Pilot Knowledge Series

VISUAL ILLUSIONS IN FLIGHT

BY ROB KNIGHT

Visual illusions

Everyone is familiar with visual illusions, with things that aren't as they appear. As young children, people learn that railway tracks don't come to a point at the horizon even though their eyes claim that they do.

If we are talking casually about light bending as it passes the surface of water that is one thing, but if the illusion is counter-productive in the control of flight, it is a far more serious issue and especially so if that illusion is misunderstood or is flawed.

Much or our brain is tied up with illusions. For example, the image that our brains receive from our eyes is upside down. Believe it – it's true – and it's because of the way our eye lenses function. But, as babies, our brains learned to mentally invert the image it received from our optic nerves so "reality became the right-way-up".

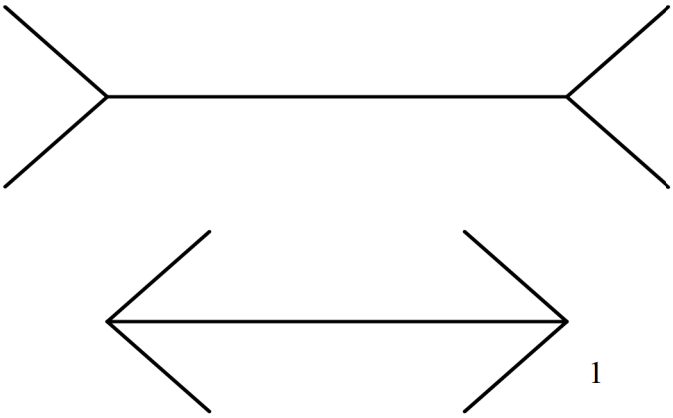
Pilots use their eyes to fly – that's why it's unwise to fly with a white cane – people will talk. But more importantly, because we use our eyes to meet so many important judgment requirements, then illusions, if they give us false impressions, can be merely a nuisance or a disaster in the making.

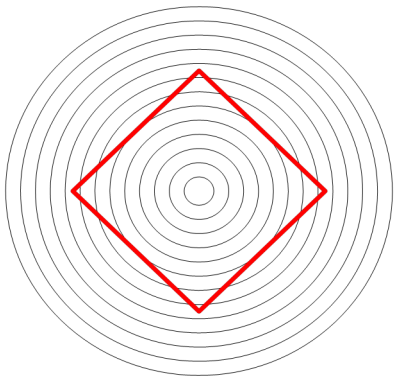
Let's look at some illusions that are mere exercises before we get too deep into the ones critical to flight. Then we can look at how we use illusions on every approach to land.

Linear perspective illusions

Everyone is familiar with visual illusions, with things that aren't as they appear. As young children, people learn that railway tracks don't come to a point at the horizon, even though their eyes claim that they do.

The two illusions below left are typical of this type of illusion. The horizontal lines are actually the same length. This demonstrate the ways in which the brain modifies what the eyes actually see and comes up with the wrong answer.





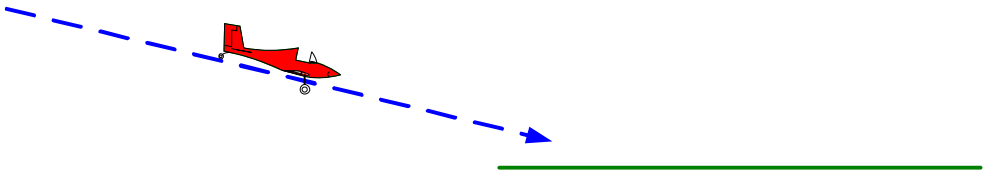
The sides of the red diamond are actually straight lines.

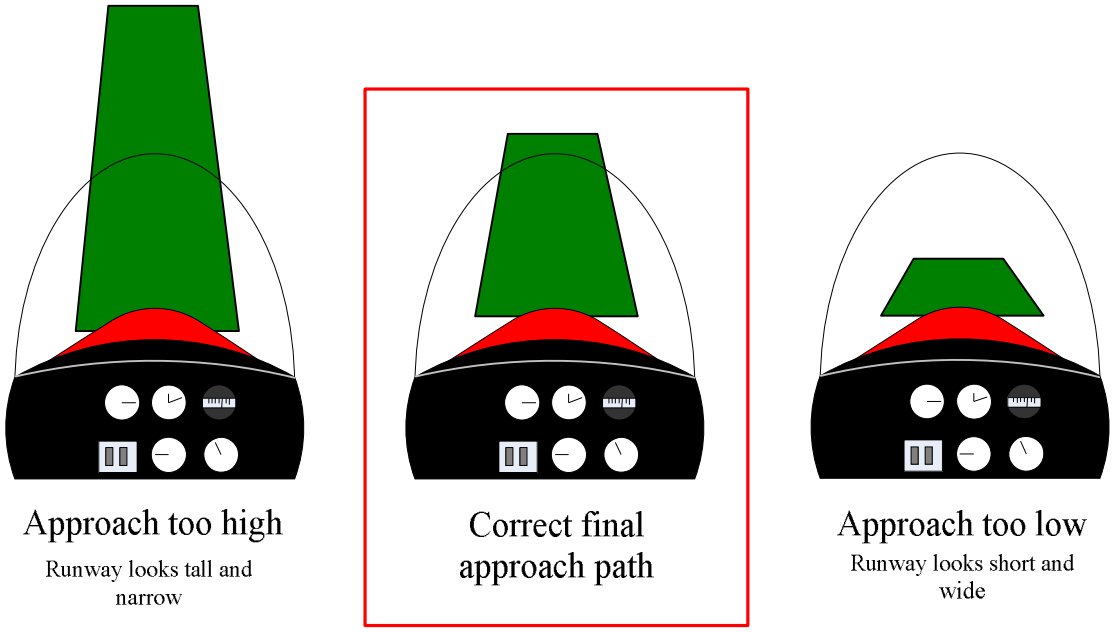
Linear Perspective Illusions in Flying

This type of illusion can occur on final approach and may encourage a pilot to change his/her approach slope path when it is already, in fact, quite correct. The conflict lies between what a pilot sees when on approach, and what runways have looked like from this position in the past.

Different runways have different ratios of widths to lengths and, while most are level, others have upslope or downslope. Pilots learn to recognize the appearance of a normal final approach by developing and recalling a mental image of the expected relationship between the length and the width of the runway they trained on, or runways they have experienced in the past. When faced with new runway dimensions and/or new or unexpected runway slope, the appearance of a *correct* final approach may be quite different from what they recollect.

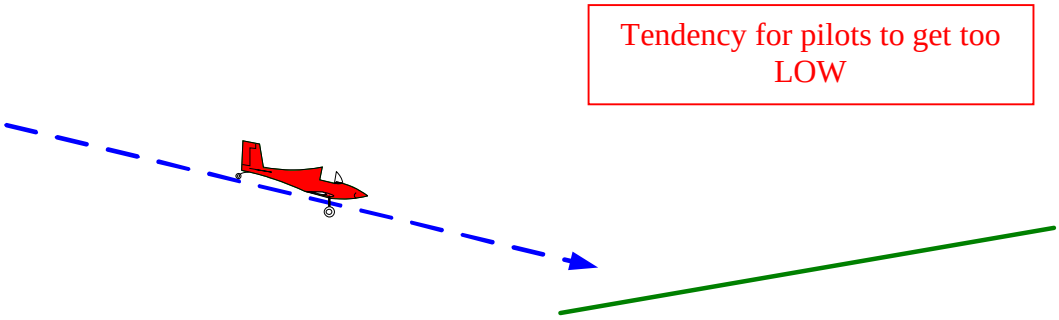
A *Normal* Approach into a Level Flat Runway.



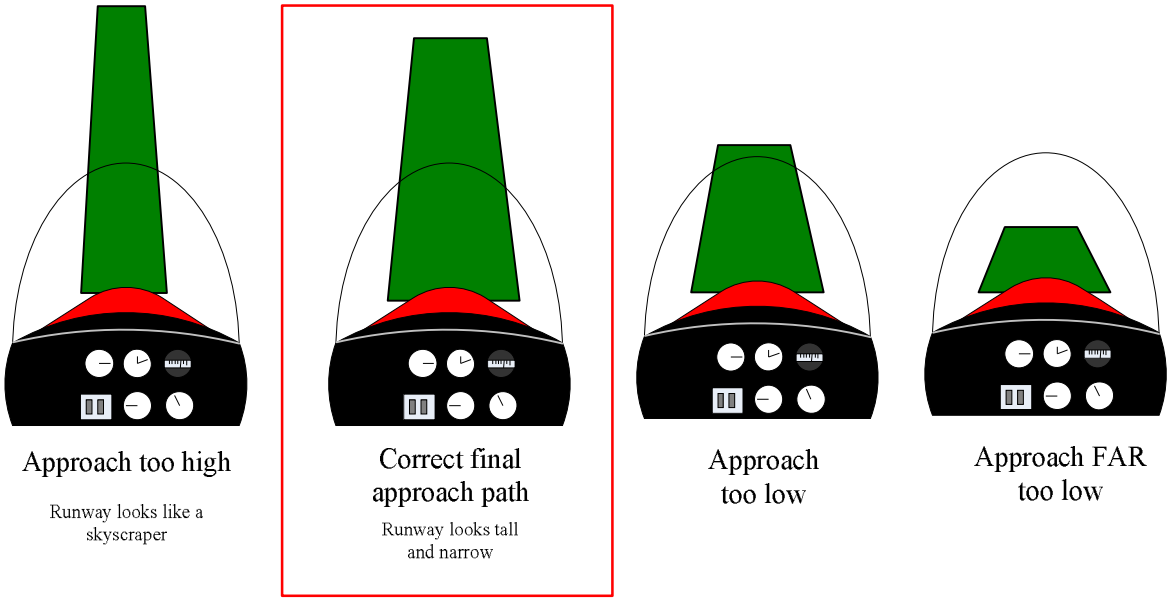


A Normal Approach into a Runway that Slopes Up-Hill

To a pilot mentally comparing it to past level runways it looks TOO HIGH.



The accustomed appearance on final approach of a level, flat runway according to the pilot's memory.



The appearance, on final approach, of a runway that slopes Up-hill.

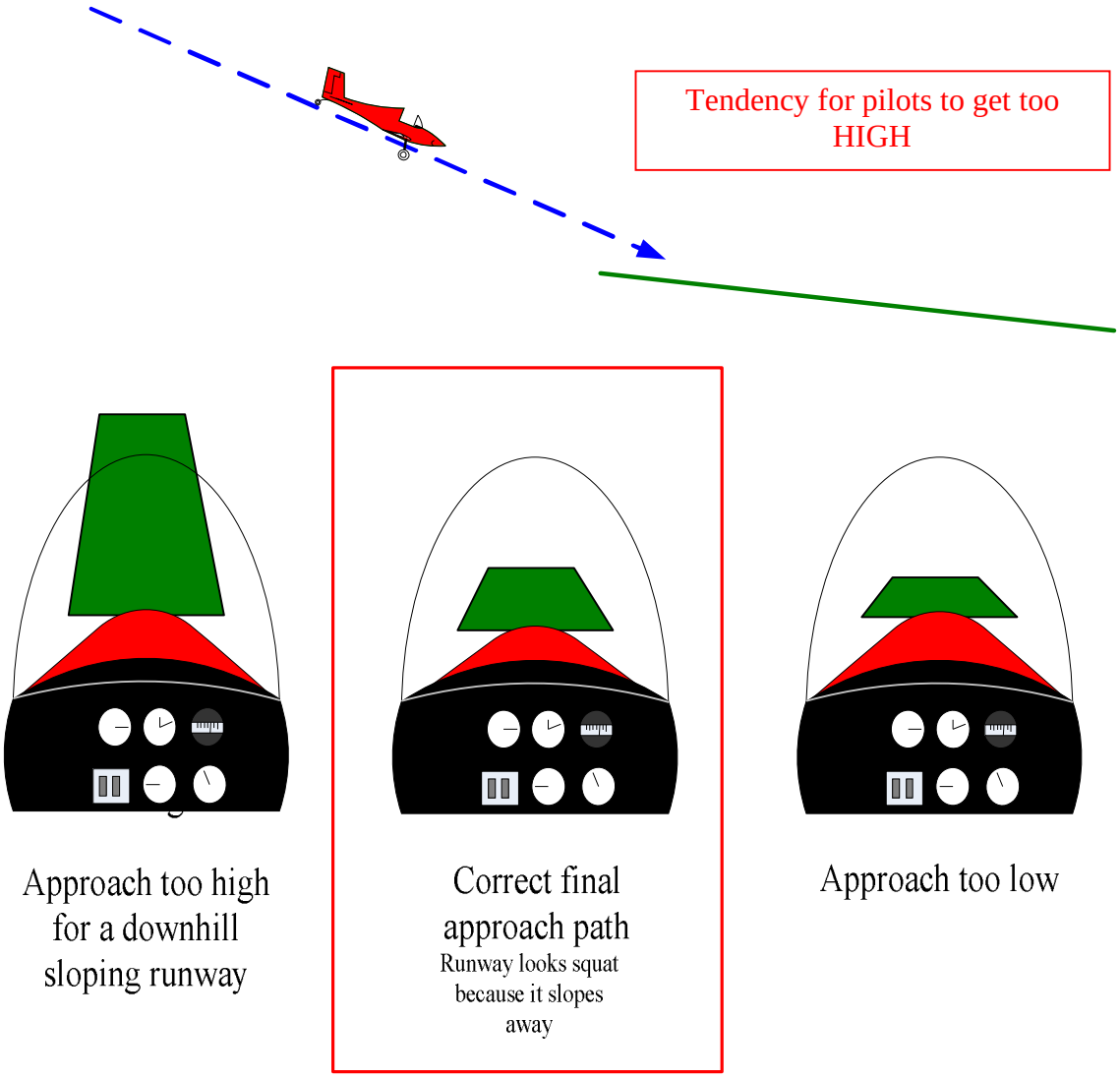
Up-hill sloping runway

Note that the same illusion will occur on final approach for an unusually narrow runway.

The final approach to an up-hill sloping runway or to an unusually narrow or long one, may produce the visual illusion of being too high on final approach. The pilot must ignore the illusion and not adjust the approach slope. The common pilot-error is to reduce power to steepen the approach and this is likely to result in a undershoot and a ground impact short of the runway. This tends to ruin one's day somewhat!

A *Normal* Approach into a Runway that Slopes Down-Hill:

To a pilot mentally comparing it to past level runways it looks TOO LOW.



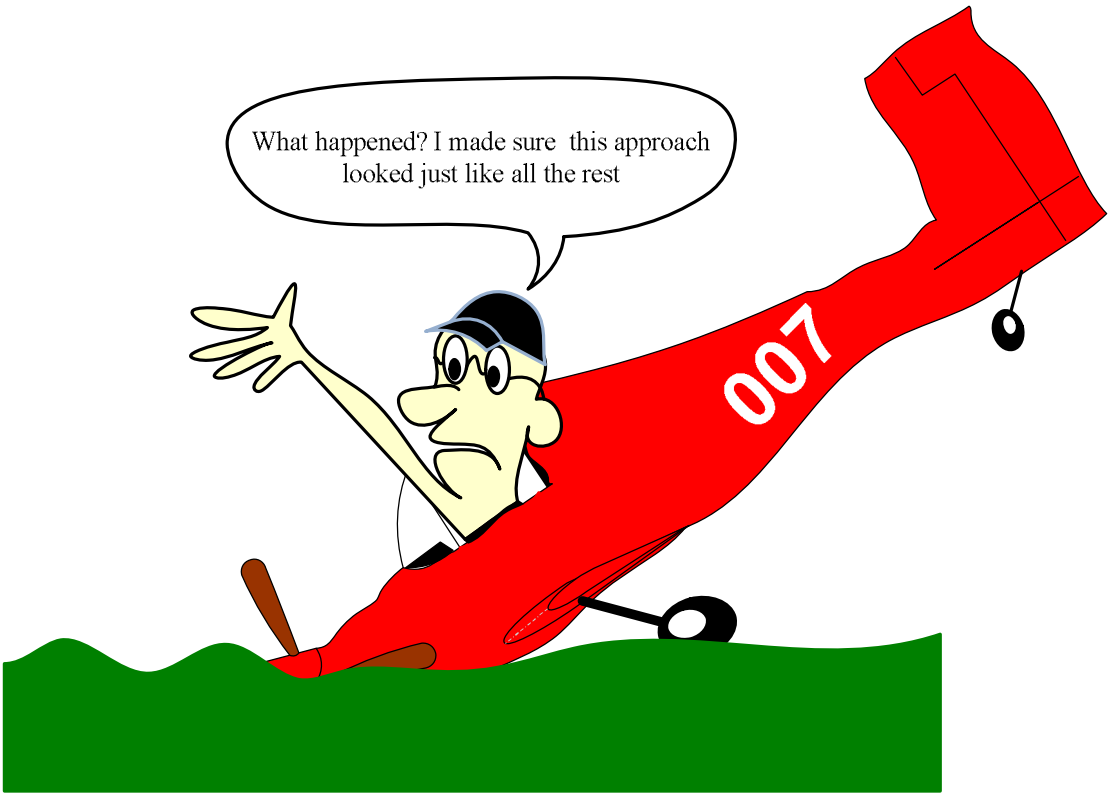
The appearance, on final approach, of a runway that slopes DOWN-hill.

Down-hill slopingrunway

Note that the same illusion will occur on finals for an unusually wide runway.

A final approach to a down-sloping runway may produce the visual illusion of being too low on final approach. The appearance of the landing area in these circumstances is likely to encourage an inexperienced pilot to add power to make the approach slope appear normal but this will result in the aircraft being too high. The only safe option is then to overshoot. To continue is likely to lead to a late flare, a touchdown too far into the field with reduced braking ability because of the down-hill slope, and an over-run through the far fence at best.

These last endeavours do not endear a pilot to their insurer.



Other visual illusions ..

Autokinetic illusion

Another illusion, called an autokinetic illusion, gives the pilot a very powerful impression that a lighted object is moving across in front of the aircraft's path when, in fact, it is quite stationary. This illusion is caused by staring at a fixed single point of light (ground light or a star) in a totally dark and featureless background. This illusion causes a completely false impression that the lighted object is on a collision course with the aircraft. You can duplicate this by staring at a lone star on a dark night and you will get the feeling it is moving across the sky.

False visual reference illusion

A false visual reference illusion may cause a pilot to attempt to orient the aircraft in relation to a false horizon. This illusion is caused by flying over a sloping cloudbank.

Vection illusion

This often occurs in lines of traffic. With few other visual clues, the brain 'sees' motion out of the side of the eye and reads it as applying to itself. This illusion appears as the car in the lane beside rolls slowly forward. The brain becomes confused and instantly believes that the vehicle it is in is moving backwards, particularly if the wheels of the other cars are not visible. In a car-wash, as the roller mechanism moves toward the rear, the driver sitting in the car feels as if he and the car are moving forward! Similar illusions can occur while taxiing an aircraft.
