

engine failure, and so on. But one should not think of these games as directly related to the professional systems that go by the same name, except perhaps in the case of Microsoft's Flight Simulator.

Any computer game, however — even the now obsolescent 'Pong', the precursor of them all — that represents a 'real-life' situation on the computer's television monitor can be regarded as a simulation of sorts. The only real difference lies in the complexity of the representation, and perhaps in the quality of the computer-generated image.

These simulations can come purely from the imagination, as Space Invaders and PacMan did. There the designer thought up the parameters of the game and translated them into possible courses of action. Or they can be more direct simulations of reality, such as the various car race games.

Not all home microcomputer-based flight simulation software is aimed at the games player. There are serious Computer Assisted Learning (CAL) packages available in the field of air navigation, air traffic control and flight planning, for example. Microsoft's Flight Simulator, however, available for IBM's Personal Computer, sets out to be both a recreational game and a serious exercise for would-be pilots.

The manual starts off by explaining that the package simulates all the instruments and equipment necessary under US Federal Aviation Authority rules for both day and night visual and instrument flying. The lower half of the screen represents the instrument panel of a Cessna 182 (the single-engined aircraft on which the simulation is based), while the upper part is



airfields in four main areas: New York/Boston, Chicago, Los Angeles and Seattle.

It is theoretically possible to 'fly' right across the country, from New York to Los Angeles via Chicago, but as there are no refuelling points outside these populated areas, you would soon crash as a result of running out of petrol. Even if it were possible to 'carry' enough fuel, the simulator works in real time, which, with a maximum speed of around 240 kilometres per hour (150mph), means that the 'journey' would take around 20 hours — most of it in straight and level flight over open country. The package therefore permits you to 'jump' from one area to another.

Refinements include the ability to decide the time of day, the season (which affects the times of dawn and dusk), weather conditions including cloud cover, wind speed and wind direction, and even a factor for air turbulence.

Microsoft's Flight Simulator is based on the simplest type of aircraft. Nevertheless it is only through the use of highly efficient machine code that the program has been squeezed into 64 Kbytes. To simulate the entire flight deck of a modern wide-bodied jet, including actually moving the mock-up physically in response to movements of the controls, is a vastly more difficult task.

'Enemy Aircraft ... Bearing 030A ...'

Computer Generated Images of this quality allow both air- and ground-crews to practise skills, like recognition in any sort of weather or lighting conditions, the instructor chooses. This example, produced on Redfusion Simulations' Novoview system, shows an American A10 ground attack aircraft



devoted to a medium-resolution animated colour picture of the view through the windscreen. This features pseudo-three-dimensional effects — that is, you get a reasonable sense of movement just from the changing perspectives.

Flight Simulator includes its own terrain map, which covers an area of approximately 2.5 million square kilometres (one million square miles) — basically the continental United States, with intrusions into Canada, Mexico and the Caribbean — encompassing some 20 different

