This report was written by Jeffrey W. McCandless and Robert S. McCann of **Ames Research Center** *and Bruce R. Hilty of Johnson Space Center. Further information is contained in a TSP (see page 1).*
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Fractal Reference Signals in Pulse-Width Modulation

A report proposes the use of waveforms having fractal shapes reminiscent of sawteeth (in contradistinction to conventional regular sawtooth waveforms) as reference signals for pulse-width modulation in control systems for thrusters of spacecraft flying in formation. Fractal reference signals may also be attractive in some terrestrial control systems — especially those in which pulse-width modulation is used for precise control of electric motors. The report asserts that the use of fractal reference signals would enable the synchronous control of several variables of a spacecraft formation, such that consumption of propellant would be minimized, intervals between thruster firings would be long (as preferred for performing scientific observations), and delays in controlling large-thrust maneuvers for retargeting would be minimized. The report further asserts that whereas different controllers would be needed for different modes of operation if conventional pulse-width modulation were used, the use of fractal reference signals would enable the same controller to function nearly optimally in all regimes of operation, so that only this one controller would be needed.

This work was done by Boris Lurie of Caltech and Helen Lurie of UCLA for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
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