through the transceivers, the transmit antenna beam can be steered to different incidence angles. By controlling the amplitude distribution, different sidelobe patterns and efficiencies can be realized. The receive beams are formed using digital beam synthesis techniques, resulting in very little loss in the receive path, thus enabling a very-low-loss receive antenna to support passive measurements.

Each azimuth stick consists of a dual-polarized Ku-band slotted waveguide linear array that is one-half of a Ku-band wavelength wide and is center-fed. The latter ensures that grating lobes will not be produced in the full array. The linear array has two sections, one supporting broadside slots and the other “edge” slots. For the broadside slots, a ridge waveguide is used to reduce the width of the waveguide section well below one-half wavelength.

For the initial instrument design, the full array will implement phase steering to form the transmit beam and digital beam synthesis to form the receive beam. The phase and amplitude of the transmit signal delivered to each vertically and horizontally polarized C and Ku-band port on the array will be controlled through dedicated, phase-locked transceivers. The array will be conically scanned to map a large surface swath beneath the aircraft and provide multiple looks at each along and cross track pixel within the swath. This will permit ocean vector wind scatterometry techniques to be applied. The coincident passive measurements obtained with this antenna will allow the atmospheric attenuation to be estimated and used to aid the ocean vector wind retrieval process, especially in the presence of precipitation where the Ku-band receive signals will be attenuated.

This antenna’s compact design will reduce deployment costs for ground-based applications, and will be ideal for mobile applications where space is often limited. Its ability to separate transmit and receive modes permits very low losses to be achieved during the receive phase, allowing for coincident active and passive measurements. Its flexibility to support frequency, phase, and digital beam synthesis techniques allows it to service a broad market, and its scalability will enable it to be customized to commercial applications at very little cost.

This system has application in monitoring the ocean surface vector wind in tropical cyclones and other severe ocean storms. In defense applications, it has uses where an imaging and mapping dual-band, dual-polarized antenna would provide strategic advantages. Search and rescue missions also can benefit from this antenna technology.

This work was done by James R. Carswell of Remote Sensing Solutions, Inc. for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15706-1

Time-Separating Heating and Sensor Functions of Thermistors in Precision Thermal Control Applications

This technology can be applied to telescope sensor and optics uses.

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A method allows combining the functions of a heater and a thermometer in a single device, a thermistor, with minimal temperature read errors. Because thermistors typically have a much smaller thermal mass than the objects they monitor, the thermal time to equilibrate the thermometer to the temperature of the object (τ_t) is typically much shorter than the thermal time of the object to change its temperature in response to an external perturbation (τ_O), $\tau_t << \tau_O$.

It is possible to switch the heater controlling the object’s temperature off for this shorter length of time. While the heater is switched off, the thermistor is allowed the time equal to several τ_t to reach equilibrium with the object, then its temperature is measured, after which the heater is turned back on. The measured value is provided for any temperature control, and the voltage on the thermistor during the heating potion of the cycle will be determined by that control.

In one tested implementation, the τ_t was measured to be under 0.5 ms, and $\tau_O \approx 2$ s. In the timing sequence in this implementation, the heater circuit is turned off, and the measurement current is turned on. After ≈3 ms, the voltage readout is accomplished in ≈1 ms. A fraction of ms later, the heater is turned back on for ≈95 ms.

In one embodiment of this solution, a sample and hold circuit captures the voltage (resistance) readout during the short measurement interval and provides the capture value for the duration of the cycle. This embodiment can be used with any temperature controller, including off-the-shelf PID controllers.

Another embodiment involves a readout that is synchronized with the multiplexed readout of one sensor in a collection, and the heater is connected to the same sensor while the multiplexer is reading other sensors. This solution requires a PID circuit compatible with the multiplexed readout, typically implemented in an FPGA solution with a clock-driven timing.

This work was done by Hyung J. Cho, Kalyani G. Sukhatme, John C. Mahoney, Konstantin Penanen, and Rudolph Vargas, Jr., of Caltech for NASA’s Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-46900