

Review of NaturalPoint's TrackIR head motion sensor for use in the Condor simulator

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One of the enduring problems with any flight simulator is the restricted field of view (FOV) imposed by the computer display screen. This restriction severely limits peripheral vision, which in turn detracts from perceived realism. High-end airline and military sims use multiple screens to provide a wider FOV, but that's not very practical for PC-based sim. The Condor sim addresses this issue to some degree with a feature called 'Mouse Look', which substitutes mouse movement for head movement. Moving the mouse to the left is the same as looking to the left, moving it to the right is the same as looking to the right, etc. Amazingly, after a few minutes of practice with this you don't even realize that you aren't moving your head – your brain makes the connection and simply substitutes wrist muscle commands for neck muscle commands.

Recently I have been trying a product from NaturalPoint called TrackIR (<http://www.naturalpoint.com/trackir/>) that promises to provide a much higher level of realism and 'immersion' for PC-based simulations. The basic idea behind the TrackIR system is to convert very small head movements to much larger in-game view changes, so the pilot has a more direct connection between a desired view change and what happens on the PC monitor. Of course, this requires some way of accurately tracking head movements, and the TrackIR system accomplishes this by means of a small IR LED/Camera system that sits on top of the display, and a companion piece that is mounted to the pilot's headset or a baseball cap. The baseball cap arrangement uses an array of three passive IR reflectors arranged in a way that makes yaw/pitch/roll head motions easier to measure. The 'Clip-Pro' headset arrangement is an array of three active IR LED's that does the same thing, but more accurately because it provides the camera with a much higher Signal-to-Noise Ratio (SNR).

Figure 1 below shows the overall setup, with the IR camera visible on the top of the display, and the Track Clip Pro headset IR LED's shown on the left side of the pilot's headset



Figure 1: Clip-Pro IR LED shown mounted to left side of pilot's headset, with IR camera on top of display

The good news regarding this setup is that it does indeed live up to its promise of providing a more realistic and immersive simulation experience when flying Condor, and after some initial teething problems I have decided to move from 'Mouse Look' to the TrackIR arrangement as my view management system of choice. The bad news is that the TrackIR system is much more complicated than the dirt-simple Mouse Look method, requires a fair bit of patience and experimentation to get right, and has some side-effects that can detract significantly from the overall quality of the experience.

First, the good news:

- The TrackIR software and hardware is pretty easy to set up and get operating. The TrackClip Pro has a nice padded clip that will accommodate just about any headset arrangement, and it comes with an extra-long USB cord and a neat adaptor that lets you piggyback power for the TrackClip Pro active LEDs from the same USB port used for the headset.
- The software utility is a combination calibration test suite and game driver that runs all the time you are in the sim in order to control the sim's POV. This utility can also (has to) be used for initial setup and calibration, and is very well thought out. One of the things I really liked (when I

finally figured it out) was the 'camera' view that shows you everything the IR camera unit sees so you can easily tell if the unit is tracking something else in the room besides the headset-mounted LED's. As Figure 2 shows, in my setup the camera not only 'sees' the three IR LED's (the three green dots), but also sees (but disregards) a faint IR reflection from my glasses (the two red dots)

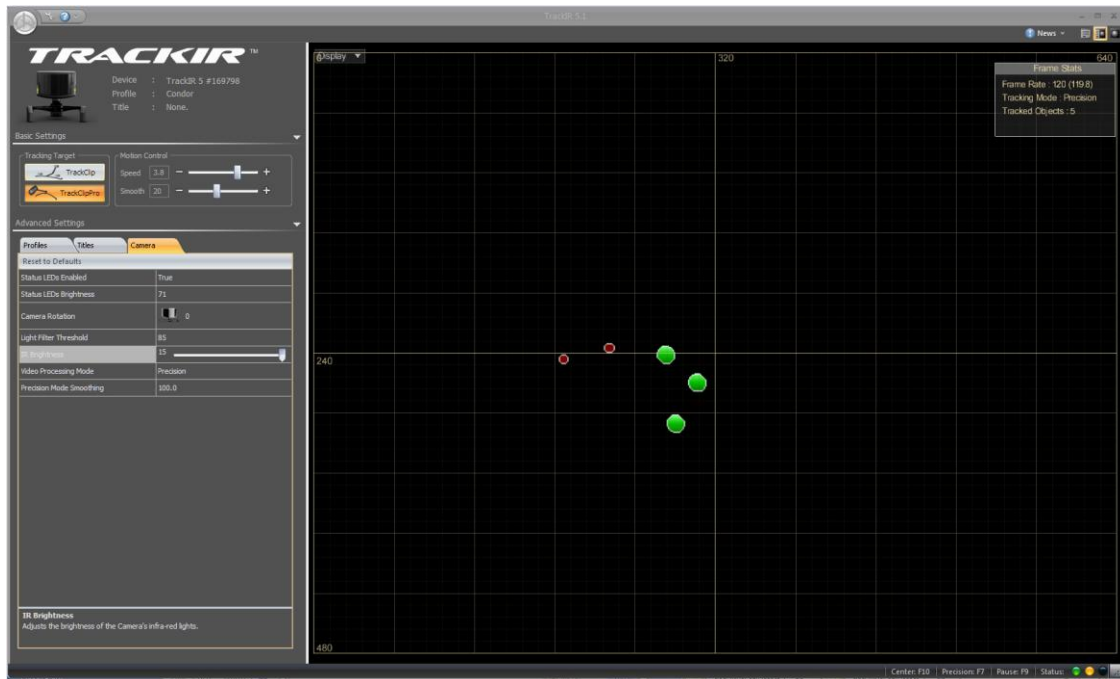


Figure 2: TrackIR setup screen, showing 'Camera View'

- The utility also allows the user to adjust the system dynamics – the scaling between actual head movement and POV movement, and what kind of smoothing, if any, is applied to the dynamics. Points on the small graph in the lower left-hand portion of Figure 2 can be dragged up or down to create a customized transfer curve, or you can use one of the provided templates. In my case, I found the 'default' (pretty much a straight-line ratio) to be pretty close, but I tweaked it a little bit for my taste.
- Once tweaked and properly calibrated, the effect is really cool – you look around just as if you were looking around at the view outside your real-life cockpit. If you want to look at that glider across the thermal, you just look in that direction and the view changes accordingly. Same thing with looking up to evaluate a cloud as you come in underneath – just look up and magically the view changes to make it happen. After a very short while your brain stops thinking about absolute neck motion and just does whatever is necessary to make the appropriate view happen. The following four figures show the head movement necessary to completely encompass the entire range of views, from straight up to straight down, and from looking at the left wingtip to looking at the right wingtip (Note: It may be difficult to see any difference between head positions in the photos, so I recommend you concentrate on the pilot's headset headband)



Figure 3: Looking at left wingtip. Note angle of pilot's headset



Figure 4: Looking out at right wingtip



Figure 5: Looking down at Condor pilots lap



Figure 6: Looking straight up through canopy

Now for the bad news:

- Although it is pretty easy to set up and get calibrated, it isn't as simple as the Mouse Look feature built into Condor, and pretty much by definition it isn't as portable. Instead of just needing a mouse and/or mousepad, you need the display-mounted camera with its USB cable, and either the ballcap-mounted passive reflector or the headset-mounted active IR LED setup.

Oh, and did I mention that either headgear option makes you look like a prime candidate for the nearest loony bin, with things growing out of your head?

- Headgear aiming calibration is critical; otherwise, you might wind up having to point your head slightly off-center in order to get a straight-ahead POV in the sim. Over the extent of a long flight, this can get annoying and/or tiring. At first, I was calibrating TrackIR before each flight and hoping for the best, but later I found that TrackIR allows the default calibration function key (F12) to be switched to F10, a key that isn't used in Condor. This meant that I could recalibrate 'on the fly' as many times during the flight as desired – nice!
- If you wear blended lens glasses (aka Progressive Addition Lens or PAL) like I do, there is another not-so-nice side effect in that PAL users have all trained themselves to adjust their heads in the pitch axis to focus properly on the desired object. However, since this pitch-axis motion also causes the POV to change (a lot), I wind up chasing objects up and down the screen. Same thing for side-side (yaw axis) motions. For the first several hours of flying, this was not only immensely annoying, but was also producing mild symptoms of nausea. However, after about 5 hours, seems to have damped out considerably, and now I'm pretty comfortable flying with the TrackIR system, even with my progressive lenses. I recently tried a pair of prescription Occupational Progressive Lens (OPL) glasses that are optimized for computer use, and these seem to work much better, without as much of the object-chasing syndrome I noticed with my PAL glasses. I would definitely recommend a pair of these to the elder-pilot set.
- The TrackIR system, especially with the Track Clip Pro upgrade, isn't cheap. In fact, it will cost you about \$150, almost twice the cost of the Condor sim and both plane packs.
- The TrackIR program consumes a fair amount of CPU time to do its magic, and this tends to degrade Condor's frame rate somewhat. My primary Condor PC is a 2-year old laptop that normally runs in the 90-120 FPS (Frames Per Second) range. Adding the TrackIR load drops the frame rate into the 45-75FPS category. Anything over 50FPS is considered very good, but sometimes there is some very mild (but noticeable) 'stutter' when using TrackIR

Summary:

If you are a committed Condor addict like I am, or even a semi-serious Condor XC racer, then TrackIR can be a great addition to your setup. It definitely enhances the 'feel' and immersive quality of the experience. I think this technology would also enhance the student experience, as it would make out-of-cockpit viewing much more natural than it is with the current 'Mouse Look' technology. However, be aware that you don't want to add the associated CPU load to an already maxed-out system or the results might not be as good as advertised. I would recommend checking the frame rate on your current Condor system before purchasing TrackIR. If your frame rate is less than 120FPS or so, you might want to consider holding off on TrackIR until your next PC purchase.