Acknowledging the increased levels of risk involved in night flying and knowing as much as you can about their nature are the first steps in successfully managing them.

Managing the risks

By Dale Wilson
If you're like me, you probably enjoy flying at night. The ride is often smoother, the radio is usually quieter, and as one of my instructors from the Midwest said, "It's just plain purdy." But it's not without risk. Driving an automobile at night increases the risk of a fatal accident and so does flying an aircraft — according to the AOPA Air Safety Foundation — by almost a factor of three. As an instructor you may not be fully aware of all of the hidden dangers that lurk in the dark, but if you want your students to know how to effectively manage these unseen threats, you owe it both to yourself and to them to find out.

Some of the hazards unique to piloting when the sun goes down can manifest themselves even before you get airborne. For example, the loss of optic flow in our peripheral vision often causes us to taxi too fast. It's also easier to get lost while navigating on the apron at night — especially at an unfamiliar airport, increasing the possibility of departing from the wrong runway or even from a taxiway. A 2007 study discovered more than 600 reports of wrong runway, or attempted wrong runway, takeoffs in the United States over a recent 25-year period. A tragic example of this involved a Comair regional jet at Blue Grass Airport in Lexington, Kentucky. Good visual meteorological conditions (VMC) prevailed, but it was dark that early morning in August, and the moon was below the horizon. This may have contributed to the crew's misidentification of Runway 26 for Runway 22. Unfortunately, they attempted a takeoff and ran off the end of this runway — which was half as long (only 3,500 feet) as their intended runway — impacting the airport perimeter fence and terrain, and killing all but one of the 50 people on board.

**Runway Incursions**

Confusion while operating on the apron increases the risk of a runway incursion. Of the six fatal runway incursion accidents involving major and regional U.S. airlines during the 1990s, five of them occurred in good VFR weather conditions during the hours of darkness (or at dusk). The pilots in two of these accidents reported they were unable to see the other aircraft until their landing lights had illuminated them during the landing rollout.

**The Dark-Night Takeoff Accident**

An equally serious accident can occur after liftoff, especially on dark nights (i.e., no moon illumination and/or overcast sky and few if any surface lights ahead of the aircraft). They even have a name for it: the dark-night takeoff accident. In the absence of adequate outside visual references our somatosensory and vestibular sensations create the illusion of a nose-up attitude when accelerating on climb-out after takeoff or during a go-around (Figure 1). This has resulted in tragedy as pilots, in response to these false sensations, have unknowingly pushed their aircraft right into the ground. This false climb illusion was specifically cited as a factor in a dark-night takeoff accident involving a Part 135 cargo flight in Kamuela, Hawaii, that claimed the life of the ATP-certificated pilot. More recently, an 18,000-hour commercial pilot died when his Beechcraft Baron G58 impacted the waters of Lake Erie after a night departure from a lakeshore airport in Cleveland, and a commercial pilot flying a Cessna 340 lost his life in a dark-night takeoff accident in Bishop, California — the sky was clear with 10 miles' visibility.

**VFR Into IMC**

You and your students should be aware of two major threats that arise during the en route portion of flight — namely the inability to adequately detect weather or terrain in the dark. Attempted VFR flight into instrument meteorological conditions (IMC) is a major killer in aviation. Statistics indicate the odds of experiencing such an accident increase by more than a factor of three when you're navigating in the dark; it's simply harder to see adverse weather at night.

**Controlled Flight Into Terrain**

Unfortunately, it's also easier to inadvertently fly into unseen terrain at night. This is what claimed the lives of eight members of country singer Reba McEntire's band and two flight crew members. While waiting for an IFR clearance below the San Diego TCA (now called Class B airspace), the crew of the Hawker-Siddeley 125 flew under controlled flight into mountainous terrain (CFIT) near Brown Field airport.

I talked to someone who was in the vicinity on the night of the accident; he said the weather was CAVU, but it was very dark. The official accident report indicates a clear moonless night with a visibility of 10 miles. Unfortunately, the occupants of an air ambulance Learjet 35 suffered the same fate in almost the same location 13 years later. While waiting for an IFR clearance and maintaining VFR flight below a cloud deck in the dark, the aircraft crashed within 1.5 miles of the HS-125 crash site, killing all on board.

**Approach and Landing**

Accident statistics make it clear that compared to the other phases of flight, the final approach and landing pose the greatest risk. Even though they occupy less than 5 percent of total flight time, more than a third of the world's fatal airline accidents occur during these segments of flight. A United Kingdom study found that 40 percent of fatal approach and landing accidents occurred at night, and a worldwide study of commercial CFIT accidents found that half took place in the dark with 70 percent of those occurring during the approach and landing.

**Visual Landing Illusions**

Elevated risk levels while landing in VMC at night are often due to the increased probability of experiencing a visual landing illusion on final approach. These have fooled many pilots into thinking they were either too high or low on the approach. Especially hazardous are illusions that cause us to conduct an unsafe low approach resulting in a hard landing near the runway.
threshold or, at worst, a fatal CFIT accident short of the runway. For example, since we usually judge our approach angle by the familiar trapezoidal image the runway shape casts on the retinas of our eyes, we will experience an illusion of excess height when conducting an approach to an up-sloped runway — especially in conditions of limited visual cues such as at night — causing us to conduct an approach that is too low (Figure 2). Similarly, an approach to a smaller runway — especially one that has the same proportions or length-to-width ratio (L/W) as the runway(s) we’re used to — or to a runway that is longer or narrower (i.e., greater L/W) than we are accustomed to also creates a height illusion causing us to respond by flying too low ( ). These illusions are caused by a common malady known as the ‘home-drome syndrome,’ where the home-base aerodrome is so indelibly etched into our perceptual memory that we misperceive other runways as similar to our own. It’s especially strong where there’s little or no surrounding context that would give cues to a runway’s actual size — such as during the hours of darkness — and is more pronounced in low-time pilots (e.g., students) who lack real-time experience conducting approaches to a variety of different-sized runways.

**Black-Hole Illusion**

By far the most deadly threat while flying an approach at night — especially during dark-night conditions — is the black-hole illusion. Relying solely on outside visual references when conducting an approach in black-hole conditions inevitably leads to a dangerously low approach and possible CFIT accident short of the runway.

Analogous to relativity theory, the pull of the black hole has left many pilots unable to escape its grasp. The most likely cause of this deadly threat was discovered by Boeing research scientists during a series of simulation studies in the late 1960s. They concluded that rather than maintaining a constant descent angle, pilots who conduct visual approaches attempt to maintain a constant visual angle between the runway threshold and runway-end lights (or ground lights beyond). This results in a curved approach path bringing the aircraft dangerously low on the approach (Figure 4). This illusion recently fooled the crew of a Federal Express Boeing 727 while approaching Runway 09 at Tallahassee Regional Airport in Florida. The aircraft struck trees on short final and crashed short of the runway, seriously injuring three crew members aboard. The NTSB report indicates the approach was conducted over unlighted terrain in VFR conditions at night, resulting in black-hole conditions that contributed to the crew’s failure to properly perform the approach.

**Reducing the Risks**

If “risk equals probability of an accident times its consequences,” then the risk is most certainly greater after dark. The accident record clearly indicates the probability of flying into adverse weather or terrain, crashing short of the runway while on the approach, or experiencing a dark-night takeoff accident rises significantly at night.

Also, consider the consequences of these types of accidents: nearly all CFIT (whether en route or on the approach), VFR flight into IMC, and dark-night takeoff accidents involve fatalities. In response to a question about the safety of night flying, a pilot of a Cessna 210 stated that flying at night “was no different than flying in the daytime.” He died that evening in a typical dark-night takeoff accident. It appears he was unaware of the old adage that says, “Flying at night is no different than flying in the day — except you can’t see anything!”

Acknowledging the increased levels of risk involved in night flying, and knowing as much as you can about their nature are the first steps in successfully managing them. Here are additional strategies for you and your students to minimize the risks:

1. **Don’t Believe Everything You See**

Understand that what you see is not always what you get. Awareness of an illusion doesn’t immunize you from being deceived by one. A CFI and his student and passenger were lucky to land safely after striking trees on final approach during a training flight in dark-night conditions. According to the Aviation Safety Reporting System report, the instructor carefully explained the phenomenon of the black-hole illusion to the student beforehand — that is why he, rather than the student, flew the approach. He reported that it was ironic that he was “consciously aware of the illusion problem and trying to correct for it” when they hit the trees! Remember, visual illusions can completely trick you into believing everything looks fine — that’s why they’re called illusions.

2. **Do Your Homework**

Determine minimum safe obstruc-
tion clearance altitudes for your route of flight. Find the minimum elevation figure (MEF) on VFR sectional charts for the quadrants you will be flying over and add at least 1,000 feet (2,000 feet in mountainous) to that value since it only provides 100 to 300 feet of obstruction clearance. If you don’t have an instrument rating, learn how to determine how to fly at or above minimum en route altitudes (MEAs) as shown on IFR charts. Find out beforehand if a given airport is conducive to landing illusions. Consult the Airport/ Facility Directory or other publications, NOTAMs, and even other pilots to ascertain the presence of irregular-shaped runways, sloped runways, or runways conducive to black-hole conditions.

3. Take Extra Precautions
Reduce your risk by avoiding VFR flight on dark nights: Fly in what the AIM calls “high lighting conditions,” which consist of cloud coverage less than broken (5/8th), at least 50 percent moon illumination, and flight over surface lighting that provides for adequate illumination of obstacles, terrain features and a horizontal reference by which you can control the aircraft. Use the airport taxi diagram to avoid getting lost on the apron at night, and request “progressive taxi instructions” if you’re having trouble finding your way around an unfamiliar airport. Raise your personal VFR weather minimums considerably when flying in the dark and resolve to stick with them if the weather falls below them. Pay particular attention to visibility and cloud reports and forecasts, and accept the fact that you can’t count on your vision to avoid inadvertent entry into IMC. If at all possible, don’t let you first flight into an unfamiliar airport be at night, and consider overflying an airport before committing to an approach — especially if there is high terrain nearby or you suspect the possibility of an illusion. Avoid long straight-in approaches — they almost always result in a premature descent and low approach, even in the daytime!

4. Supplement Outside References With Inside Ones
Flying at night is in many ways like instrument flying; therefore, don’t rely solely on outside visual references to accurately orient yourself. John F. Kennedy Jr. piloted his Piper Saratoga on a 30-mile direct route over open water in VMC at night when he succumbed to spatial disorientation, lost control of his aircraft and crashed into the water seven miles off the coast of Martha’s Vineyard. Even though he had received training toward an instrument rating, it appears from the accident report that he failed to adequately supplement outside visual references with his cockpit instrumentation. Haze was present that evening, but even in clear VMC there are times when you need to use cockpit aids to vision. For example, when departing into black-hole conditions use your flight instruments to ensure an adequate climb gradient until you can accurately orient yourself using outside visual references. If you have glide path information from an ILS or GPS, why not use it right down to the threshold crossing height (TCH) when conducting an approach at night? With DME information from the airport you can maintain an approximate 3 degree glide slope by maintaining 300 feet AGL per nautical mile (NM) from the runway threshold. For added safety at night a 500 feet per NM descent will yield a 5 degree slope for better obstacle clearance.

5. Use the VASI
Make sure you know the on-glide-path indications from the various types of visual approach slope indicator systems (VASI) and use them while on the approach. While many of the indications are visible up to 20 miles or more at night, according to the AIM the visual glide path generally provides safe obstruction clearance only up to plus or minus 10 degrees of the extended runway centerline out to 4 NM from the runway threshold. The NTSB determined that the precision approach path indicator (PAPI) at Tallahassee was fully functional when the FedEx crew allowed their B-727 to strike the trees short of the runway; unfortunately, the crew failed to effectively use the system. When conducting an approach in Class D airspace to a runway served by a VASI, regulations (91.129) require that you fly at or above the glide path until a lower altitude is necessary for a safe landing. Why not make that your practice at every VASI-equipped runway?

As a flight instructor, you play a crucial role in educating your students about the hazards that lie hidden in the dark. However, you must first educate yourself about the unique nature of these threats — and more importantly, how you can effectively manage them — before you can successfully impart this knowledge to your students.

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