RCHS 64

RADIO CONTROLLED

HELICOPTER SIMULATOR

By John Kallend

FOR COMMODORE 64

DAVE BROWN PRODUCTS

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RCHS 64

R/C HELICOPTER SIMULATOR

INTRODUCTION

The RCHS 64 Radio Control Helicopter Simulator is designed to provide an accurate, realistic simulation of flying a radio-controlled helicopter using a Commodore 64 microcomputer. The user is presented with a realistic, animated view of the helicopter as it "flys", as if taken by a TV camera located on the ground at the pilots feet. The view presented accurately portrays the orientation of the helicopter with full compensation for the direction of viewing (That is, for example, when the model is flying level and is high overhead, you see the underside of the model). Liftoffs, Aerobatics, and Landings can all be attempted, and the characteristics of the helicopter can be adjusted within wide limits to closely simulate a large variety of flight characteristics.

Helicopter aerodynamics are complex (e.g. Wayne Johnson's book on helicopter theory runs to 957 pages of equations!). Solving the equations, and then generating the 3-D graphics in real time, required some simplification be made in order to enable the program to run at reasonable speed on a microcomputer. Virtually all manuvers are possible,including loops and rolls, when the helicopter is configured properly. The program does have some features not apparant in casual use, such

as dual-rate cyclic control which allows you to change the sensitivity of the control sticks at the press of a button, and inverted flight capability. You are strongly urged to read this instruction manual thoroughly.

DISCLAIMER

This program attempts to give an accurate simulation of the control of a radio controlled model helicopter. While we expect it to be of significant value in learning to fly an R/C model helicopter, IT IS NOT INTENDED TO TAKE THE PLACE OF PROPER FLIGHT AND SAFETY TRAINING WITH A SUITABLE MODEL UNDER THE GUIDANCE OF AN EXPERIENCED R/C PILOT-INSTRUCTOR.

DAVE BROWN PRODUCTS and JSK Associates accept no responsibility for any damages caused by failure to heed this warning, or for any consequential damages.

WARRANTY

If this product fails to run within 90 days of purchase, it will be replaced free if returned, with proof of purchase, to Dave Brown Products. Thereafter, a nominal charge of $5.00 will be made to cover the cost of packing and shipping. The ORIGINAL DISK must be returned with any request for disk replacement. No other warranty service is provided. THE WARRANTY IS VOID IF THE DISK HAS BEEN TAMPERED WITH.

UPDATES

If you wish to recieve nominal cost updates of this software, please register your purchase with Dave Brown Products within 30 days of purchase. Be sure to include your program serial number, and proof of purchase. You will be notified by mail of any update. UPDATE SERVICE WILL NOT APPLY IF YOUR PROGRAM IS KNOWN TO HAVE BEEN ILLEGALLY DUPLICATED OR DISTRIBUTED.

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HARDWARE

In order to use this program, you will need a Commodore 64 computer , at least 1 disk drive, a video monitor or TV, and the Dual Joystick "Transmitter" from Dave Brown Products.

NOTE: The Commodore 64 version of RCFS WILL NOT WORK WITH STD COMMODORE STICKS.

INSTRUCTIONS

The Dual Joystick "Transmitter" box is attached to your Commodore 64 computer by inserting the connectors marked #1 and #2 into control ports 1 and 2 on the right side of the computer.

Turn on the computer and disk drive, Insert the diskette into the disk drive, and close the disk drive door. At the keyboard type

LOAD "*",8

and press the <return> key. The disk drive light will come on while the program loads. When the program has loaded, type

RUN

and press the <return> key. If none of the above means anything to you, you should read the manuals from Commodore which come with the computer.

THE MAIN MENU

After the program has loaded, you will be presented with a menu of two items. To select one of these, just type the appropriate number. The items available are:

1. Run the Simulator (current set up). This selection will run the simulator using the last configuration which was saved, or the configuration entered after using selection 2 below.

2. Change the parameters. This selection will lead to a secondary menu, enabling you to change the parameters describing the performance of the helicopter. The current values of these parameters will be displayed, and the current value may be accepted by simply pressing the <return> key on the keyboard. if you wish to change any of these, just enter the new value from the keyboard. Do not worry if you make a mistake, as you can return to correct it later. Except for the thrust - weight ratio, the parameters are in arbitrary units. The effects of these parameters are as follows:

GYRO EFFECT controls the tendency of the tail to swing in responce to torque changes. If a large value is chosen, the program will behave as if a sensitive rate gyro is installed in the tail rotor circuit to provide correction for torque changes.

WEATHERVANE controls the tendency of the helicopter to turn into the effective wind. (that is, into the direction in which it is flying.) A large value of this parameter gives a strong tendency to turn into the effective wind, and makes coordinated turns in forward flight easier, while making sideways and backward flight more difficult.

SPEED-PITCH COUPLING is the tendency of a helicopter to pitch up in responce to forward speed. If not carefully controlled by the pilot, severe, unstable oscillations may develop. The degree of coupling, in the simulation, is controlled by this parameter.

SENSITIVITY of the pitch and roll cyclic controls can be adjusted by this parameter. Dual rate controls is available on these functions - see the section on controls..

DRAG PARAMETER is a measure of the aerodynamic drag. A low value corresponds to a streamlined machine.

THRUST/WEIGHT ratio is the ratio of available lift in hover to the weight of the helicopter. Because of ground effect and translational lift, it is possible to fly with a thrust/weight ratio of less than one.

The preset values are somewhat arbitrary so you may want to experiment with the values until you like the results. After completion of this section, you will be returned to the main menu.

RUNNING THE SIMULATOR

When you have configured the helicopter, you can run the simulator by selecting item 1 from the main menu. At this time, you are asked if you wish to save your configuration to the disk, so the next time you run the program, you will not have to re-configure the helicopter. Answer by pressing 'Y' to save the new configuration, or 'N' to try a new configuration without saving it. The main part of the program will then be loaded.

You are now asked to center the joysticks, and press the 'RETURN' key to allow the computer to determine where the neutral settings are. After pressing the 'RETURN' key, the program starts and you will be presented with a frame corresponding to the picture from an imaginary TV camera pointing at the helicopter. The helicopter will be about 40 feet out in front of you, facing right. At the bottom of the display is a read-out giving the distance, in feet, of the helicopter from you, its velocity, the throttle setting, in percent, and the altitude, in feet.

CONTROLS

The two joysticks give control of lateral cyclic pitch, fore and aft cyclic pitch, tail rotor pitch, and throttle/collective pitch.

Using the Dave Brown Products Dual Joystick "transmitter", the throttle/collective pitch is operated by the fore and aft movement of the left stick, the tail rotor (yaw) is operated by the left/right movement of the left stick, the fore and aft cyclic is controlled by the fore and aft movement of the right stick (you push forward to tilt the helicopter forward), and the left/right cyclic (roll) are controlled by the left/right movement of the right stick. This is the most common "stick mode" used in flying R/C model helicopters, and is illustrated in figure 1-A below.

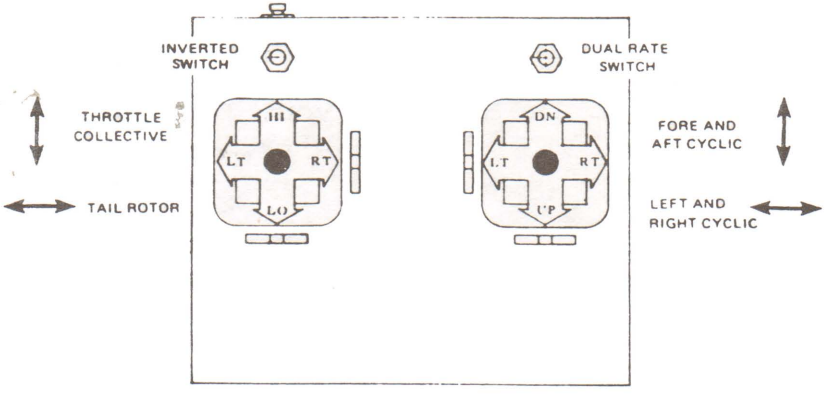

FIG. 1-A

FLYING

At this point, you are ready to try to 'fly' your helicopter simulator. If you slowly open the throttle, the helicopter will lift off. The helicopter will be in nearly neutral trim (or at least as nearly neutral as a helicopter gets!). Notice that the ground drops away as the model rises, because the "camera" is moving to track the helicopter. Also notice that the size of the helicopter decreases as it moves away, just like the real thing!

You're in for a wild time if you have had no previous experience! Control the helicopter as you would a real model, using the cyclic controls to keep it level, the tail-rotor control to keep it straight, and the throttle / collective to rise or fall. It's somewhat like rubbing your belly, patting your head, and standing on one leg all at once! One trick, is to try to keep the ground in sight, as this plane of reference makes hovering easier. You will probably noticed by now that the helicopter tries to climb whenever it is moving forward (or in any direction). This is due to translational lift which is best described as an increase in the lifting efficiency of the rotor when it is moving compared to a stationary hover. This means that you will use less throttle to fly at a constant altitude and airspeed when moving than when in a hover.

As you accelerate in a forward direction from hover, you will need less throttle to maintain altitude, and conversly, you will need more throttle as you slow down from forward flight to a hover. It sounds difficult, and it is, but it's just a matter of practice, practice, practice.

The program is modeled on a helicopter with collective pitch control, and "idle up" (a means of maintaining rotor speed, and thus cyclic control, even when no lift is commanded). Dual Rate control input is toggled by the pushbuton located above the right stick. This button toggles between high and low control sensitivity on the cyclic controls (when low sensitivity is enabled, a "D" appears at the bottom right corner of the screen.

Inverted flight may be attempted (!) by rolling the helicopter over, and pressing the button located over the left hand stick. This pushbutton reverses the collective pitch, tailrotor, and the fore and aft cyclic controls, thus enabling inverted flight(?). When the inverted mode is enabled, an "I" is displayed at the bottom right corner of the screen.

CAUTION: If the inverted button is pushed while the helicopter is on the ground (indicated by the "I" in the right corner of the screen), the helicopter will not lift off.

ORIENTATION

Two of the most difficult aspects of model flying are: 1) Judging the orientation of the model, especially when it is far away, and 2) Getting used to the apparent reversal of controls when the model is comming toward you. Both of these difficulties are present in the simulation! In fact, the orientation problem is more severe because the ground is out of sight when the model is high, and the program accurately presents the view that the "camera" will see. Some of the consequences of this are:

1. As the helicopter flies past you on a constant heading, you will see it apparently turn away from you as it passes. This is due to the fact that the "camera" is turning to track the airplane, and you start to look at the tail of the helicopter more and more as it gets further away.

2. As the helicopter flies higher, you will be presented more and more with a view of it's underside (assuming it's flying level) as the "camera" points up at it. This is particularly confusing at first, especially if you have a tendency to fly too close to over your head.

The program presents several aids to judging orientation.

First, the altitude and distance values will tell you if the helicopter is coming or going.

Second, the underside of the cabin is striped, and some structural detail is present on the rear of the cabin. The stripes cannot be seen from above, and the structural detail cannot be seen from the front. This information gets harder to see as the airplane gets farther away (just like the real thing).

Third, the rate at which the apparent size of the helicopter gets smaller as the helicopter gets farther away is less than it would be in real life. This makes it easier to see at large distances.

Fourth, The rate of "camera" movement, as it tracks the helicopter, is shown by the moving scale marks on the left side and the bottom of the frame.

Fifth, There is a white marker at the right of the screen, which climbs from the bottom of the frame when the "camera" points straight ahead at the horizon, to the top of the frame when the "camera" is pointing straight up. If the behavior of the model seems strange, check to see if you are flying overhead.

Sixth, In the upper right hand corner of the frame is a map of the flying field, corresponding to an area of about 1000 feet square. The runway is in the center, and the position of the helicopter is shown by the flashing dot. When the model flies outside this area, the scale automatically changes to show an area of about 1 mile square, and the size of the runway is correspondingly reduced.

Seventh. The outline of the rotor is dotted when viewed from below, and solid when viewed from the top.

Taken together, these clues make it fairly easy to judge the orientation of the helicopter, except at extreme distances. When you are at extreme distances, a technique which works well is to push the stick a little to the left, and see what the helicopter does. If the helicopter turns left, then it is going away from you. If it turns right, it's coming toward you. After you get it coming toward you, try increasing the throttle/collective, if it climbs, it's right side up,if it dives, it's inverted and you need to roll it to upright.

MISCELLANEOUS

It is a safety hazard to fly over or taxi through the pit area at a model flying field. Your colleagues will (rightly) chastise you for this. If you try this with the simulator, the program will object with a flash on the screen and a beep, and will move your airplane instantly to the other side of the pit area while maintaining its heading, and the "camera" will have swung around 180 degrees to see the airplane going away.

The following functions are available by pressing the appropriate "function" key.

F1 - Freeze the action. A second press will resume the action.

F3 - Restart on the runway

F5 - Return to the menu to reconfigure the airplane.

F7 - Turn engine sound off/on.

FLYING HINTS

Do not allow the airplane to get too far away. Very many crashes of real models result from loss of orientation when the model is a long way away.

Do not fly directly over your head, the program doesn't mind, but it is very easy to lose orientation when doing this. Besides, if you do this with a real model, you will soon get a stiff neck.

If you have no model flying experience, find an experienced R/C modeler to assist you if you have problems.

The Academy of Model Aeronautics is the national organization for model airplane enthusiasts, and is ready and willing to help you to locate, or start, a club in your area. This organization of 90,000 members (and still growing) is a must for those who want to try R/C model airplanes for real.

The Academy of Model Aeronautics
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Reston, Va 22090

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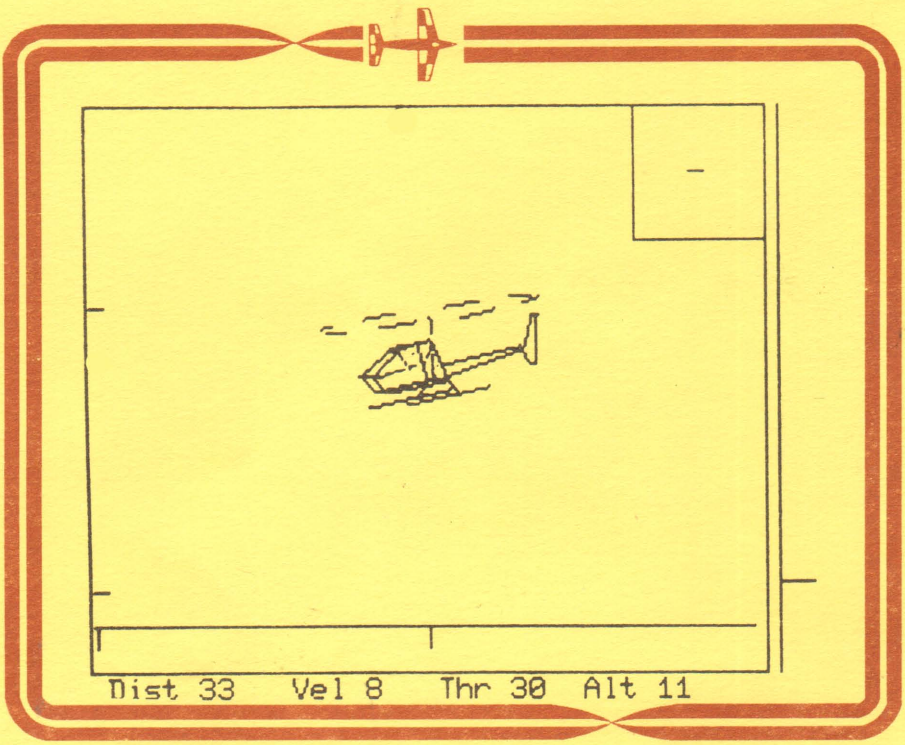
This program marketed by Dave Brown Products through agreement with JSK Associates.



ACTUAL VIEW OF SCREEN

- GREAT AS A TRAINING AID FOR BEGINNER OR EXPERT
- FULL AEROBATIC INCLUDING LOOPS, ROLLS, AND INVERTED FLIGHT
- CONFIGURE FOR A LARGE VARIETY OF MODEL TYPES FROM TRAINERS TO HOT AEROBATIC MODELS
- PROVIDES AN ACCURATE SIMULATION OF R/C HELECOPTER FLYING
- MUST BE USED WITH DAVE BROWN PRODUCTS DUAL JOYSTICK "TRANSMITTER"
- IT EVEN HAS "DUAL RATE" CONTROL SENSITIVITY

NOTE: Requires Commodore 64 with 1 disk drive and Dave Brown Products Dual Joystick "Transmitter"

Instruction Booklet written by DAVE BROWN, 5 time U.S. R/C Aerobatic Champion and 5 time World Championship Medalist

5.25" Floppy Disk Cover

THE DUAL JOYSTICK "TRANSMITTER"

FROM DAVE BROWN PRODUCTS INC.

Welcome to the wonderful world of R/C Model aircraft. Your purchase of the Dual Joystick "transmitter" will enhance your "flying" enjoyment with the RCFS 64 Flight Simulator, as well as future programs which will surely make use of it's ability to access 4 analog inputs and 3 pushbutton inputs on your Commodore 64 computer. All our Dual Joysticks are tested before they leave our factory, so when you open the box, you are ready to install the plugs and start having fun. Before plugging in your Dual Joystick, refer to your Commodore 64 instruction manual for the location of the 2 control ports. Insert the plugs marked #1 and #2 from the dual joystick box into the appropriately numbered control ports, being careful to ensure that they are right-side up..

This instruction sheet includes a short Basic program with which you may test your Dual Joystick. Plug in your joystick, type in the test program, and run the program. The numbers on the screen indicate the position of the joystick knobs. They should vary from "O" to "255" as the sticks are moved. Each number corresponds to one axis of travel on one stick. The neutral, or spring centered, position of each axis should be approximately "126" to "129" for most symmetrical control input. If they are not. then adjust the neutrals with each appropriate trim lever. On axis without spring centering it is sufficient to ensure that the travel will go from "0" "255". For use with the Dave Brown Products R/C Flight Simulators, the vertical axis (up and down axis), of the left stick, should have the centering-spring disabled for use as the throttle. All other axis should be spring-centered. The next step is to test the pushbuttons. Depress each pushbutton and the message "1>0N","2>0N", or "3>0N" will appear. For most programs, only pushbuttons 1 and 2 are used, but this unit has the third one installed for any possible future use.

JOYSTICK TEST PROGRAM

Note: This test program cannot be used to test a 'normal' Commodore joystick, as the normal joysticks are digital (on/off) rather than analog (proportional).

```
10 C=12*4096:REM SET PADDLE ROUTINE START
11 REM POKE IN THE PADDLE READING ROUTINE
15 FOR I=0TO63:READA:POKEC+I,A:NEXT
20 SYSC:REM CALL THE PADDLE ROUTINE
30 P1=PEEK(C+257):REM SET PADDLE 1 VALUE
40 P2=PEEK(C+258):REM  "      "   2   "
50 P3=PEEK(C+259):REM  "      "   3   "
60 P4=PEEK(C+260):REM  "      "   4   "
65 JV=PEEK(56320)
67 PV=PEEK(56321)
70 PRINT P2;TAB(6);P4;TAB(12);P1;TAB(18);P3;TAB(25);
72 IFJV=126THEN PRINT "1 ON ";
74 IF JV=111 THEN PRINT "2 ON ";
76 IF JV=110 THEN PRINT "1 ON 2 ON ";
78 IF PV<255 THEN PRINT "3 ON";
79 PRINT
90 GOTO 20
95 REM DATA FOR MACHINE CODE ROUTINE
100 DATA 162,1,120,173,2,220,141,0,193,169,192,141,2,220,169
110 DATA 128,141,0,220,160,128,234,136,16,252,173,25,212,157
120 DATA 1,193,173,26,212,157,3,193,173,0,220,9,128,141,5,193
130 DATA 169,64,202,16,222,173,0,193,141,2,220,173,1,220,141
140 DATA 6,193,88,96

READY.
```