



August 2008

Propwash

MUROC MODEL MASTERS, EDWARDS AIR FORCE BASE, CALIFORNIA

Visit us online! <http://www.murocmodelmasters.org>

The Muroc Model Masters is an
Academy of Model Aeronautics
Club No. 1737

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**Muroc Model
Masters
P O Box 2194,
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CA 93560-
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The Muroc Model Masters
September Meeting Will Be On Tuesday,
September 2, 2008
At Floyd Mathews House
in Rosamond at 6:00 pm.
See You There!

Tips & Tricks

Push Rods

Did you ever go through all the trouble to make up your control surface push rods only to find at installation that they were a quarter inch too short? Try this easy way to get the lengths just right. Tie a string to the control horn on the control surface. Drop the free end of the string through the fuselage. With the control surface in neutral position, tie the other end of the string to the servo arm. Cut off the excess string at both tie points. Now, cut the string at the ties and what you end up with is a piece of string that is the exact length of the push rod you will need to fabricate.

2008 Membership Cards

For 2008, please remember to get your AMA insurance renewed before you renew your MMM membership. In order to have a 2008 MMM card issued, you need to provide a copy of your 2008 AMA card and driver's license or military ID.

Club applications may be mailed to Muroc Model Masters, **Post Office Box 2194, Rosamond, CA 93560-2194**. Checks can be made payable to Muroc Model Masters. Membership dues are still just \$25 for the whole year. If applying in person, please see Charlie Threewit, Treasurer, at the field or meetings.

From the San Gabriel Valley Radio Control League, South El Monte, California

Electric Motors 101

By Vic Walton

If you're like me, you sometimes use technology that you just don't know that much about. Take electric motors—how do they work really? I knew it had to do with magnets and electromagnets, and something about brushes, but I hadn't taken the time to figure out how they all worked together.

And now we have "brushless" motors—how do they work? So I did a little reading and have shamelessly cobbled together this primer from various Internet sources.

In a typical "brushed" DC motor, there are permanent magnets on the outside and a spinning armature on the inside. The permanent magnets are stationary, so they are called the stator. The armature rotates, so it is called the rotor. Clever, eh? Picture a big horseshoe magnet. Now take a big nail and drill through the middle cross-wise, and put a wire through the hole; now the nail can spin head-over-heels. Wrap some wire around it, and then attach it to a battery. You have an electromagnet right?

Now this particular arrangement isn't that useful; the nail just sits there. Of course, if you were to reverse the current, it would flip around, right? And if you were really clever and fast, you could reverse the current again, just as the nail was flipping, and it would flip back. This is what the brushes in a brushed motor do. They make contact with terminals on the rotor (called the commutator) and as it spins, at just the right spot they break contact and reconnect on the other side, causing the electric field to reverse, spinning the motor around another half-turn (or one-third turn, since most electric motors have three coils for efficiency). The horseshoe magnet is your stator, the nail the rotor.

This setup works and is simple and cheap to manufacture, but it has limitations because of the need for the brushes to press against the commutator:

- It creates friction.
- At higher speeds, brushes have increasing difficulty in maintaining contact. They may bounce off the irregularities in the commutator surface, creating sparks. This limits the maximum speed of the machine.
- The current density per unit area of the brushes limits the output of the motor.
- The imperfect electric contact also causes electrical noise. Brushes eventually wear out and require replacement, and the commutator itself is subject to wear and maintenance.
- Having the electromagnet in the center of the motor makes it harder to cool.

So in comes the brushless DC motor. In this design, you put the permanent magnets on the rotor and you move the electromagnetic to the stator. Think about that. The electromagnets are on the stator—they are stationary. That's a problem because now you need something even more clever than a commutator and brushes to flip the polarity of the current at the right moment. This very clever thing is the microcontroller in your ESC.

What it does is sense the position of the rotor (utilizing something called the EMF feedback through the main phase connections, which I have decided I don't need to understand) to switch the field rapidly at just the right moment to pull the permanent magnets on the stator around at the RPM that you have requested. This system has all sorts of advantages:

- There is no sparking and much less electrical noise. A happy situation for our radios, particularly as the motors get bigger.
- There are no brushes to wear out.
- With the electromagnets on the stator, they are easier to cool.
- You can have a lot of electromagnets on the stator for more precise control.
- The timing of the pulses sent to the electromagnets on the stator can very precisely adjust the speed of the motor.

So that's how it works. But one more thing: what's an inrunner and what's an outrunner?

An inrunner is a brushless motor with the permanent magnets rotating inside the electromagnets; in an outrunner this situation is reversed, with the permanent magnets on the casing of the motor and the windings of the electromagnets inside. Outrunner motors generally have some torque, but spin somewhat slower. This makes them better for spinning large propellers, which our airplanes need. Inrunner motors spin a lot faster but with less torque; this means that in order to get the same torque, you have to put the inrunner in a gearbox, adding weight, complexity, and most importantly, cost. However, if you can afford it, this is the most efficient setup for any given size motor.

By the way, airplanes aren't the only things that use brushless motors. Computer hard drives, CD drives, and hybrid cars are some of the other uses. It's only a matter of time before someone takes the brushless motor out of a Pruis and uses it in an airplane.→

MMM Minutes 05 August 2008

Meeting called to order @ 6:15 PM by President Ron Scaggs. The meeting was held at the Skypark home of Floyd Mathews in Rosamond, Ca. There were 17 members and one new member. Congrats to Carey Hughson for joining our club. Jerry V. Rice, Secretary read last month's minutes and Charlie Threewit moved they be accepted and seconded by Dan Garrabrant. The Treasurer's report was given by our Treasurer, Charlie Threewit and Lou Figueroa moved they be accepted, seconded by Mac Macglahan.

Old Business:

Ron Scaggs spoke about the film crew that did an article on UAV's and they thanked the members for their help; it was a fine day for all who participated.

The Cub Scouts from Edwards had another rocket fly day on the 26th of July and everyone had a great time. The boys were ready to set another date to come out again. Ron also had some of the boys on a buddy box, and they enjoyed that too.

The frequency board is still in the same shape. In Ron's hanger.

New Business:

There will be a Scale Model Qualifier event at The Sepulveda Basin flying field across from Woodly Park. Check in is on Friday the 8th and flying will be on Saturday and Sunday.

Our Vice President, Wes Parmeter flew a floatplane at Littlerock Dam. None of the authorities seemed to mind. You will have to pay the park fees to enter.

We have more members in the club and the field is starting to attract a lot of members on the weekends. So we discussed the fact that we still don't have our frequency board (box) at the field yet. Someone should act as frequency monitor while at the field and also support an impound for transmitters if there are more than three people at the field.

Show and tell:

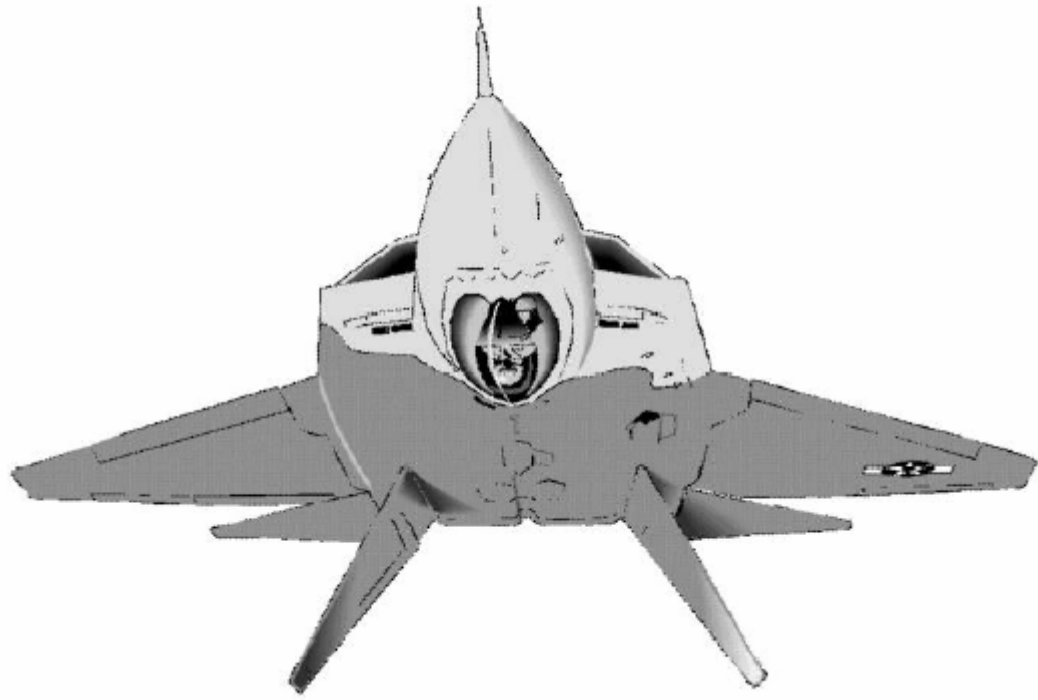
Lou Figueroa brought a Four Star sport plane that his kids bought and put together for him for his birthday. He still needs to install the engine.

Our members that attended this day are as follows:

Ron Scaggs; Wes Parmeter; Jerry Rice; Charlie Threewit; John Sturgeon; Harold Thomas; Bob Knoob; Blake Parmeter; Antwain Mallory; Lou Figueroa; David Stilwell; Dan Garrabrant; Steve Wells; Mike Blanchard; Mac MacGlashan; Dick Skouglund; Floyd Mathews, and our newest member Carey Hughson.

Charlie Threewit moved that the meeting be closed at 7:03 PM, seconded by Steve Wells. The next Meeting is Tuesday, September 2, 2008 at 6:00 PM at the Rosamond Skypark home of Floyd Mathews.

Jerry Rice - Secretary



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