Books & Reports

Controlling Attitude of a Solar-Sail Spacecraft Using Vanes

A paper discusses a concept for controlling the attitude and thrust vector of a three-axis stabilized Solar Sail spacecraft using only four single degree-of-freedom articulated spar-tip vanes. The vanes, at the corners of the sail, would be turned to commanded angles about the diagonals of the square sail. Commands would be generated by an adaptive controller that would track a given trajectory while rejecting effects of such disturbance torques as those attributable to offsets between the center of pressure on the sail and the center of mass. The controller would include a standard proportional + derivative part, a feedforward part, and a dynamic component that would act like a generalized integrator. The controller would globally track reference signals, and in the presence of such control-actuator constraints as saturation and delay, the controller would utilize strategies to cancel or reduce their effects. The control scheme would be embodied in a robust, nonlinear algorithm that would allocate torques among the vanes, always finding a stable solution arbitrarily close to the global optimum solution of the control effort allocation problem. The solution would include an acceptably small angle, slow limit-cycle oscillation of the vanes, while providing overall thrust vector pointing stability and performance.

This work was done by Edward Mettler, Ahmet Acikmese, and Scott Ploen of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-42156.

Wire-Mesh-Based Sorber for Removing Contaminants From Air

A paper discusses an experimental regenerable sorber for removing CO_2 and trace components — principally, volatile organic compounds, halocarbons, and NH_3 — from spacecraft cabin air. This regenerable sorber is a prototype of what is intended to be a lightweight alternative to activated-carbon and zeolite-pellet sorbent beds now in use. The regenerable sorber consists mainly of an assembly of commercially available meshes that have been coated with a specially-formulated washcoat containing zeolites. The zeolites act as the sorbents while the meshes support the zeolite-containing washcoat in a configuration that affords highly effective surface area for exposing the sorbents to flowing air. The meshes also define flow paths characterized by short channel lengths to prevent excessive buildup of flow boundary layers. Flow boundary layer resistance is undesired because it can impede mass and heat transfer. The total weight and volume comparison versus the atmosphere revitalization equipment used onboard the International Space Station for CO_2 and trace-component removal will depend upon the design details of the final embodiment. However, the integrated mesh-based CO_2 and trace-contaminant removal system is expected to provide overall weight and volume savings by eliminating most of the trace-contaminant control equipment presently used in parallel processing schemes traditionally used for spacecraft. The mesh-based sorbent media enables integrating the two processes within a compact package. For the purpose of regeneration, the sorber can be heated by passing electric currents through the metallic meshes combined with exposure to space vacuum. The minimal thermal mass of the meshes offers the potential for reduced regeneration-power requirements and cycle time required for regeneration compared to regenerable sorption processes now in use.

This work was done by Jay Perry of **Marshall Space Flight Center**, *and Subir Roychoudhury and Dennis Walsh of Precision Combustion, Inc.*

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to MFS-32308-1, volume and number of this NASA Tech Briefs *issue, and the page number.*