A SMALL ION PROPELLED SPACECRAFT FOR NEAR EARTH EXPERIMENTS

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It has become increasingly apparent that designers of today's large and complex spacecraft are reluctant to adopt many new and innovative technologies due to the lack of in-orbit operational experience with these devices, a particular example being ion propulsion. The reasons for this are understandable, but, as a consequence, many new ideas are caught in a 'chicken and egg' situation where they will not be flown until they have been flown and shown to work reliably. A study has been carried out in an attempt to provide a simple, low cost spacecraft that can be launched from almost any vehicle into any orbits that could subsequently be used as a testbed for small innovative ideas.

A small lightweight spacecraft has been considered and emphasis placed on designing the most reliable and cost effective configuration. Maximum flexibility of the design in terms of potential launches and possible missions is achieved by the use of a combined electric and chemical thruster system. The application of both propulsion systems are investigated in detail. The chemical system is proposed for the early stages of the mission where the serious effects of air-drag, eclipse and spacecraft size rule out the use of a pure electric propulsion system. The electric propulsion can then subsequently be used to greatly enhance the scope of any mission, providing large orbit raising manoeuvres, plane changes, drag make-up or a combination of the above.

In addition to the technology applications it is shown that a vehicle of this kind can also perform meaningful scientific work. A mission to map the Earth's radiation belts is discussed in detail with orbit prediction analysis being carried out during the slow spiralling manoeuvre out to the belts. This mission is particularly interesting since it also facilitates the testing of technologies in the harsh radiation environments experienced at these altitudes.

Two baseline spacecraft configurations and designs are proposed in which both thruster systems can be scaled to suit the available launch, technology and scientific payload requirements.