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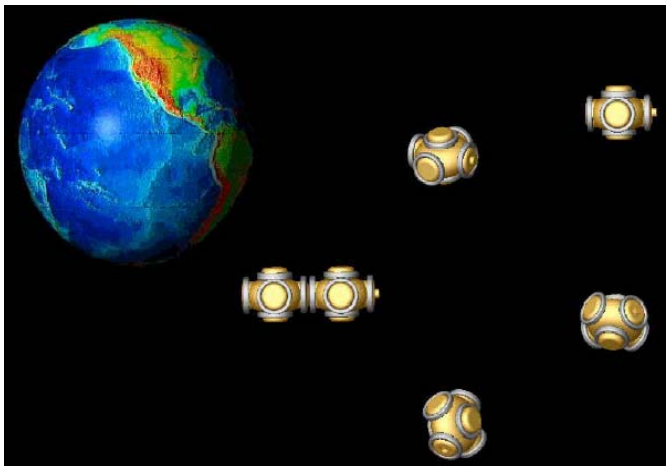
Electromagnetic Formation Flight

Satellite formation flight has been identified as the next revolutionary step in remote sensing technology. This allows for the synthesis of large sensor apertures without the need for prohibitively large satellites. These systems also provide mission flexibility by being able to change their geometry to reflect the current mission needs. Furthermore, satellite formations increase reliability, ease deployment, allow staged deployment, improve coverage and lower cost. By providing these benefits, distributed satellite systems will replace many of today's single, larger satellites.

However, one of the main problems identified with distributed satellite systems is the additional propellant needed to maintain these formations. Distributed satellite systems have a much higher demand on the onboard propellant system due to the need to keep satellites properly positioned with respect to each other. Even if the geometry of the satellite formation is to remain unchanged throughout the mission, many perturbative effects including differential drag, non-uniform geo-potential (J_2), and solar pressure all contribute to changes in the formation's geometry and must be counteracted. The amount of propellant that can be carried on the satellite puts an upper limit on the mission lifetime. When the satellites have exhausted the available propellant, there will be a number of perfectly good, but generally useless, satellites continuing in their orbits.



In response to this limitation, the MIT Space Systems Lab (SSL) has been exploring electromagnetic formation flight (EMFF). Electromagnets will be used to provide the necessary control authority to maintain satellite formations in the presence of disturbances. Electromagnets offer the added capability to reshape the geometry of the formation while in orbit. By changing the angle of the electromagnetic field, different forces in any direction can be produced. These forces can be used to resize or tilt a frame free orbit ellipse or reshape the satellite formation into almost any geometry. Electromagnets also have the added benefit that they provide a limitless means of control. Since the power source is electrical, it is a renewable resource and does not limit mission life. Also, unlike conventional thrusters which may leave a plume of propellant by-products around the formation that can deposit on sensitive optics, there are no contamination issues with electromagnets. Detailed studies, along with experimental testing, will verify the usefulness of EMFF and prove the ability of EMFF as a viable means of controlling satellites in formation.