An optoelectronic metrology apparatus now at the laboratory-prototype stage of development is intended to repeatedly determine distances of as much as several hundred meters, at sub-millimeter accuracy, to multiple targets in rapid succession. The underlying concept of optoelectronic apparatuses that can measure distances to targets is not new; such apparatuses are commonly used in general surveying and machining. However, until now such apparatuses have been, variously, constrained to (1) a single target or (2) multiple targets with a low update rate and a requirement for some a priori knowledge of target geometry. When fully developed, the present apparatus

This Apparatus Includes N Laser Assemblies (of which only the first and N th are shown here), for measuring distances to N targets. The lasers are turned on, one at a time, to illuminate their targets for short intervals in rapid succession to obtain a high update rate.
Neither excitation of the motor nor mechanical brushes is necessary.

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The upper part of the figure illustrates the major functional blocks of a direction-sensitive analog tachometer circuit based on the use of an unexcited two-phase brushless dc motor as a rotation transducer. The primary advantages of this circuit over many older tachometer circuits include the following:

- Its output inherently varies linearly with the rate of rotation of the shaft.
- Unlike some tachometer circuits that rely on differentiation of voltages with respect to time, this circuit relies on integration, which results in signals that are less noisy.
- There is no need for an additional shaft-angle sensor, nor is there any need to supply electrical excitation to a shaft-angle sensor.
- There is no need for mechanical brushes (which tend to act as sources of electrical noise).
- The underlying concept and electrical design are relatively simple.

This circuit processes the back-electromagnetic force (back-emf) outputs of the two motor phases into a voltage directly proportional to the instantaneous rate (sign · magnitude) of rotation. This work was done by Carl Christian Liebe, Alexander Abramovici, Randall Bartman, Jacob Chapko, John Schmalz, Keith Coste, Edward Litty, Raymond Lam, and Sergi Jerebets of Caltech for NASA’s Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

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