

Generated Imaging (CGI) has revolutionised the production of animated films (see page 181). These same techniques are now used in flight simulators to provide pilots with moving images showing the appearance of an airport as the aircraft makes its approach. And because the animated image is held in software and can be loaded from disk, one simulator system can provide the pilot with a large repertoire of airports.

An even more impressive use of this technique is to be found in the flight simulators used by military pilots. Here the object is not to convert pilots from one aircraft type to another, for modern avionics systems are so refined that the aircraft virtually fly themselves. Pilot and observer training systems for military use are applied more to target recognition and weapons-aiming techniques, both air-to-ground and air-to-air. The basic need, however, is still to present the aircrew with a view from the cockpit that is as close to

the controls and relative to the 'scene' outside. As the pilot goes into a diving turn, for example, so the appearance of the terrain in front of him must change.

In an air-to-air combat simulation the situation is further complicated by the manoeuvres being performed by the adversary, and these must be randomised (or be taken from a large library of possible manoeuvres) so that the pilot is presented with a condition to which he responds not 'parrot-fashion' but with flexibility, making a fresh decision at every turn.

Military training schools go even further with their 'training by simulation'. They make use of extremely high-resolution images, satellite photographs from high-flying surveillance aircraft and the reports of agents, to produce an animated film showing detailed physical features of the terrain over which a pilot would fly on a low-level bombing mission.

Using this film in conjunction with a flight simulator allows 'whole mission' simulation to take place. This training method takes the pilot through the entire course of his sortie, from take-off to landing back at his home base, without his ever leaving the ground. The same flexibility of image generation that allows commercial pilots to 'practise' take-offs and landings at a variety of airports allows the military pilot to experience a

**At The Controls**

Microsoft's Flight Simulator software puts the user at the controls of a Cessna 182 single-engined aircraft, flying from a representation of one of 20 actual airfields in the United States. A very comprehensive replica control panel occupies the lower half of the monitor screen, while the upper part represents a view of the 'outside world' given in full perspective. While the package includes a dogfight game, it is more of a true Computer Aided Learning program, aimed at teaching basic flying skills



reality as possible.

When we talked about spreadsheet programs (see page 158), we described a technique called 'windowing' that allowed the operator to, as it were, pass the monitor screen over a larger sheet than it could contain. A similar technique is essential to the operation of an advanced flight simulator, in which the entire cockpit rig actually moves just as the real aircraft would in response to



wide variety of missions and targets.

Having been developed as a training aid for aircrew members, simulation techniques are now used by the Merchant Navy to familiarise watch-keeping officers with the appearance of channels and port approaches; by commercial divers, to help in object recognition in conditions of poor visibility; and by astronauts to simulate conditions in space. The power of Computer Generated Imaging techniques interacting with users under computer control makes it possible to replicate virtually any visual experience, which has made possible a whole new generation of games and entertainments.

Games programs that act as simple flight simulators are an obvious example of this phenomenon, challenging the user to make a successful flight, perhaps under a variety of adverse conditions: low fuel, poor visibility,

**Aerial Projections**

Three three-gun (red, blue, green) TV projectors are used to throw the animated image of the outside world onto a screen in front of the pilot, by way of a collimating mirror, which adjusts for distortion caused by the curved back-projection screen

