POWER AZIMUTH SPECTRUM MEASUREMENTS IN HOME AND OFFICE ENVIRONMENTS AT 62.4 GHZ

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Introduction

- A measurement campaign was conducted in an attempt to estimate the level of Line-of-Sight (LoS) and scattered signal power in indoor environments at 60 GHz

- These were performed in a home and an office environment

- The PAP was measured in a number of locations using an omni Tx antenna and a highly directional Rx antenna

- An attempt was made to identify the MPC using a serial cancellation algorithm

- An outline of the measurement system, procedure and results is presented in the following slides
Measurement System

- The transmitter consisted of a 20.8 GHz PLL with enhanced frequency stability (±1 kHz) whose signal frequency is multiplied by a factor of three by means of a frequency multiplier, leading to an output frequency of 62.4 GHz. This signal was fed to a waveguide attenuator and subsequently to an appropriate Tx antenna.

- The received signal was mixed with a 61.8 GHz PLL local oscillator obtaining a very stable IF of 600 MHz. This was then used to evaluate the received signal strength via a Log-Amp.

- To further decrease the noise floor of the 600 MHz DAQ data logger, an IF bandpass filter was used which resulted in a noise floor of -55 dBm.

- A laptop PC was used for the control of two servomotors where the transmitter and receiver modules were mounted. A PCMCIA DAQ card was used to perform the data acquisition.
Antenna Elements

- At the transmitter (Tx) a commercial (Flann) omni–directional antenna was employed.
- This provided a vertically polarised 360° field of view in the azimuth with the widest possible acceptance angle in the elevation.
- The length of the antenna was 6.2 cm.

- The receiver (Rx) was connected to a custom–made 36 dBi directional lens horn antenna.
- This had a 3 dB beamwidth of approximately 1.5° and was rotated through the Azimuth plane.
Measurement Procedure

- The PAP measurements were conducted by rotating the directional antenna by 360° in 1° steps by the use of a turntable controlled by a laptop PC.
- The Tx antenna remained fixed throughout each measurement.
- A laser pointer was mounted and calibrated on the Rx antenna so that individual reflectors could be identified.
Measurement Results (Home Environment)

- In the first measurement a furnished small lounge area was used
- PAPs were measured at two LoS locations
- In non-LoS the dynamic range of the measurement system did not allow us to receive any power above the noise floor
- The LoS component was found to be more than 10 dB higher than the reflected MPCs
Measurement Results (Office Environment)

- For the second measurement a furnished office at the University of Bristol was used.
- Again, PAPs were measured for two LoS locations whereas in non-LoS the dynamic range of the measurement system did not allow us to receive any power above the noise floor.
- A number of strong first-order reflections were observed but the LoS signal was again significantly stronger (5-12dB).
MPC Identification

- The measured PAPs were post-processed using an MPC identification technique.
- A serial cancellation algorithm was used to remove the antenna pattern effect from the received PAS. Since the Tx antenna had an omni pattern this process was performed directly on the received power.
- In order to determine the number of MPCs that were effectively contributing to the PAS, the minimum Root Mean Squared Deviation (RMSD) between the measured PAS and the reconstructed PAS was calculated for different number of MPCs.
- The exact procedure followed can be found in the paper.
Discussion of MPC Identification

- A close fit between the reconstructed and the measured PAS was observed. The RMSD was less than 1 % in all the examined scenarios.
- As far as the identified MPCs are concerned it is clear that the results are not very accurate.
- This unavoidable inaccuracy can be attributed to our ability to measure only the (real-valued) received power, therefore the effect of multipath fading has decreased the accuracy of this method.
- Antenna arrays and super-resolution algorithms should be used in order to get optimum results.
- For the purposes of our investigation, the results are proven sufficiently accurate and demonstrate clearly that the LoS signal along with the first and second order reflections dominate the PAS at 60 GHz.
Conclusion and Acknowledgments

- The outcome of these measurement campaigns has shown that the strength of the LoS signals at 60 GHz are significantly higher than this of the reflected MPCs.
- This effect can be attributed to the very high power loss associated with the reflections on scattering objects and indicate the need for a LoS signal in order to achieve a high SNR at this frequency range.
- Even though these results give some insight on the expected power levels at 60 GHz, more comprehensive studies are needed in order to characterise the wireless channel at this frequency range.

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