Detecting Negative Obstacles by Use of Radar

Changes in diffraction and reflection would be used to detect abrupt downslopes.

NASA’s Jet Propulsion Laboratory, Pasadena, California

Robotic land vehicles would be equipped with small radar systems to detect negative obstacles, according to a proposal. The term “negative obstacles” denotes holes, ditches, and any other terrain features characterized by abrupt steep downslopes that could be hazardous for vehicles. Video cameras and other optically based obstacle-avoidance sensors now installed on some robotic vehicles cannot detect obstacles under adverse lighting conditions. Even under fa-
A Robotic Vehicle Approaching a Ditch would carry a radar system that would detect the ditch by recognizing through differences between (1) the signals actually diffracted and reflected and (2) the signals that would be diffracted and reflected from level or nearly level ground.

Cryogenic Pound Circuits for Cryogenic Sapphire Oscillators
Thermomechanical instabilities and associated frequency instabilities are reduced.

Two modern cryogenic variants of the Pound circuit have been devised to increase the frequency stability of microwave oscillators that include cryogenic sapphire-filled cavity resonators. Invented in the 1940s and named after its inventor (R. V. Pound), the original Pound circuit is a microwave signal at the input terminal of the resonator that is used to sample the microwave signal. Therefore, each of the present cryogenic Pound circuits includes passive circuitry that transforms the AM into the required frequency-error signal by converting a phase modulation (PM) to an amplitude modulation (AM). The AM in question is generated when a microwave signal that is reflected from a resonator has a high value of the resonance quality factor (Q) and the signal frequency differs from the resonance frequency. A pure PM signal is required because any AM at the input terminal of the resonator would generate a frequency error.

In the present cryogenic Pound circuits (see figure), the active microwave devices are implemented by use of state-of-the-art commercially available tunnel diodes that exhibit low flicker noise (required for high frequency stability) and function well at low temperatures and at frequencies up to several tens of gigahertz. While tunnel diodes are inherently operable as amplitude detectors and amplitude modulators, they cannot, by themselves, induce significant phase modulation. Therefore, each circuit contains a Pound signal detector that is used to sample the microwave signal at the input terminal of the high-Q resonator for the purpose of verifying the desired AM null at this point. Finally, each circuit contains a Pound signal detector that puts out a signal, at the modulation frequency, having an amplitude proportional to the frequency error in the input signal. High frequency stability is obtained by processing this output signal into feedback to a voltage-controlled os-