powered), Hughes Racer, Mystery Ship, Sig TriStar and CadCat. Gerhard Spielman had a really cute Clancy Aviation Lazy Bee twin powered with Speed 400s. He had made the hubs for the three-bladed props and the prop extensions. It is really neat, the twin Lazy Bee, and it flies well. I hope the photo does it justice. Bob Aberle and Tom Hunt flew their Train-EE and Acrobat E as well as their 16 lb. 1/4 scale Nosen Cub. The Cub is powered by two Speed 700 12v motors attached to the ModelAir-Tech BD-103 (H-1000DP) 1000 watt twin belt-drive. It is very impressive in flight and comes out of VERY LONG grass easily - I saw it!

Talk about a great flying site! Ya gotta go!

Many of the folks attending on Friday were the SEFLI folks that CD Larry Sribnick rounded up and brought with him.

And then the storm. As some of us went to dinner, a tremendous thunderstorm and downpour hit. We managed to get our dinner in during power outs, but some of the people in the city of Muncie weren't so lucky and lost power through the whole night.

Saturday dawned with a hazy sun and light breezes as contestants came from all over the USA to take part. It was a great day for flying, sunny but with some humidity. The old-timers took to the air first and had 3 successful rounds. Places were; Bill Jenkins - 1st, Don Belfort - 2nd, Bob Aberle - 3rd. The Lanzo Bomber was very successful in this event, but almost any old-timer with an Astro Cobalt 05 and 7 cells did well. A typical set up is an old-timer with an AF FAI 5 or 6 turn 05 and 7 1000 mAh sub-C cells. This is an event that anyone who practices a little at spot landing and staying aloft for 8 minutes can do.

The A sailplane uses the same type of power systems with 2 meter type sailplanes with the same task. They flew after lunch on Saturday and had a wonderful time. The winners; Tom Hunt - 1st, Wayne Fredette 2nd, Rick Vaughn 3rd.

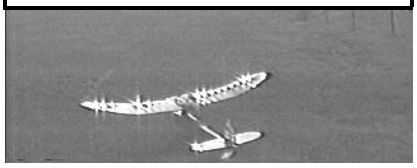
Through out the day, Bob Aberle and Tom Hunt talked about and demonstrated their planes and belt drives.

Sunday was one more sunny day. In the morning the old-timer B class took to the still air with the winners being; Bill Jenkins 1st, Tom Hunt 2nd and Bob Aberle 3rd. Class B sailplane, unfortunately, had the only real problem at the event when Tom Hunt's plane and another glider kissed too hard in mid-air and rekitted themselves on the way down, as well as on impact. What a shame, for it was a truly outstanding and wonderfully safe meet.

The People

As always, it is the people that make the event. Everyone couldn't have been better, nicer or more helpful. The event was organized and run by Larry Sribnick - superb job. Everything came off on time and was very efficiently run. Steve Anthony, Larry's right-hand man, is an absolute joy to spend time with. His continuous encouragement and help to all contestants was much appreciated. With enthusiasm like his, electric has a great future. The SEFLI members, that Larry recruited and brought along, were fantastic. I am afraid to list them for fear that I might forget someone, but they were all great, super, fantastic people that I will never forget 'em. Warm and friendly - what a great group. The fliers from all over; New York, Pennsylvania, Louisiana, Texas, Georgia, Michigan, Ohio and more. What wonderful folks. Sounds like I am gushing - I am - you really should have been there.

Mr. Stucker's old-timer glistens in the early morning sun. He uses Sky Shine to help him spot it way up high.



Well what can you do about it? Plan on attending next years electric NATS at Muncie and see for yourself, come the end of July 1996! See ya ALL there - Ken.

BRUSHLESS MOTORS -CHARACTERISTICS AND APPLICATIONS

by Ed Koffeman

from the "**Electric Model Flyer**"

Newsletter of the: Electric Model Flyers of Southern Ontario

editor: Rob Campbell, 34 Hopkins Ct., Dundas, Ont. L9H 5M5, Canada

The purpose of this article is to provide basic information to people about brushless motors. I must warn you that I have a vested interest in this subject. As a result of becoming aware of the benefits of using brushless power systems, I am now a local dealer for MaxCim Motors. I am also the designer and manufacturer of the brushless motor controller sold by MaxCim. So please

keep in mind that I am not exactly impartial as you read the article. I have, however, tried to relate what I believe to be true.

Introduction

Many of you have become aware of a relatively new type of power system for R/C electric aircraft. Most of you probably have an idea that brushless motor systems are better in some way, but perhaps you don't know exactly why. This article should give you more insight when considering how a brushless motor system might work for you.

Why Brushless?

The most prevalent general impression about brushless power systems is that they are morn efficient. While this is generally true, it is not necessarily the case in every comparison. Neither is it necessarily a sufficient reason to abandon brushed motors.

Each segment of our sport has different requirements for the power system, and therefore the application of a brushless power system in place of a brush system affects them in different ways.

Sport Flying

For Sport flying in particular the wide range of efficient operation is valuable. The typical requirements are for high power bursts (takeoff, climbs, other manoeuvres) with large periods of partial throttle. This requires efficiency at low currents as well as at high currents. A particular brush motor is usually rather more applicable to one or the other. A brushless power system can deliver a better combination of power and efficiency across the entire range of flight, typically offering more duration as well as more sprightly takeoffs and climbs.

Gliders

The Astro FAI series and some of the more expensive brush motors from Europe have good efficiencies at high power, but tend to be extremely poor at low currents. This makes them less suitable for applications where they will run at part throttle. Gliders that only climb at full throttle can make effective use of these high-current brush motor systems. Brushless power systems may provide more efficiency or lighter weight in some applications, but the difference at low cell counts may not be enough to justify the extra investment, and you would be well advised to do enough performance calculations to determine whether you will achieve any gain.

If you were to continually use a non-FAI brush motor for high power climbs, you may find that the brushes and commutator wear out rather quickly, though. In the F5B competitions, the brushless system that won the World's Competition in Australia was used in part because it eliminated the need to rebuild the brush motors so often!

If you fly a glider for sport, and use part-throttle for a large part of the flight, then a brushless system can give you a better run-time, for the same or better climb rate. Compared to an FAI style motor, the brushless will have much better low-load performance.

All-Up-Last-Down

This is where a properly set up brushless system can make a substantial difference. Assuming an average current of 10A is about 12 minutes on 2000 mAh cells, and 5A is 24 minutes, the brush motor may be well into its range of poor efficiency, and the brushless may be much better. It is still advisable to select a relatively lower RPM/volt motor for very low current applications like this.

Characteristics

There are significant characteristic differences between brushless and brush power systems. The table Brush vs. Brushless Motors illustrates some of the characteristic advantages of brushless motors.

Characteristic	Brushless	Brush
Break-in Required?	NO	YES
Wear Elements?	NO	YES - brushes, commutator
Wears faster when pushed hard?	NO	YES
Degrades with usage?	NO	YES
Capacitor required on motor?	NO	YES
Complex timing requirements	NO	YES
Compromise required in timing adjustment	NO	YES

Brush vs. Brushless Motors

Meaningful Differences
Education Required

To get the most out of a brush motor without shortening its life, one must really learn about quite a few things. There are entire articles on breaking in brushes, and setting the correct amount of timing advance, and even soldering capacitors on. None of those things need to be studied to achieve high efficiency or long life from a brushless motor. This can help our sport by making it easier to get involved and become successful.

Low-Power Efficiency

At low loads the brush drag wastes a relatively larger proportion of power compared to what is being produced as output. The brushless motor has no fixed

drag and thereby can have relatively more efficient low-load operation.

High-Power Efficiency

A motor with a high RPM/volt can be used to replace a motor that turns relatively slowly. The higher RPM/volt for a given motor design, the fewer turns it will use, and these will be of a thicker wire, therefore they will have less resistance. A high gear ratio is used to keep the same propeller RPM for a given throttle setting. The available gearbox ratios can be a limiting factor, though.

Typical brush motors won't take very high RPMs, so you are forced to choose motors with low RPM/volt and therefore relatively higher resistance (more turns of thinner wire), which limits their efficiency.

Brushless motors can be made reliable at relatively higher RPMs, and allows selection of the therefore relatively more efficient high RPM/volt configurations. A well designed brushless motor can also provide an additional margin of lower resistance for a given RPM/volt at a given motor weight and size. For our applications, it also allows a high short-term load without causing increased wear, because the only limiting factor is the temperature of the windings. This rises relatively slowly because the windings of the brushless motors are directly embedded in the outer portion of the motor, which is relatively massive compared to a brush motor armature, and therefore takes time to heat. This means you can have an extremely wide range of relatively efficient power output.

Purchase Price

Mail Order prices in US dollars shown for comparison purposes:

Item	MaxCim	Aveox	Brush
Controller - Sport	$135 (micro, BEC)	$199 analog	$80 FX-350 micro, BEC
Motor (continuous/peak) Watts Output	$175 (350/750)	$190 (360/600)	$130 Astro 25 Sport (350/450 10 sec)
Gearbox	$40	$40 other co.	$40 Astro
Wires, Connectors	included	included	$10
350W S tern	$340 package deal	$360 package deal	$260
System Weight	12.5 oz	13.6oz	15.8oz

Purchase Price

Brushless power systems cost about US$135 (MaxCim) up to US$240 (Aveox) for the controller and US$170 for the motor to US$550 for the Aveox F5B motor. Brush motors range from $10 to $400, controllers from $50 to $200.

Life Span

Sooner or later, all brush motors need maintenance, or are worn out:

- the cheapest ones are thrown away, but meanwhile deliver less performance
- the better ones last a long time, unless pushed hard, but deteriorate as they wear
- the best ones are designed for particular jobs, and can cost more than brushless motors! They also can wear rather quickly when pushed hard
- brushless motors generally have the life of their ball bearings, and can be pushed hard without accelerated wear

Limiting Factors

Brush bounce, winding strength, brush friction, brush wear, and commutator deterioration all conspire to limit the power output and efficiency for a given size brush motor. Brushless are RPM limited by the strength of the method used to retain the magnets to the rotor. Motors of both types are limited by the power dissipated in the copper windings.

Conclusion

Brushless power systems are available right now.

- They make sense if you are serious about electrics.
- They generally deliver the best all-round performance for a given motor size and weight.
- They last long enough to make them a good investment.
- The breadth of the performance envelope means a single motor can be appropriate for a wide range of applications. (*This is extremely important to note! - km*)
- Fewer compromises must be made, and it can be easier to achieve high power at the same time as efficiency.

I would be glad to assist any of you in deciding whether a brushless system makes sense for you. I have done a great deal of numerical analysis of both brushless and brush power systems to best be able to apply each of them. I may follow this article with a more technical one if there is enough interest.

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MaxCim Info

This info was taken from the product release info of the Aug. 1995 Model Aviation

It is presented here for your information and reference

Max15 Series brushless DC cobalt motors from MaxCim Motors, 57 Hawthorne Dr., Orchard Park,