Inexpensive Implementation of Many Strain Gauges

Arrays of metal film resistors would sense strains at multiple locations.

NASA’s Jet Propulsion Laboratory, Pasadena, California

It has been proposed to develop arrays of strain gauges to monitor local strains associated with electronic readout circuitry on printed-circuit boards or other suitable substrates. This proposal is a by-product of a development of instrumentation utilizing metal film resistors on printed-circuit boards to monitor temperatures at multiple locations. The model used was observed to have issues with being sensitive to temperature, the metal film resistors were also sensitive to strains in the printed-circuit boards to which they were attached.

Because of the low cost of metal film resistors (typically <\$0.01 apiece at 2007 prices), the proposal could enable inexpensive implementation of strain arrays of many (e.g., 100 or more) strain gauges, possibly concentrated in small areas. For example, such an array could be designed for use as a computer keyboard with no moving parts, as a device for sensing the shape of an object resting on a surface, or as a device for measuring strains at many points on a mirror, a fuel tank, an airplane wing, or other large object.

Ordinarily, the effect of strain on resistance would be regarded as a nuisance in a strain-measuring application. The strain-induced changes in resistance of the metal film resistors in question are less than those of films in traditional strain gauges. The main novel aspect of present proposal lies in the use of circuitry affording sufficient sensitivity to measure strain plus means for compensating for the effect of temperature.

For an array of metal film resistors used as proposed, the readout circuits would include a high-accuracy analog-to-digital converter fed by a low noise current source, amplifier chain, and analog multiplexer chain. Corrections would be provided by use of...