Books & Reports

Magnetic Control of Concentration Gradient in Microgravity

A report describes a technique for rapidly establishing a fluid-concentration gradient that can serve as an initial condition for an experiment on solutal instabilities associated with crystal growth in microgravity. The technique involves exploitation of the slight attractive or repulsive forces exerted on most fluids by a magnetic-field gradient. Although small, these forces can dominate in microgravity and therefore can be used to hold fluids in position in preparation for an experiment. The magnetic field is applied to a test cell, while a fluid mixture containing a concentration gradient is prepared by introducing an undiluted solution into a diluting solution in a mixing chamber. The test cell is then filled with the fluid mixture. Given the magnetic susceptibilities of the undiluted and diluting solutions, the magnetic-field gradient must be large enough that the magnetic force exceeds both (1) forces associated with the flow of the fluid mixture during filling of the test cell and (2) forces imposed by any residual gravitation and fluctuations thereof. Once the test cell has been filled with the fluid mixture, the magnetic field is switched off so that the experiment can proceed, starting from the proper initial conditions.

This work was done by Fred Leslie of **Marshall Space Flight Center** *and Narayanan Ramachandran formerly of Universities Space Research Association. For further information, contact Paul Hale at paul.hale@msfc.nasa.gov. MFS-31972*

Avionics for a Small Robotic Inspection Spacecraft

A report describes the tentative design of the avionics of the Mini-AERCam — a proposed 7.5-in. (≈19-cm)-diameter spacecraft that would contain three digital video cameras to be used in visual inspection of the exterior of a larger spacecraft (a space shuttle or the International Space Station). The Mini-AERCam would maneuver by use of its own miniature thrusters under radio control by astronauts inside the larger spacecraft. The design of the Mini-AERCam avionics is subject to a number of constraints, most of which can be summarized as severely competing requirements to maximize radiation hardness and maneuvering, image-acquisition, and data-communication capabilities while minimizing cost, size, and power consumption. The report discusses the design constraints, the engineering approach to satisfying the constraints, and the resulting iterations of the design. The report places special emphasis on the design of a flight computer that would (1) acquire position and orientation data from a Global Positioning System receiver and a microelectromechanical gyroscope, respectively; (2) perform all flight-control (including thruster-control) computations in real time; and (3) control video, tracking, power, and illumination systems.

This work was done by Larry Abbott and Robert L. Shuler, Jr., of **Johnson Space Center**. *For further information, contact the Johnson Innovative Partnerships Office at (281) 483-3809.*
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Simulation of Dynamics of a Flexible Miniature Airplane

A short report discusses selected aspects of the development of the University of Florida micro-aerial vehicle (UFMAV) — basically, a miniature airplane that has a flexible wing and is representative of a new class of airplanes that would operate autonomously or under remote control and be used for surveillance and/or scientific observation. The flexibility of the wing is to be optimized such that passive deformation of the wing in the presence of aerodynamic disturbances would reduce the overall response of the airplane to disturbances, thereby rendering the airplane more stable as an observation platform. The aspect of the development emphasized in the report is that of computational simulation of dynamics of the UFMAV in flight, for the purpose of generating mathematical models for use in designing control systems for the airplane. The simulations are performed by use of data from a wind-tunnel test of the airplane in combination with commercial software, in which are codified a standard set of equations of motion of an airplane, and a set of mathematical routines to compute trim conditions and extract linear state space models.

This work was done by Martin R. Waszak of **Langley Research Center**. *Further information is contained in a TSP (see page 1).*
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