bordered by the Tremblor Mountains to the east and the Caliente Mountains to the west. The central feature is Soda Lake, one of the largest undisturbed alkali wetlands in the state. In May, the lake may have evaporated leaving behind a glistening expanse of white salts which illuminates your sailplane as it is crossing.

The South Bay Soaring Society would like to welcome any and all pilots to participate in this fun and challenging event. If you have any questions or want additional information, please feel free to call me.

(408) 683-4140 or Gervais@garlic.com

Thank you for your interest and hope to see you there.

C. D. Mike Gervais

SCHEDULE OF SPECIAL EVENTS

September 19-21, 2003
Golden State X.C. Race — California Valley, CA
Mike Gervais, (408) 683-4140
Gervais@garlic.com

September 20-21, 2003
Last Fling of Summer — Broken Arrow, OK
Dave Register, (918) 335-2918
regdave@aol.com

October 10-12, 2003
Texas National Tournament (TNT) — Dallas, TX
www.SLNT.org

October 17-19, 2003
2003 Electric Soaring World Challenge — Moriarty, NM
www.soarabq.org

November 29-30, 2003
Tangerine Soaring Championships — Orlando, FL
www.orlandobuzzards.org

Modifying a Servo for Reversed Operation

by Bill & Bunny Kuhlman
bsquared@appleisp.net

For our most recent project, the Blackbird XC, we installed flaps in the wings and placed an actuating servo, an Hitec HS 605BB, right over each flap. We ended up using a Y-harness to drive the two servos. Since the servos were mounted facing outward, one turned in the correct direction, the other in the opposite. What would be the best way to reverse the direction of rotation of one servo?

We did an internet search ("servo reversing") and found a number of available in-line servo reversers. These electronic devices are similar to extension cables and contain a small circuit board which changes the signal so the connected servo rotates opposite to the factory-set direction. All of the reversers we found cost around $20.00, and the connectors fit most any servo or receiver. There are a couple of these servo reversers which are designed to replace the standard Y-harness. These Y-harness cables send the normal signal to one servo and the reversed signal to the other, and at least one has built-in noise reduction circuitry so it's better suited for use with longer leads.

But somewhere in the deep recesses of our minds we seemed to remember reading that a servo can be reversed by exchanging the motor leads and exchanging the two outer wires on the potentiometer. We wouldn't need to purchase servo reversing circuitry if we could confirm that procedure being correct.

Another internet search ("reversing servos") found <http://www.barnyard-buzzards.com/Builders_Corner/Electronics/index.htm>. This page is on the web site of the Barnyard Buzzards, a power club in the Monroe Washington area. Photos and accompanying text depict the elevator control system on an MAT AirTrax, an IMAA legal airplane. This large aircraft requires two servos to drive the elevator, a situation which mandates one servo be reversed. Down near the bottom of the page is a simple method for reversing a servo. As a pleasant surprise, a photo of a partially disassembled HS 605BB servo leads off the instructions, showing there is a lot of working room inside. The remainder of the photos show how to modify the smaller HS 85 for reversed rotation.

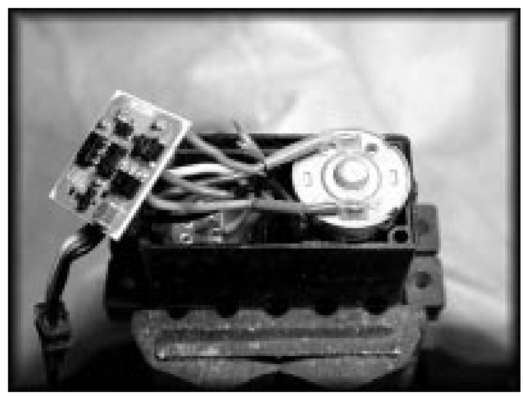
Simply stated, our foggy memory was right on. You want to exchange the two wires on the motor so it runs backwards from the norm, and exchange the two outer wires on the potentiometer so the feedback signal is reversed. Doing this of course voids any warranty, so make sure you're up to some fine soldering before pulling the case apart.

Rather than unsolder and then resolder directly to the small SMT (Surface Mount Technology) circuit board, as described on the Barnyard Buzzards page, we decided to cut the four wires, bare a small portion at each end, solder the wires in the reconnected pattern and slide some shrink tubing over each of the joints to reestablish the insulation.

The HS 605BB has a lot of room inside due to the large size of the motor, the small size of the circuit board and potentiometer, and the location of the potentiometer at the very top of the case. There was sufficient slack to pull the wires up and out of the case for easier access once the circuit board was removed from the case and pushed aside.

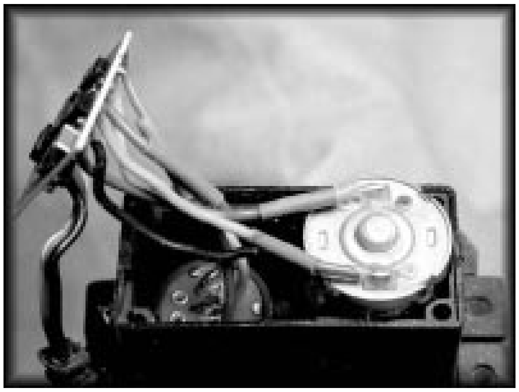
The orange and brown motor leads were cut at a point just past the edge of the motor. The red and green potentiometer wires were cut closer to the circuit board so the soldering iron would not have to be put inside the case.

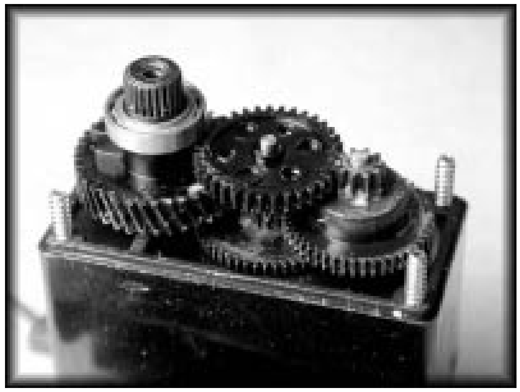
To bare the end of any of the wires, the insulation must be held firmly in place with tweezers while a wire stripper is used. If you don't hold the insulation in place, it pulls off the wire. We slid short lengths of very small shrink tubing over the longer leads before



soldering the wires together in their new positions. Once the joints cooled, the shrink tubing was smoothed over the soldered joint. Because the wires bend once the case is put back together, the tubing will not slip. Given the close surroundings, plastics and electronics, there's no room to manipulate a heat gun anyway.

After carefully folding the potentiometer wires under the board and bending the motor wires around the motor casing, we seated the circuit board in position and put the casing back together. Before screwing the case shut, we hooked up the modified servo and its twin to the Y-harness. Both worked flawlessly. Once the case was back together, a permanent sticker was placed on the outside of the servo to



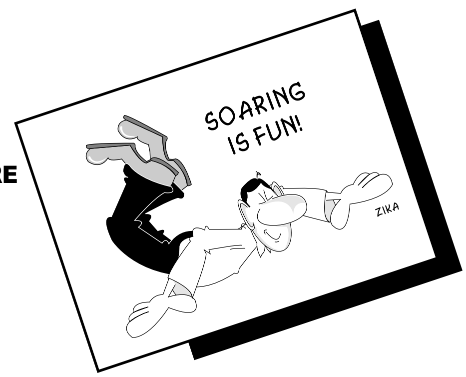


note the reversed rotation modification.

The leads to the two flap servos are around 20 inches in length, the leads to the elevon servos are nearly four feet. All of the cabling in this airplane is therefore twisted to reduce the possibility of noise in the signal lines. This is accomplished by taking the flat servo cable and splitting it into three separate strands. The strands are then twisted for the entire length and held in place while a heat gun is applied to set the twist.

While we had the HS 605BB servo apart, we took a good look at the mechanics. It's a pretty impressive piece of machinery for its $30 price tag. It has dual ball bearings and very large plastic helical gears (a metal gear set is available, #6397), puts out 77 oz-in of torque, and can rotate 60 degrees in 0.16 secs on 4.8 volts. Weight is 1.73 ounces. A few minutes in time and a minuscule amount of solder proved to be an educational experience which saved $20.00 and eliminated a possible source of in-flight electronic failure.

■



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22nd ANNUAL LAST FLING OF SUMMER

BLUE SPRINGS SOD FARM, Broken Arrow, Oklahoma
September 20 and 21, 2003

Saturday, Sept 20th, 9AM:	Class D: Unlimited	6 Rounds
Sunday, Sept 21st, 9AM:	Class B: 2 Meter	4 Rounds

Awards:

1st Place Overall	Trophy For Combined 2m and Unlimited scores (Flyoff in case of tie)
2m and Unlimited	1st thru 3rd (Cash awards, Certificates thru 5th place)

Event	Entry Fees	
Saturday Unlimited	$20.00	T1(modified) / L6
Sunday 2 Meter	$20.00	T1(modified) / L6
Event Discount	-$5.00 (More than 1 event)	
Total:	$________	

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ENTRY FORM

Name:________________________________ Phone:________________________________

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PARACHUTES: $12.50 (includes S&H U.S.A.) Send check or money order to Dale King, 1111 Highridge Drive, Wylie, TX 75098; (972) 475-8093.

Reference Material

Summary of Low-Speed Airfoil Data - Volume 3 is really two volumes in one book. Michael Selig and his students couldn't complete the book on series 3 before series 4 was well along, so decided to combine the two series in a single volume of 444 pages. This issue contains much that is new and interesting. The wind tunnel has been improved significantly and pitching moment measurement was added to its capability. 37 airfoils were tested. Many had multiple tests with flaps or turbulation of various configurations. All now have the tested pitching moment data included. Vol 3 is available for $35. Shipping in the USA add $6 for the postage and packaging costs. The international postal surcharge is $8 for surface mail to anywhere, air mail to Europe $20, Asia/Africa $25, and the Pacific Rim $27. Volumes 1 (1995) and 2 (1996) are also available, as are computer disks containing the tabulated data from each test series. For more information contact: SoarTech, Herk Stokely, 1504 N. Horseshoe Circle, Virginia Beach, VA 23451 U.S.A., phone (757) 428-8064, e-mail <herkstok@aol.com>.

BBS/Internet

Internet soaring mailing listserve linking hundreds of soaring pilots worldwide. Send msg. containing the word "subscribe" to soaring-request@airage.com. The "digestified" version that combines all msgs. each day into one msg. is recommended for dial-up users on the Internet, AOL, CIS, etc. Subscribe using soaring-digest-request@airage.com. Post msgs. to soaring@airage.com. For more info., contact Michael Lachowski at mikel@airage.com.

T.W.I.T.T.

(The Wing Is The Thing)

T.W.I.T.T. is a non-profit organization whose membership seeks to promote the research and development of flying wings and other tailless aircraft by providing a forum for the exchange of ideas and experiences on an international basis. T.W.I.T.T. is affiliated with The Hunsaker Foundation which is dedicated to furthering education and research in a variety of disciplines. Full information package including one back issue of newsletter is $2.50 US ($3.00 foreign). Subscription rates are $20.00 (US) or $30.00 (Foreign) per year for 12 issues.

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A Division of the Soaring Society of America

The purpose of the Sailplane Homebuilders Association is to stimulate interest in full-size sailplane design and construction by homebuilders. To establish classes, standards, categories, where applicable. To desiminate information relating to construction techniques, materials, theory and related topics. To give recognition for noteworthy designs and accomplishments.

SHA publishes the bi-monthly **Sailplane Builder** newsletter. Membership cost: $15 U.S. Student (3rd Class Mail), $21 U.S. Regular Membership (3rd Class Mail), $30 U.S. Regular Membership (1st Class Mail), $29 for All Other Countries (Surface Mail).

Sailplane Homebuilders Association
Dan Armstrong, Sec./Treas.
21100 Angel Street
Tehachapi, CA 93561 U.S.A.

The Vintage Sailplane Association

Soaring from the past into the future! The VSA is dedicated to the preservation and flying of vintage and classic sailplanes. Members include modelers, historians, collectors, soaring veterans, and enthusiasts from around the world. Vintage sailplane meets are held each year. The VSA publishes the quarterly BUNGEE CORD newsletter. Sample issues are $2.00. Membership is $15 per year. For more information, write to the:

Vintage Sailplane Association
1709 Baron Court
Daytona, FL 32124 USA

International Scale Soaring Association

There is a growing interest in scale soaring in the U.S. We are dedicated to all aspects of scale soaring. Scale soaring festivals and competitions all year. Source for information on plans, kits, accessories and other people interested in scale. For more information:

web site: www.soaringissa.org

ESL

The Eastern Soaring League (ESL) is a confederation of Soaring Clubs, spread across the Mid-Atlantic and New England areas, committed to high-quality R/C Soaring competition.

AMA Sanctioned soaring competitions provide the basis for ESL contests. Further guidelines are continuously developed and applied in a drive to achieve the highest quality competitions possible.

Typical ESL competition weekends feature 7, or more, rounds per day with separate contests on Saturday and Sunday. Year-end champions are crowned in a two-class pilot skill structure providing competition opportunities for a large spectrum of pilots. Additionally, the ESL offers a Rookie Of The Year program for introduction of new flyers to the joys of R/C Soaring competition.

Continuing with the 20+ year tradition of extremely enjoyable flying, the 1999 season will include 14 weekend competitions in HLG, 2-M, F3J, F3B, and Unlimited soaring events. Come on out and try the ESL, make some new friends and enjoy camaraderie that can only be found amongst R/C Soaring enthusiasts!

ESL Web Site: http://www.e-s-l.org

Books by Martin Simons: "World's Vintage Sailplanes, 1908-45", "Slingsby Sailplanes", "German Air Attaché", "Sailplanes by Schweizer". Send inquiries to: Raul Blacksten, P.O. Box 307, Maywood, CA 90270, <raulb@earthlink.net>. To view summary of book info.: http://home.earthlink.net/~raulb