



### **Progress in Acoustic Transmission of Power Through Walls**

A document presents updated information on implementation of the wireless acoustic-electric feed-through (WAEF) concept, which was reported in "Using Piezoelectric Devices To Transmit Power Through Walls" (NPO-41157), *NASA Tech Briefs*, Vol. 32, No. 6 (June 2008), page 70. To recapitulate: In a basic WAEF setup, a transmitting piezoelectric transducer on one side of a wall is driven at resonance to excite ultrasonic vibrations in the wall. A receiving piezoelectric transducer on the opposite side of the wall converts the vibrations back to an ultrasonic AC electric signal, which is then detected and otherwise processed in a manner that depends on the modulation (if any) applied to the signal and whether the signal is used to transmit power, data, or both.

The present document expands upon the previous information concerning underlying physical principles, advantages, and potential applications of WAEF. It discusses the design and construction of breadboard prototype piezoelectric transducers for WAEF. It goes on to present results of computational simulations of performance and results of laboratory tests of the prototypes. In one notable test, a 100-W light bulb was lit by WAEF to demonstrate the feasibility of powering a realistic load.

*This work was done by Stewart Sherrit, Benjamin Doty, Xiaoqi Bao, Yoseph Bar-Cohen, Mircea Badescu, and Zensheu Chang of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*

*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 NPO-44928, volume and number of this NASA Tech Briefs issue, and the page number.*

### **Lightweight Carbon-Carbon High-Temperature Space Radiator**

A document summarizes the development of a carbon-carbon composite radiator for dissipating waste heat from a spacecraft nuclear reactor. The radiator is to be bonded to metal heat pipes and to operate in conjunction with them at a temperature approximately between 500 and 1,000 K. A goal of this development is to reduce the average areal mass density of a radiator to about 2 kg/m<sup>2</sup> from the current value of ≈10 kg/m<sup>2</sup> characteristic of spacecraft radiators made largely of metals.

Accomplishments thus far include: (1) bonding of metal tubes to carbon-carbon material by a carbonization process that includes heating to a temperature of 620 °C; (2) verification of the thermal and mechanical integrity of the bonds through pressure-cycling, axial-shear, and bending tests; and (3) construction and testing of two prototype heat-pipe/carbon-carbon-radiator units having different radiator areas, numbers of heat pipes, and areal mass densities. On the basis of the results achieved thus far, it is estimated that optimization of design could yield an areal mass density of 2.2 kg/m<sup>2</sup> — close to the goal of 2 kg/m<sup>2</sup>.

*This work was done by W. O. Miller and Wei Shih of Allcomp Corp. for Glenn Research Center.*

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### **Stochastic Analysis of Orbital Lifetimes of Spacecraft**

A document discusses (1) a Monte-Carlo-based methodology for probabilistic prediction and analysis of orbital lifetimes of spacecraft and (2) Orbital Lifetime Monte Carlo (OLMC) — a Fortran computer program, consisting of a previously developed long-term orbit-propagator integrated with a Monte Carlo engine.

OLMC enables modeling of variances of key physical parameters that affect orbital lifetimes through the use of probability distributions. These parameters include altitude, speed, and flight-path angle at insertion into orbit; solar flux; and launch delays. The products of OLMC are predicted lifetimes (durations above specified minimum altitudes) for the number of user-specified cases. Histograms generated from such predictions can be used to determine the probabilities that spacecraft will satisfy lifetime requirements.

The document discusses uncertainties that affect modeling of orbital lifetimes. Issues of repeatability, smoothness of distributions, and code run time are considered for the purpose of establishing values of code-specific parameters and number of Monte Carlo runs. Results from test cases are interpreted as demonstrating that solar-flux predictions are primary sources of variations in predicted lifetimes. Therefore, it is concluded, multiple sets of predictions should be utilized to fully characterize the lifetime range of a spacecraft.

*This work was done by Washito Sasamoto of Langley Research Center and Kandyce Goodliff and David Cornelius of Analytical Mechanics Associates, Inc. Further information is contained in a TSP (see page 1). LAR-17498-1*