



### **High-Resolution Wind Measurements for Offshore Wind Energy Development**

*NASA's Jet Propulsion Laboratory, Pasadena, California*

A mathematical transform, called the Rosette Transform, together with a new method, called the Dense Sampling Method, have been developed. The Rosette Transform is invented to apply to both the mean part and the fluctuating part of a targeted radar signature using the Dense Sampling Method to construct the data in a high-resolution grid at 1-km posting for wind measurements over water surfaces such as oceans or lakes.

This new technique enables the use of NASA satellite scatterometer data, such as QuikSCAT data, which have been collected globally over a decade for measur-

ing high-resolution wind field at 1-km posting on water surfaces. Valid in near-shore waters (10–15 km from shore), the high-resolution wind data are unique and critical to calculate accurate wind power density and its variability for the development of future offshore wind farms. The new technique was originally developed to monitor urban and suburban environments, and it has been applied to obtain high-resolution radar signatures over ocean and lake environments for high-resolution wind measurements.

*This work was done by Son V. Nghiem and Gregory Neumann of Caltech for NASA's Jet*

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*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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### **Spring Tire**

**This tire design can be used where low vehicle energy consumption is required and for vehicles traveling over rough terrain.**

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

The spring tire is made from helical springs, requires no air or rubber, and consumes nearly zero energy. The tire design provides greater traction in sandy and/or rocky soil, can operate in micro-gravity and under harsh conditions (vastly varying temperatures), and is non-pneumatic.

Like any tire, the spring tire is approximately a toroidal-shaped object intended to be mounted on a transportation wheel. Its basic function is also similar to a traditional tire, in that the spring tire contours to the surface on which it is driven to facilitate traction, and to reduce the transmission of vibration to the vehicle. The essential difference between other tires and the spring tire is the use of helical springs to support and/or distribute load. They are coiled wires that deform elastically under load with little energy loss.

This design is an advancement of the wire-mesh tire technology defined under U.S. Patent 3,568,748, entitled "Resilient Wheel." The difference between the two tire technologies is the



The **Spring Tire**, co-invented by NASA Glenn Research Center and the Goodyear Tire & Rubber Company. This airless, rubberless tire is capable of contouring to the rocky surface of the Moon, yet consumes far less energy than an Earth tire. Photo Credit — Aaron Vandersommers/Goodyear

fundamental element used to create the wire mesh that forms the tire. The resilient wheel uses crimped wire mesh to form the tire, but the spring tire uses a coiled wire mesh. Under the weight of the vehicle, the tire is driven or towed, as well as steered. The springs within the tire passively contour to the terrain by flexing and moving with respect to each other.

There are three steps required to manufacture the spring tire. First, the springs are twisted together to form a rectangular sheet with length of the tire circumference. Second, the ends of the rectangular sheet of springs are interlaced to form a mesh cylinder. Third, one end of the mesh cylinder is collapsed and attached to the wheel, and the other end is flipped inside out, attaching it to the opposite end of the wheel.

The load-support springs are configured radially. This mitigates the pantographing of springs (rotation at their intersections). As a result, a relatively high mesh density may be used without excessive interference and stress be-

tween neighboring springs. Elimination of pantographing also reduces friction forces.

The load support springs are also interwoven. This minimizes or eliminates the need for load distribution springs to hold the load support springs together. With fewer load distribution springs, the load support springs con-

tour more freely and the overall tire weight is reduced. Cross-sections of the tire are approximately round, which distributes applied loads relatively uniformly. This reduces tire stresses and improves flotation and traction development in soft soil.

*This work was done by Vivake M. Asnani of Glenn Research Center and Jim Benzing and*

*Jim C. Kish of Goodyear Tire & Rubber Company. 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, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18466-1.*