is to maintain a constant, known angular velocity when scanning the antenna along a given direction. To ensure alignment of the individual subscans within the full raster, the angular position of the first data point of each subscan is determined from readings of azimuth- and elevation-angle encoders, while the angular positions of the rest of the subscan data points are determined by timing at the constant angular velocity. Hence, if the TPR reading is sampled at a constant known rate, then the relative angular position at which each datum is taken is known with high accuracy, and antenna-settling time is no longer an issue. The data-acquisition algorithms used in OTF mapping provide for computation of the angular positions of radio sources, such that at any given time, the position of the antenna relative to a source is known.

The acquisition of data in the OTF mode necessarily entails attenuation of high-frequency information as a consequence of the integration that occurs during the sampling intervals. The high-frequency information can be recovered in an inverse-filtering computation.

Even though the antenna beam does not sample all of the radiation from an extended radio source at a given instant, the completed raster scan does cover the entire solid angle subtended by the source and, hence contains a sampling of all the radiation from that source. Consequently, no source-size correction is necessary in OTF mapping. The resulting set of data registered on a two-dimensional field of sampling points (see figure) can be used to determine a least-squares-best-fit main beam pattern. The calibration parameters can then be determined from the main beam pattern.

*This work was done by David Rochblatt, Paul Richter, and Philip Withington of Caltech for* **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1). NPO-30648*

# Working Fluids for Increasing Capacities of Heat Pipes
## Fluids are formulated to make surface tensions increase with temperature.

*John H. Glenn Research Center, Cleveland, Ohio*

A theoretical and experimental investigation has shown that the capacities of heat pipes can be increased through suitable reformulation of their working fluids. The surface tensions of all of the working fluids heretofore used in heat pipes decrease with temperature. As explained in more detail below, the limits on the performance of a heat pipe are associated with the decrease in the surface tension of the working fluid with temperature, and so one can enhance performance by reformulating the working fluid so that its surface tension increases with temperature. This improvement is applicable to almost any kind of heat pipe in almost any environment.

The heat-transfer capacity of a heat pipe in its normal operating-temperature range is subject to a capillary limit and a boiling limit. Both of these limits are associated with the temperature dependence of surface tension of the working fluid. In the case of a traditional working fluid, the decrease in surface tension with temperature causes a body of the liquid phase of the working fluid to move toward a region of lower temperature, thus preventing the desired spreading of the liquid in the heated portion of the heat pipe. As a result, the available capillary-pressure pumping head decreases as the temperature of the evaporator end of the heat pipe increases, and operation becomes unstable.

Water has widely been used as a working fluid in heat pipes. Because the surface tension of water decreases with increasing temperature, the heat loads and other aspects of performance of heat pipes that contain water are limited. Dilute aqueous solutions of long-chain alcohols have shown promise as substitutes for water that can offer improved performance, because these solutions exhibit unusual surface-tension characteristics: Experiments have shown that in the cases of an aqueous solution of an alcohol, the molecules of which contain chains of more than four carbon atoms, the surface tension increases with temperature when the temperature exceeds a certain value.

There are also other liquids that have surface tensions that increase with temperature and could be used as working fluids in heat pipes. For example, as a substitute for ammonia, which is the working fluid in some heat pipes, one could use a solution of ammonia and an ionic surfactant.

*This work was done by David F. Chao of* **Glenn Research Center** *and Nengli Zhang of Ohio Aerospace Institute. Further information is contained in a TSP (see page 1).*

*Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland Ohio 44135. Refer to LEW-17270.*