

VOICE OVER PARTICLES - OPTICAL COMMUNICATION

By Rex Moncur, VK7MO and Justin Giles-Clark VK7TW

At the following URL we reported on Voice Communication using Cloud bounce.

http://reast.asn.au/optical/VK7MO_VK7TW_Optical_VOCB_20070912.pdf

Since then we have partly overcome the drop-off in performance with frequency and on 15 September good copy was obtained over a 1.1 km path when no clouds were present, i.e. with reflection from small particles in the air. A recording of the signal is at the following URL:

http://reast.asn.au/soundfiles/ParticlebounceVK7MO_TH_VK7TW_SH_20070915.mp3

BACKGROUND

For this test VK7MO used his 60 Luxeon array with a pulse width modulator and a new 6 pole anti-aliasing filter designed to cut-off at 2.5 KHz. In testing the cut-off was slightly lower with the 3 dB point at 2.37 KHz. VK7TW used his KA7OEI pre-amp and mounted it on his 355 mm mirror dish.

FREQUENCY RESPONSE TESTS

Tests were carried out to compare the pulse width modulator using the new anti-aliasing filter with the older square wave modulator with the following results.

Frequency	Square Wave Modulator	Pulse Width Modulator
450 Hz	0 dB	0dB
950 Hz	-8 dB	-8dB
1950 Hz	-13 dB	-15 dB

While there is still a significant drop in signal level with frequency it is much less than with old anti-aliasing filter and both modulators give very similar performance. The slight drop-off in the pulse width modulator at higher frequencies can be explained by the fact that it does start to cut-off around 2.4 KHz. Thus the bulk of the drop in performance seems to be due to other factors of which the following are possible:

- The frequency response of the KA7OEI pre-amp has not been optimised and while the same components were used as for the KA7OEI design small component differences such as leakage currents and photo-diode capacitance could produce a greater roll-off than KA7OEI reported.
- The FETS that switch the Luxeons are common to both modulators and it is possible that some effect in this area is rolling off the high frequency response.

To determine the cause of the roll-off further tests were conducted using a particle backscatter and a receiver with the VK7MJ circuit (Mike's small Yellow Box). This produced the following results.

Frequency	Pulse Width Modulator
500 Hz	0 dB
1000 Hz	+2 dB
1500 Hz	+3 dB
2000 Hz	+3 dB
2300 Hz	+1 dB
2500 Hz	-1 dB

As the results are within 3 dB over most of the audio frequency range it would appear that the roll-off in the earlier tests is a function of VK7TW's receiver. Justin will conduct tests to see if he can track down the reasons for this.

VOICE TESTS

The path was optimised using tones and found to occur with the lowest possible elevations at both ends ie 30 degrees at the VK7TW end and 20 degrees at the VK7MO end. Lower elevations were not possible due to obstructions at both ends, but indications are that non-line of sight paths where very low elevation angles can be used, and thus approach 180 degree forward scatter, will provide significant performance improvements. Relative Humidity as reported by the Hobart Met Office was 68% during the test.

As indicated by the recording at the above URL the signal was around 5/3 on the RS scale and quite consistent in strength, which is characteristic of particle scatter.

CONCLUSIONS

Voice over particles has been demonstrated over this short path and there seems to be potential for longer distances where the scattering angle approaches 180 degrees. There might be some potential to improve performance if we can improve the drop-off in frequency response at higher frequencies.