THE KNIGHT FLYER

Jul - Aug - Sep **2002**
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Summertime Fun

Sunday June 23rd was forecast to be a "hot windy" day. Normally one takes a weather forecast with a grain of salt.

After all, the more money that is spent on forecasting, the less accurate it becomes. And with the TV moguls spending millions of dollars on weather radars, this forecast promised to be no better than average.

But as the day wore on, it began to look like it was really going to be a "hot windy" day.

Using the old "look out the window" technique many of the knights (including your editor) felt that the wind would be too much and sallied off to the picnic, sans plane.

Big mistake!

Certainly it was breezy, and sure, the sun didn't shine a lot, but those who did bring their planes really had a ball.

North Collins Flight Line Barriers

Though older knights held back on their flying, there was no such reluctance on the part of young Matty Partacz. He took off, flew the pattern a bit and landed, with nary a thought about wind.

Under the new shelter

The club as promised supplied the hot dogs and with some outstanding dishes contributed by the members. The picnic was a great success.

The new shelter really proved its worth. The welcome shade was a great improvement over the open field picnics of the past.

At least a dozen, planes occupied the flight line behind our new orange and white barriers.

There was plenty of room and seating space for everybody.

About two dozen Knights and their families attended the 2002 annual fun-fly and picnic.

Talking with Airplanes

When you move the stick on your transmitter to give your plane a command to go up, how does your elevator know how to respond.

Sure, your plane listens, but there are several important stops or way points in between. See (Fig. 1).

1. The first waypoint is the control stick itself.
2. The second is the transmitter.
3. The third is the receiver.
4. The fourth and last stop is the servo that actually moves the control surface.

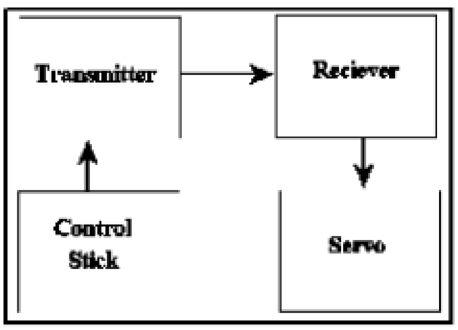

Fig1

Let's hop a ride on the radio wave that converts your intention into action.

The Control Stick

First, the movement of your hand must be changed into an electrical signal that can be transmitted to the receiver in your plane.

This bit of magic occurs in the gimbal on the transmitter. The stick is connected to a variable resistor, (called a potentiometer) that takes a voltage from your battery and divides it into a fraction

At one end of the "pot" the voltage is 100% and at the other it is 0%, with a complete range in between. See Fig. 2.

However this fractional voltage that represents the position of the stick is not satisfactory for a number of reasons. One, is that it is an analog signal which means that is is really indistinguishable from noise which is also an analog signal.

Long ago (a few decades) it was found that it is much better to use signals that are not like noise.

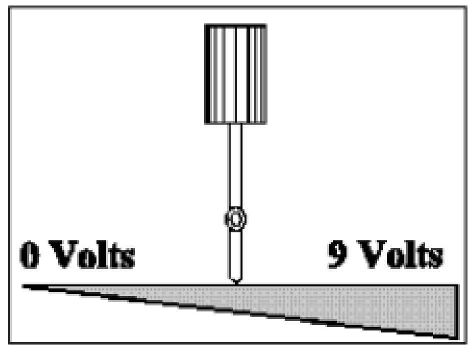

Fig 2

We'll see this idea applied again later. For now the voltage signal is converted to a simple digital form.

In most radio systems the form is simply a timed pulse. The length of the pulse is proportional to the amount of voltage. The greater the voltage the longer the pulse.

For many years now the standard neutral pulse length has been one millisecond, or one thousandths of a second.

This represents the center of the stick. At the bottom of the stick, (zero volts) the pulse is shrunk to one half of its size, or .5 milliseconds.

At the other end (maximum) it is stretched to one and a half times or 1.5 milliseconds. See Fig. 3.

So our information ("go up") now is a pulse whose length represents the position of the stick.

The information can also be coded into bits so that there is a digital representation of the stick position. Three bits are often used for this.

See Fig. 4 for digital encoding.

The bottom position of course is no bits at all. Maximum then is three bits.

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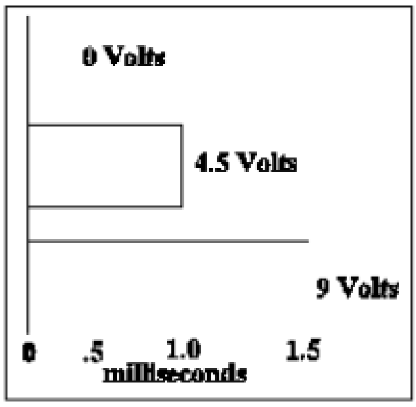

Fig 3

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In between would be six more positions, 001, 010, 011 and so forth with 111 being the max.

This is usually done in a chip called an A/D converter. If more bits are used the precision is greater as there are more positions available.

Some of the new computer radios use this method of encoding the position of the stick.

In some radios this method of pulse coding is used throughout.

However in most radios the length of the pulse is the measure of information.

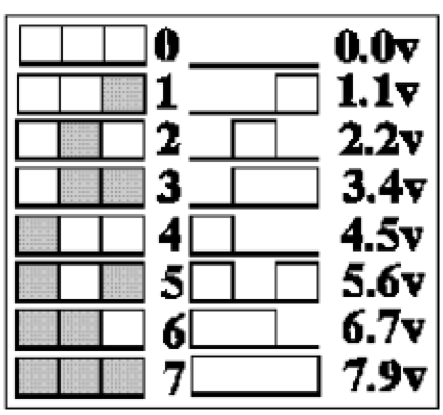

Fig. 4

Each stick or switch generates one pulse and the entire array of controls on a given transmitter are strung together like beads on a string.

The string of four to eight pulses is called a frame and its total length is about 60 milliseconds. Each pulse in the string represents the position of its respective stick or switch.

There is a long gap between the train of pulses. It is used to synchronize everything. This is the way that the first pulse in the string is marked.

The Transmitter

At this waypoint, the pulses are impressed upon a radio wave. This wave is generated by a crystal oscillator and amplified to give an "in air" range of about one mile.

The radio wave is a continuous oscillation.

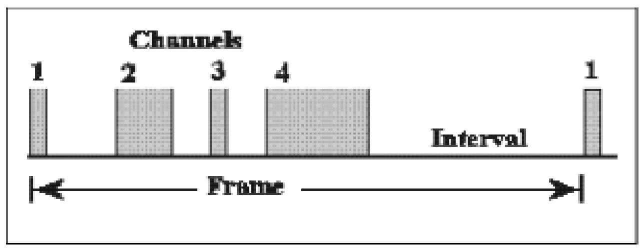

Fig 5

It is like a blank slate. Our information must be impressed upon it.

There are several ways to do this. Some are better than others.

The first, simplest and oldest way is called AM (amplitude modulation). Here, the pulses make the intensity of the radio wave change.

This works fine until the signal gets weak (like when the plane is far away). The problem is that noise behaves the same way. At some point, the signal and the noise will look alike and the signal gets lost.

The second and better way is FM (frequency modulation). In this method the pulse makes the frequency of the wave change. This is much better, because noise does not change its frequency so the signal is always good no matter how weak it gets.

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The third method is the best because the pulses are also coded (similar to that shown above) which provides even more noise immunity.

The types of modulation are shown in Fig. 6.

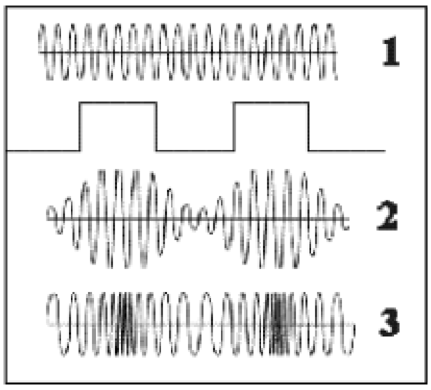

Fig 6

The string of pulses is applied to the radio wave.

These frames are continuously sent out from the transmitter.

The Receiver

The third way point is the receiver. This is the airborne part of the system

The job of the receiver is to detect and recover the shape of the pulses from the radio wave or carrier. It preserves the width of the pulse for each channel.

All receivers use a technique called AGC to maintain a strong signal under all conditions of range and antenna direction. AGC stands for "automatic gain control".

When the synchronizing space is detected, each recovered pulse is sent to to the proper output line.

The first pulse after the space is the pulse for channel number one.

The following pulses then occur in the correct order. Each channel gets its correct pulse.

Hence the signal that started with the elevator stick is now sent to the line that is connected to the elevator servo.

Fig. 7 shows how the receiver parcels out each pulse.

Each servo gets its appropriate pulse. The job of the receiver is now complete.

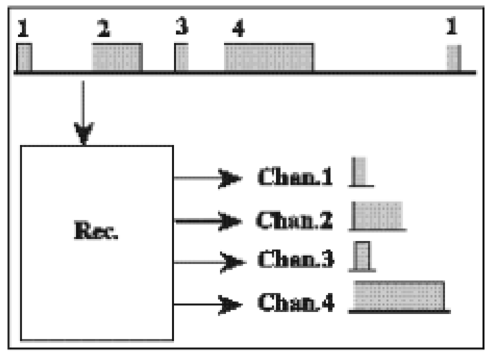

Fig 7

The servos

This is the terminal waypoint, where the action is. Here's where the rubber meets the road.

Recall that the "length" of the pulse is proportional to the position of the stick. We must now convert this length back into a position.

Fig. 8 shows how it is done.

When the servo circuit sees a pulse come in, it starts a pulse of its own. This is a reference pulse. It's length is controlled by the actual position of the servo itself.

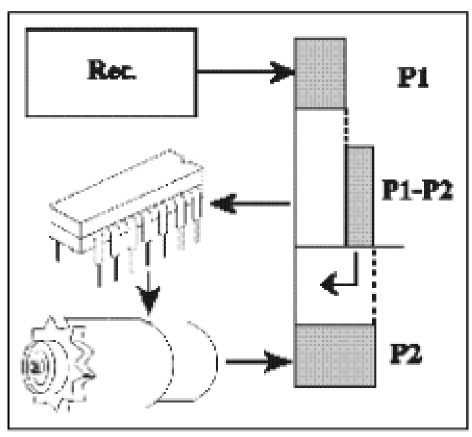

Fig 8

If the servo is centered then the pulse will be one millisecond long.

Recall that this is the length of the pulse when the stick is in the center position.

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If the servo is centered then the pulse will be one millisecond long. Recall that this is the length of the pulse when the stick is in the center position.

These two pulses are then subtracted from each other. If they are of equal length the result is zero and the servo does not move.

However if the sent pulse is longer than the servo pulse there will be a positive voltage generated and this voltage will drive the servo in the direction that will make its pulse equal to the input pulse.

As the servo moves the pulse length becomes equal to the input pulse and when they are equal the result of the subtraction of the two pulses will be zero.

The servo will then stop moving.

The surface that is connected to the servo arm is now positioned exactly where you wanted it to be when you moved the transmitter stick.

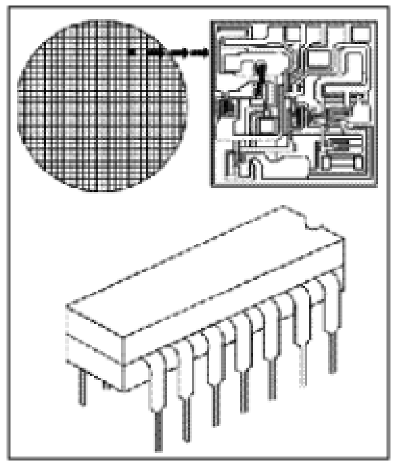

Fig. 9

A few years ago, these components could be assembled in your basement.

In fact, you could see and touch the parts and put them together to build your own circuits.

Not so today. See Fig. 9

Now the magic that lets you talk with airplanes is accomplished with a few mysterious micro circuits.

In Remembrance

Dick Clark, a former member of the Flying Knights, passed away this spring.

Dick lived in the village of Boston and was an active member during the 1990's.

He was a diligent worker and was quick to participate in our club activities.

Our condolences go out to his family.

Effort Appreciated

All those who worked so hard to put up our shelter and who contributed in so many ways to make the field improvements should be, really must be congratulated.

They have gone above and beyond in their efforts to help our club.

Many thanks to all of our members who worked on the improvements to our North Collins field.

A Special thanks should go out to Bob Waldraf, Chuck Shummer and Stu Breirley.

Our Rally and Auction will soon be upon us. If you have not already volunteered for one of the numerous tasks, please consider doing so.

The Rally is a two day event and no one should have to work both days. The more people we have the easier it will be on everyone.

Call Ron Wojcik at 662-4043 to find out where you can help.