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In the May installment of Condor Corner, I shared with you my list of "Instructional Challenges"; issues I believe make glider flight instruction less efficient, less effective, and less extensive than it could be. So, to reset the stage, here is a quick review of the issues.

**Instructional Challenges:**
1) The worst place to learn to fly is in an aircraft
2) The second-worst place to learn to fly is on the ground
3) All of us, especially student pilots, need more opportunity to practice
4) The weather never cooperates (a slight exaggeration)
5) We need to expand the breadth and depth of our student's flying experience, especially emergency and other dangerous and/or unusual situations

Flight simulation provides us with the opportunity to address these challenges; to dramatically improve glider flight instruction; to produce better, safer glider pilots, in less time (at least in a calendar sense), and at a lower cost than we are doing it today.

So, allow me to make my case.

**Dealing with Instructional Challenges 1 & 2:**
All learning is based on perception, our ability to take in information through our five senses. The advantage of in-flight instruction is that it is a very sensory-rich experience. The challenge, however, with in-flight instruction (instructional challenge #1) is that there is simply "too" much going on. From a learning perspective, the in-flight experience would often best be characterized as "sensory overload". If you have ever had a student "go dumb" on you in flight, they are very probably, and simply, overloaded. Learning has ceased.

In the same, but opposite, context, ground-based flight instruction (the other side of our instructional coin) could best be described as "sensory deprivation". The glazed look that develops in our student's eyes, as we describe at great length some important concept, is likely the result of an overwhelming lack of stimuli. Few, if any, of the student's senses are being engaged. As such, there is little, if any, learning taking place.

The problem with our current flight instruction regimen is that it forces us to operate at or near one of these two sensory extremes. The solution to this dilemma would be a learning environment that provides the rich sensory experience of real flight, conducted primarily within the safe, comfortable, confines of a ground-based venue; in other words a solution that retains the advantages of both in-flight and ground instruction while eliminating their disadvantages.  That is a pretty good characterization of flight simulation.

So, we learn through our senses, but only two of our senses dominate in flight.  Our sense of sight accounts for as much as 75% of all perception, with hearing representing more than half of the remaining 25%.  While it has some limitations, Condor's glider flight simulation is exceptional in its ability to stimulate those two dominant senses.

**Visualization**
The first step in the learning process is for the student to understand "what" needs to be learned.  To grasp a concept, they need to develop a strong mental "image" of the learning objective.  In actual flight, we provide this mental image by doing a "demonstration".  We show; they watch.

Flight simulation can be used to implant these same mental images.  The difference, however, is that flight simulation is far superior to actual flight with respect to helping the student visualize a concept.  To drive that point home, allow me to describe Condor's visualization features.

**1) Views**
In actual flight, there is one view of the world; inside the cockpit looking out.  Condor provides this same perspective, albeit with a somewhat limited field of vision (more on that in a future issue).

Condor, however, goes on to provide an impressive array of additional perspectives not readily available in real life, including:

- An external view of the glider from any position around the glider
- Fixed-position views behind, in front of, on the right wing tip, and on the vertical stabilizer of the glider
- A view of the glider from the ground
- A view of the glider as it "flies by" a fixed point in space
- An external view of the tow plane from any position around the tow plane
- The ability to zoom in/out of any of the views mentioned above

This incredibly diverse viewing capability helps ensure the student's mental grasp of the learning objective.  The student can visualize airspeed control, turn coordination, descent control, glide angles, tow position, landing flare, and a myriad of other important soaring concepts, and develop a good understanding of each objective well before experiencing it in actual flight.

**2) Pause**
As a glider flight instructor (or as a student), imagine that during any actual flight, you could simply stop the action, have a calm and informative conversation about what was happening, and then, when you were good and ready, resume the flight.  In Condor, you can do exactly that.  Condor calls it the "Pause" function.  I call it my "Instructional

Super-Weapon". I have often thought if I had the ability to pause a real flight, I wouldn't need a flight simulator (I no longer believe that).

Then, just when you think this simulation stuff can't get any better, while paused, you can invoke any of the view features described above. From an instructional standpoint, this is incredibly powerful stuff.

**3) Virtual Reality**

Folks sometimes argue you can't do everything in a simulator you can do in real flight. That is true, but so is the counter argument. There are things you can do in simulation that can't be done in real life. Here is my favorite example:

When I do presentations on using Condor for instruction, I always ask my audience of glider pilots how many wish they could see thermals. Most raise their hands enthusiastically. The liars do not. Frank Paynter did a nice job in last month's Condor Corner talking about Condor's "Thermal Helper" function, so I won't go into much detail here. Suffice it to say, you can "see" thermals in Condor; yet another great example of how simulation enables the student to visualize, and thereby understand, a very important soaring concept.

Other virtual reality features include:

- Visible turn points:
  Enabling the student to visualize and better understand, cross-country navigation and competition tasks
- Height recovery
  Providing the student with an additional 1500 ft of altitude on demand, allowing prolonged flight time
- Wing tip Smoke
  Helping the student visualize/trace a flight path; especially effective in visualizing a spin
- Plane Recovery
  Enabling the student to recover from a structural failure caused by overstressing the aircraft or a mid-air collision.

**4) Other Amazing Stuff**

- On sunny days, you can see your glider's shadow and the shadows of clouds moving along the ground below you
- The glare on the canopy changes as you change direction
- You gray/black out pulling excessive positive Gs and red-out pushing excessive negative Gs; assuming, of course, you don't reach one of the aircraft's load limits and start shedding parts.

**Sound**

Second to visualization in the perception department is hearing. Condor has exceptional 3-D sound features. For example:

- As the tow plane taxi’s onto the runway, you hear it move from right to left across your field of vision
- Slipstream noises change with airspeed and when slipping or skidding
- The spoiler control clunks as it is taken in/out of over-center lock
- You hear the control linkages moving during your pre-takeoff control check
- The wings groan as you pull multiple positive Gs
- The aircraft makes a very disconcerting sound when you crash or hit something
- The sound of aileron flutter is one you won’t soon forget
- The landing gear rumbles when you are on the ground
- You hear the gear retraction system working

The list goes on and on; ‘absolutely amazing stuff for a $60 piece of software.

**Visualizing Boxing the Wake**

**Procedural Training**
Once the student has a good understanding (mental image) of “what” needs to be done, the next step is to learn the “how”. In addition to teaching all of the required flight maneuvers, Condor can be used to reinforce other flight-related procedures including preflight inspection, pre-takeoff and pre-landing checklists, and collision avoidance scanning.

The flight physics engine in Condor is superb, so the glider performs exactly as it would in real life. All the expected flight characteristics are present including adverse yaw, pre-stall tail buffet, over-banking tendency, tow-plane wake turbulence, crosswind effects (drift, weathervane), and accurate sound effects.

You can easily train a student to PTS standards (or better) before ever having them perform the same procedures or flight maneuvers in an actual aircraft.

**Opportunity to Practice (Challenge #3)**
Once the student knows "what" to do and "how" to do it, they need the time and opportunity to practice. Practice enables the student to internalize their learning; to make it part of themselves while developing confidence and proficiency. Repetition is the key.

Unfortunately, actual glider flights rarely provide our students with sufficient time and opportunity to perfect their newfound skills. Flight simulation, on the other hand, enables our students to practice their requisite skills for hours at a time. Instead of experiencing one or two traffic patterns on the weekend followed by 5-6 days of inactivity, the student can use flight simulation to be thinking through and executing the 50-60 approaches/landings you assign them as homework, to be completed before their next in-flight lesson.

We learn by doing. Flight simulation lets us to "do" more, and this may be its greatest attribute.

**Environmental Control (Challenge #4)**
As I mentioned in the May issue, the learning objective of the day is all too often determined by the day's weather. You end up teaching something the weather allows rather than what the syllabus would suggest.

In simulation world, however, you have complete control over the weather. Condor allows you to set all of the following parameters:

- Wind speed and variation (gusts)
- Wind direction and variation (shifting)
- The general level of atmospheric turbulence
- Cloud base (using an elegantly simple graphic interface based on the convergence of the temperature and dew point lapse rates)
- Inversion height (inversion height below temp/dew point convergence = blue day)
- Thermal strength and strength variability
- Thermal width and width variability
- Thermal activity (cycle time)
- Level of turbulence within a thermal

Again, from an instructional standpoint, this is dynamite. After determining the learning objective, you simply create the ideal meteorological environment to support it.

As if controlling the weather isn't good enough, Condor provides other environmental controls, including:

- Terrain selection

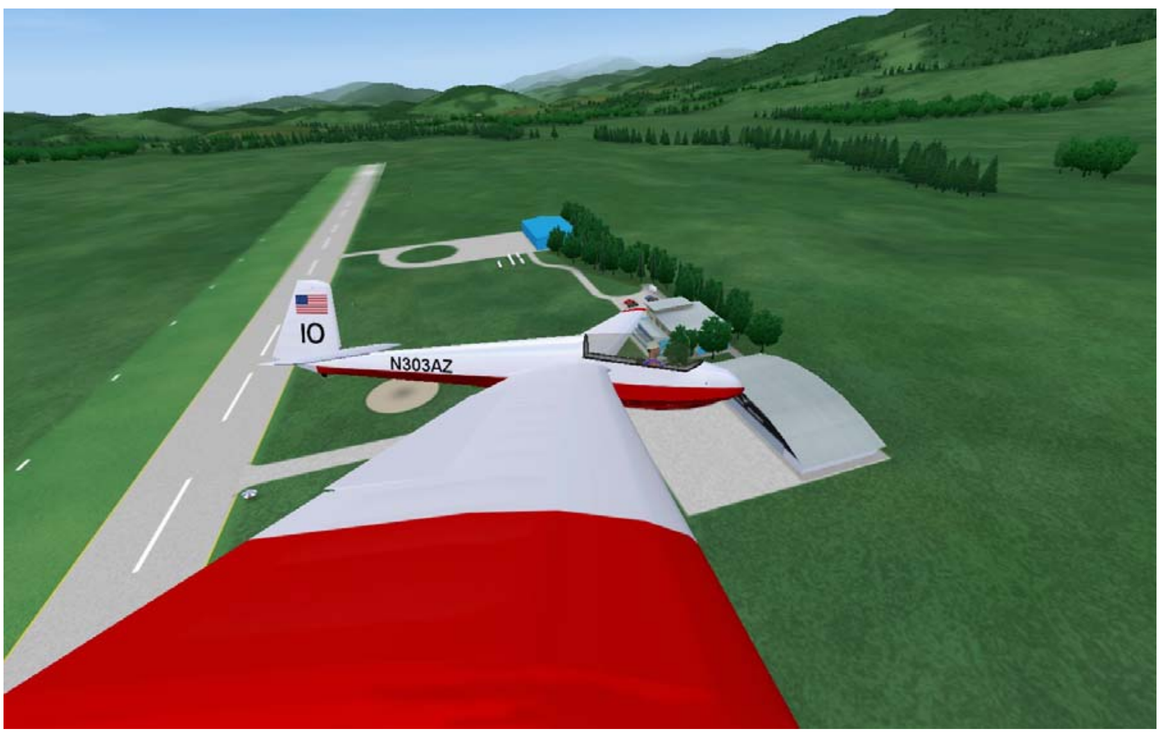
The default scenery provides plains, ridges, and rugged mountains.  Thermal, ridge, and wave soaring are all available.  The flatlands provide the unobstructed horizon so important to primary instruction.

- Launch method
  Aero-tow and winch launches are supported.  The aero-tow is very realistic, even incorporating wake turbulence.  At a pre-selected altitude, the tow plane issues the signal to “release immediately”.

  Condor also supports an “airborne” start.  You simply initiate your flight at a specified altitude above the airport; the ultimate self-launch.

- Runway surface
  Hard surface, grass, or parallel paved/grass configurations are all available depending on the airport selected.

- Aircraft Class
  Depending on the learning objective, the appropriate aircraft is available:
  - School class:  ASK-13 for primary training
  - Standard class: e.g. ASW-28 for initial cross-country training
  - 15 Meter class: e.g. ASW-27 for complex aircraft systems and competition
  - 18 Meter and Open Class ships (there is no substitute for span)
  - Aerobatic – MDM-1 Fox




**Turning Crosswind Too Low – Now What?**

**Expanded Experience (Challenge #5)**

Flight simulation allows us to dramatically expand both the breadth and depth of our student's flight training experience; to expose them, in a very meaningful way, to situations they will seldom, if ever experience in actual flight training. Many of these experiences are either too dangerous to incorporate into actual flight training or are simply not available at the training site. These critical situations include:

- Spin recognition/recovery (especially at low altitude; the turn from base to final)
- Ridge flight
- Wave flight
- Landing out
- Premature Terminations of the Tow
- Sharing a thermal with multiple gliders
- Landing in strong crosswinds or tailwinds
- Stretching a glide

Depth of experience comes with repetition and variation; repeatedly recognizing a situational variant, identifying options, deciding on a course of action, executing the plan, and evaluating the results.

**Freedom from the Time/Space Continuum**

Our current instructional paradigm pretty much limits us to what we can accomplish in a few hours per student, on the weekend, at the airport, with a few training ships, staffed by a few instructors, and towed by one (two, if we are lucky) tug(s); assuming of course the weather cooperates.

Flight simulation frees us from these constraints. Our students can now spend all the time they have available, mastering their skills wherever they can run Condor. Their glider is always available; the tug is always waiting just for them; the weather is whatever their instructor deems it to be.

My first Condor student was a 39-year-old software specialist named Craig Fulmer. Craig and I conducted his glider flight training on Thursday mornings for two hours, over the phone, running simultaneous Condor sessions from our respective residences in Boston, Massachusetts and Madison, Wisconsin. After about a year of this cyber-instruction, Craig flew out to Wisconsin where we conducted nine actual glider flights, over two days, to see how his simulator-based instruction transferred to real life.

Craig's prior flight experience consisted of two demonstration flights in a glider three years earlier. His second flight in an SGS-233A was completely unassisted. On subsequent flights, he demonstrated excellent command of the aircraft. Had he possessed a student pilot certificate, I would have seriously considered signing him off to solo.

I rest my case.

**Next Time**

In the next instruction-related Condor Corner, we'll take a look at how to incorporate flight simulation into the overall glider flight-training syllabus. Until then, send me your thoughts and suggestions. smanley@wisc.edu

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