



November 2016

VICE PRESIDENT'S CORNER

Duane Beck



I have kept myself busy lately with sailplane contests, and the necessary practice and repairs required. Unfortunately, between that and my other commitments, I have had very little time at the club field this year. I thought I would, however, share some of what I've learned about my research on Computer Numerically Controlled (CNC) machines. A CNC is controlled by digital signals sent from a computer which drive motors to move different independent components. They have become much more accessible to the hobbyist in the past several years, with prices well under \$1,000 for some do-it-yourself kits.

There are a wide variety of CNC machines, but the two I'm particularly interested in are a four-axis hot-wire foam cutter, and a three-axis router. An axis is an independent direction of motion, either linear motion along a straight line, or rotary motion about a center line. Each axis is usually either parallel or perpendicular to other axes. Motion on each axis is controlled by a motor, most often a stepper motor, driving a mechanism to convert the motor's rotation to linear motion. This mechanism can be lead screws with an anti-backlash nut,

pulley and belt, or rack and pinion. Rotary axes will usually have a belt or gear reduction to increase available torque.

Stepper motors, as their name suggests turn in small steps (such as 200 steps per rotation, or 1.8° per step) rather than turning continuously like regular motor. There is usually no position feedback with a stepper motor, so the system depends on sufficient torque to avoid slipping or "losing steps," causing a discrepancy between the actual position of the machine and the position expected by the control software. This is called "open-loop" control, as there is no feedback to the controller. Some high-end machines have servos with position feedback, somewhat like a much beefier version of the servos we use in model airplanes. That is called "closed-loop" control, as the position feedback closes the loop so the servo can continuously command movement to the desired position. Cutting a part on a CNC machine starts with a drawing using a Computer Aided Design (CAD) program, with choices ranging from free programs like SketchUp or DraftSight, mid-range products like Rhino, to high-end packages like Solidworks. The drawing can either be a two-dimensional outline of a flat part, or a three-dimensional surface. Computer Aided Manufacturing (CAM) software creates the sequence of movements necessary to cut the part (the "tool path"), and converts the tool path into the instructions for the CNC controller to guide the tool(s) along that tool path. Settings in the CAM software specify the size and shape of the tool, feed (how fast to move the tool) and speed (how fast the tool turns while cutting), and sometimes special features like holding tab (breaks in the cut to keep the part from falling out of the stock during the cut) positions and dimensions. The tool path is offset from the desired outline or surface of the part to be cut based on the diameter of the tool, and its shape – whether it's straight or tapered, square end, ball end, or radius end. The result is a sequence of tool movements that cut away stock material, leaving the desired part.

The instructions generated from the toolpath are most often written in a language called "G-code," which specifies many different instructions for setting

measurement units, motor speed, axis movement start and end position (either linear or arc), movement speed, and accessory control. The G-code file is copied to the CNC controller, which runs through the instructions in the file and sends the appropriate step and direction signals to the stepper driver. Settings in the controller software determine, for each axis, how many steps are needed to move a specified distance (e.g. 500 steps/inch), and is determined by mechanical parameters like motor steps per revolution and lead screw threads per inch. Stepper drivers convert the step and direction signals into the electrical power to drive the stepper motors, which drives the machine's movement. CNC controllers are typically a computer running software like Mach3 or LinuxCNC, but there are also specialized controllers that run firmware like GRBL on an Arduino or ARM microcontroller.

There is a lot to learn in building and operating a CNC machine, but it can be a rewarding experience. The result is a machine that can repeatedly cut accurate parts directly from a computer drawing, without having to spend time making fixtures or jigs, and without tedious and potentially error-prone hand work.

Duane Beck

EDITOR'S NOTES – Upcoming Events

Jeff Killen

1. **Club Meeting, at Warrenton Community Center, 7:00 PM, 11/22/2016**
2. **Joint FARM/CMB Christmas Party, at Warrenton Community Center, 6:30 PM, 12/3/2016**



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SECRETARY'S REPORT

Jeff Killen

The October club meeting was held on October 25 at the community center. Ten members attended, of which three were board members.

Treasurer Report

Nic Burhans noted the following:

--- The Club presently has \$3709 in the bank which is a small deficit for the year. We should be about \$1900 over the amount at the beginning of the year. We should see \$3500 in dues come in for 2017. It is nice to be in better shape than last year at the same time. The mower repair last year brought us down.

--- Our membership is now at 107 (54 regular, 40 seniors, and 5 juniors).

Secretary Report

We will provide the November newsletter after the club meeting on 11/22, as we finalize the slate of members nominated for the 2017 board at that meeting. The December newsletter will be sent out after the Christmas party on 12/3.

Old Business

We got a report on the Culpepper Air Fest held on October 8. This was all models, as the weather was an issue for full size planes. The event ended early at 2 PM. We ran buddy box flying, servicing about 20 people. Kwang also provided a demonstration. The Potomac Flight event on Friday was a dud.

For the float fly on Oct. 1 had some weather issues, and a modest turnout occurred. We had left over food, which was offered to the members at the fun fly on Oct. 9. From our donations at the float fly, we came up with \$120 for the Fauquier Food Bank, and this gift was much appreciated.

The Crockett Park event was moved to Oct. 9, so we could not support it.

New Business

Dick Sutton had some items to consider for the web site:

- Expand the "for sale" section to add "wanted items" section
- Add a facebook presence ? Much discussion here. The board would need to have control of this.

Ernie Padgett suggested receiving donated items to raffle at the Christmas Party; the board approved this. Let Ernie know what items you will bring to the party.

Multi-year renewals for FARM club membership was

discussed. Those present liked the idea, but a change in the by-laws would be needed.

Based on the safety article by Dave Rothbart in the August newsletter, we will revise our club handbook for the Safety portions. Ernie Padgett will be working this.

Club Survey

The club survey questions were reviewed by those present. About half of the questions were covered; we will continue the review at the November meeting.

Show and Tell

There were no show and tell items at the meeting.

50/50

Nic Burhans won the money but he donated it back to the club.

2017 FARM / CMB Christmas Party Menu

Bill Towne

Appetizers:

- Potato Chips and Onion dip
- Veggie platter and Dip
- Shrimp Platter and Cocktail sauce

Entrées

- Green Salad and Dressing
- Spiral Cut glazed Ham
- Roasted Turkey Breast
- Pulled Pork BBQ
- Slider sandwich rolls
- Lasagna

Deserts

- FARM Decorated Cake
- Apple, and Pumpkin pies

Beverages

- Coffee, Cream, and Sugar
- Iced Soda and Water

2017 Board Nominations

Jeff Killen

The following members were nominated:

Dave Rothbart

Bill Towne

Nic Burhans

Jeff Killen

Keith Crabill

Ernie Padgett

Charlie Koustenis

John Gilbert

Dan Jones

As we do every year, please return your picks (pick no more than 7) for next year's board to me (Jeff Killen) before December 3. You can use email, regular mail, or bring your picks to the club Christmas Party.

You can use this page as your ballot.



Flying at the field on Nov. 6. Bill Towne photo.

FARM OFFICERS for 2016

President. Dave Rothbart 703-327-0476
Vice President Duane Beck 540-341-8458
Secretary Jeff Killen 703-369-0807
Treasurer Nic Burhans 540-349-2733
Field Marshall Bill Towne 540-428-1053
Safety Officer Gene Flynn 540-937-4650
Member at Large. Charlie Koustenis 703-378-6214

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Our web site is: <http://www.farmclubrc.com>

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A show and tell item from the October, 2015 club meeting. (Hint: Send me some newer photos ! Editor)