Understanding the GM Oshawa Video.

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This paper provides a brief discussion of the GM Oshawa Video presentation. The video presents microwave channel impulse response measurements rendered as three dimensional solid models on a Silicon Graphics Personal Iris 4D25T with RGB videolink 1400AX. Hardcopy was produced using a Digital LJ250 (a modified Hewlett Packard Paint Jet Printer). The video suggests that phase is not random. The amplitude and phase have properties similar to fractals.

The indoor environment is not deep space. Suppose that the signal reflects from a wall or building column behind the receiver. A second impulse will arrive, delayed by the transit time. If the wall is 15 meters away, the signal has to go 30 meters round trip. It is delayed 100 nanoseconds.

This echo will appear as a second, smaller, pennant on the rope, most likely pointing in a different direction.

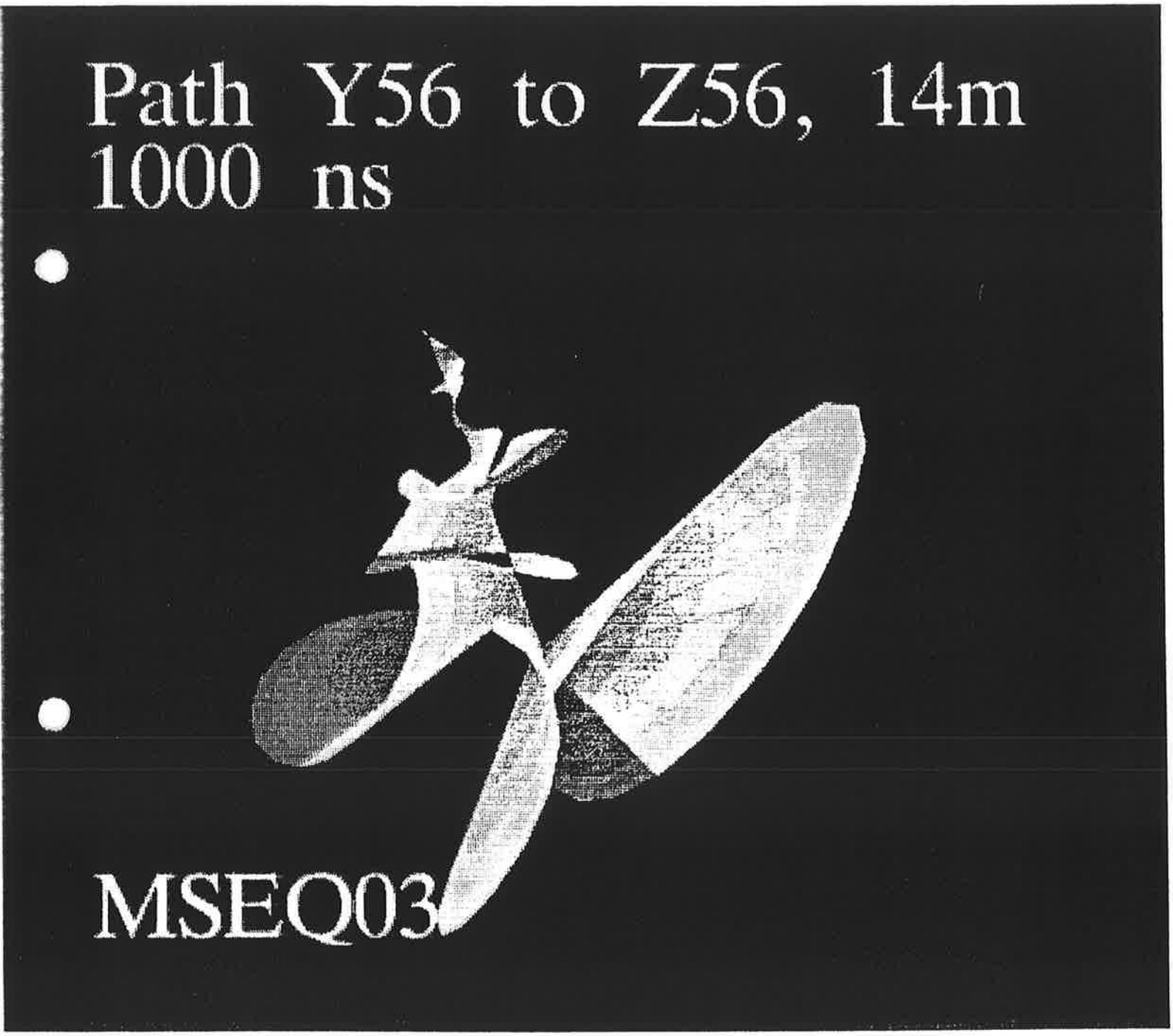
What about the floor (ceiling, side walls)? At these frequencies grazing angle reflections are very strong. The receiver will see the transmitter's reflection in the floor.

If transmitter and receiver are 15 meters apart, and 1 meters above the floor, then the reflection from the floor must travel 15.133 meters. It will be delayed .44 ns and will arrive 145 degrees out of phase with the optical path. (It may arrive 325 degrees out of phase if the floor is conductive, since that reflection is inverted.)

The combined line of sight and floor reflection arrive too close together to resolve as separate amplitude peaks - almost. Since the optical path arrives first, the initial phase is due to the optical path - later it is a combination of optical and bounce - later still it is all bounce. The result is that the peak twirls around. If before it was a flag on a rope, now it is a spiral staircase.

It is also interesting to notice that if the line of sight path is twisted by floor bounce, all of the echoes are also likely to be effected by the same floor in much the same way. It is likely that the phase structure in the first arriving paths repeats in subsequent paths. Delay and phase shift are related by wavelength (and the building material that causes the reflection), so for a given frequency and building, the phase structure of the impulse response is frequently likely to be correlated in spite of changes in transmit and receive antenna position.

All this suggests that the structure of the impulse response is fractal, not random. The immediate environment of the transmitting and receiving antenna imprint themselves on the macroscale ray paths in such a way that there is great similarity from twirl to twirl.


Path Y56 to Z56, 14m
1000 ns
MSEQ03