

# LANDING CRAFT

**In this instalment of our series of short, entertaining programs we look at one of the oldest games in computing: Lunar Lander. In many ways it may seem too simple when compared with the fast, noisy excitement of today's arcade games. But, properly programmed, the game is quite subtle and difficult to master.**

In Lunar Lander you have to guide a lunar landing craft onto the surface of the moon (or some other planet). The ship's on-board computer has failed, so you have to bring the craft down carefully with short bursts of its rocket engine. Obviously, you must hit the surface at a reasonable speed and the game involves a careful balance between dropping too fast and using up your limited amount of fuel high above the planet's surface.

The essential element of the game is that it is actually a simulation. If you program it so that firing the rocket for two seconds always takes 10 km/h from its downward speed, then the game is too easily mastered. The idea is for the program to

reflect the true behaviour of a spacecraft in such conditions as accurately as possible. Obviously, the mathematics to do this is very complicated, so the program given here is a simplified version. However, it does have many of the features of a true simulation.

Let's take a closer look at the lander problem:

- The planet you are descending on has a certain gravity. This will cause the spacecraft to accelerate towards the planet as it lands.
- The spacecraft has a rocket engine that will counteract the effects of gravity by pushing the craft upwards.
- The spacecraft has a mass (or weight). The greater this is, the less effect the rocket motor will have on pushing the craft upwards. The mass of the spacecraft is made up of its own weight and the weight of the fuel inside it. As the fuel is used up, the spacecraft becomes lighter.

So to reflect the way the lander behaves, we need a set of equations involving acceleration, mass,

## Planet Pull

The figures shown give the approximate gravitational pull of the Sun, Moon and the planets in our solar system in metres per second per second. These values for the variable  $g$  in the program should be entered in line 20. There are, of course, certain bodies that it would be foolish or deadly to land on (such as the Sun, Jupiter and Earth) but you might like to ignore such matters for the purpose of the game

